US Army Corps of Engineers®
Portland District

WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE

ENVIRONMENTAL IMPACT STATEMENT

APPENDIX Q: STATUTORY COMPLIANCE DOCUMENTATION

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1 NEPA Cooperating Agency Correspondence

1.1 U.S. Bureau of Reclamation

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 18 2019

Ms. Dawn Wiedmeier
Area Manager, Columbia-Cascades Area Office
Bureau of Reclamation
1917 Marsh Road
Yakima, Washington 98901-2058

Dear Ms. Wiedmeier:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting Bureau of Reclamation's (BOR) participation as a cooperating agency for the EIS. This request is being made because of BOR's jurisdiction by law of water storage rights for WVS conservation storage.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, BOR would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges nor

diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Cow Creek Band of Umpqua Tribe of Indians, Bonneville Power Administration, National Marine Fisheries Service, Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, Oregon Parks and Recreation Department, Oregon Department of Environmental Quality, Oregon Department of Land Conservation and Development, Oregon Department of State Lands, and Oregon Department of Agriculture.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

Sincerely,

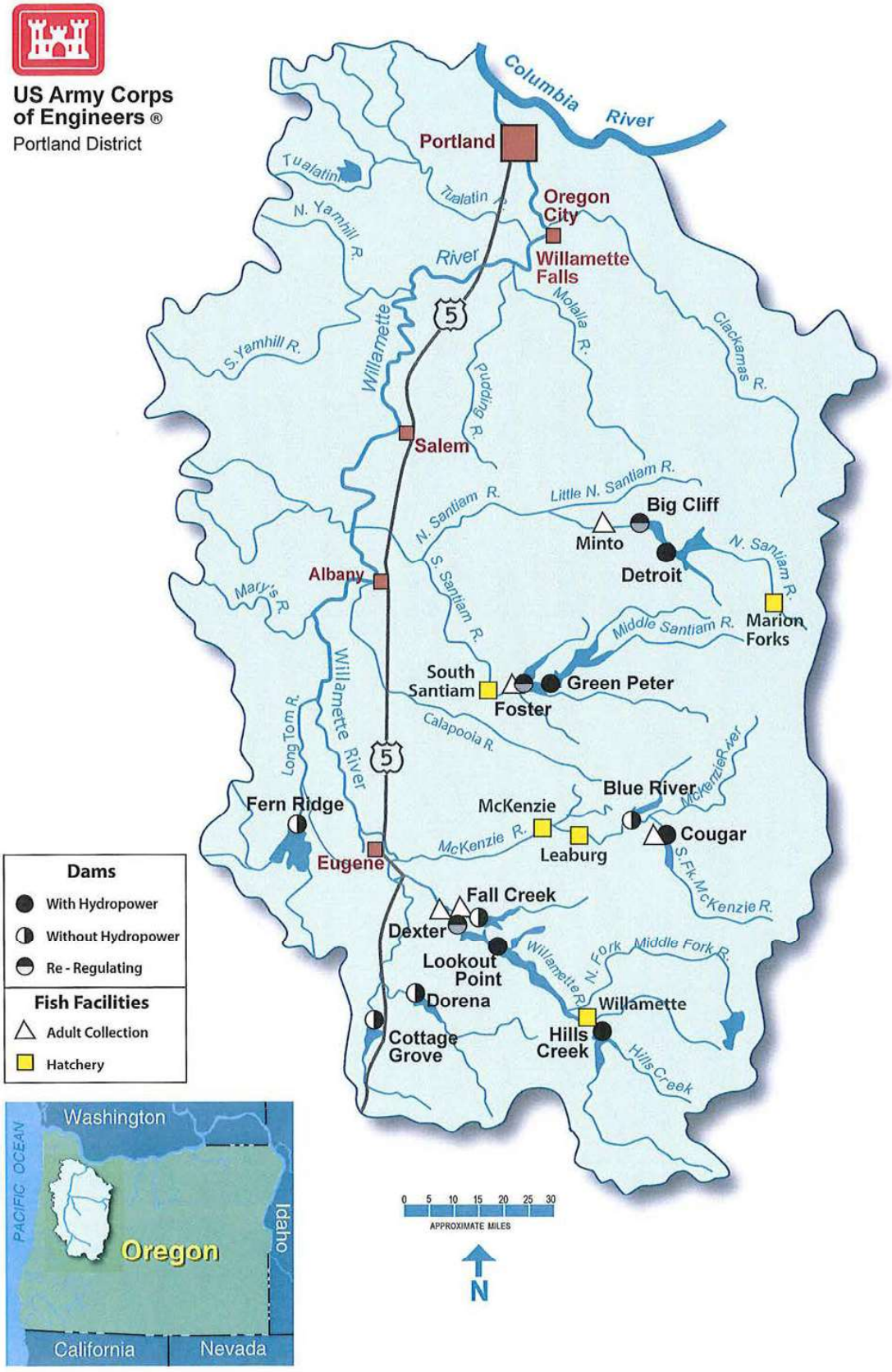


Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Carolyn Chad, Columbia-Cascades Area Office Deputy Area Manager

The Willamette River Basin



1.2 Bonneville Power Administration

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 1 8 2019

Mr. Scott Armentrout
Vice President, Environment, Fish and Wildlife
Bonneville Power Administration
P.O. Box 3621- E-4
Portland, OR 97208-3621

Dear Mr. Armentrout:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting Bonneville Power Administration's (BPA) participation as a cooperating agency for the EIS. This request is being made because of BPA's jurisdiction by law and/or special expertise related to power generation of the WVS.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, BPA would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges nor diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Cow Creek Band of Umpqua Tribe of Indians, Bureau of Land Management, National Marine Fisheries Service, Bureau of Reclamation, U.S. Forest Service, U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, Oregon Parks and Recreation Department, Oregon Department of Environmental Quality, Oregon Department of Land Conservation and Development, Oregon Department of State Lands, and Oregon Department of Agriculture.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

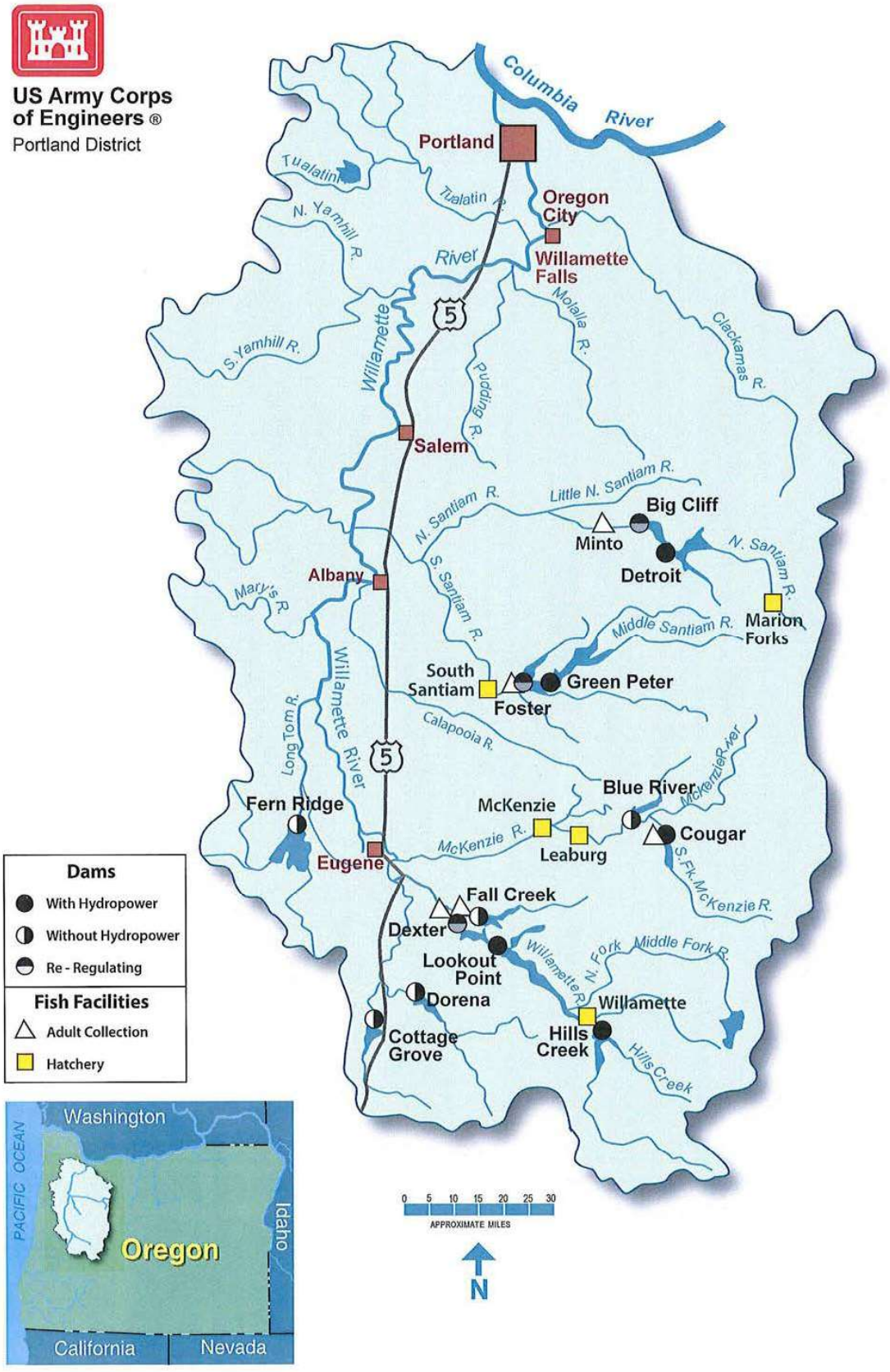
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Jason Sweet, Fish Operations Policy and Planning
Daniel Spear, Fish Operations Policy and Planning

The Willamette River Basin



Department of Energy

Bonneville Power Administration
P.O. Box 3621
Portland, Oregon 97208-3621

Environment, Fish and Wildlife

February 12, 2019

In reply refer to: EC-4

Amy C. Gibbons
Chief, Environmental Resources Branch
U.S. Department of the Army
Corps of Engineers, Portland District
PO Box 2946
Portland, OR 97208-2946

Dear Ms. Gibbons:

Bonneville Power Administration (BPA) is in receipt of your recent correspondence requesting that BPA become a cooperating agency for an Environmental Impact Statement to assess the continued operations and maintenance of the Willamette Valley System in U.S. Army Corps of Engineers (Corps) owned and maintained facilities within the Willamette Valley. BPA appreciates the request and accepts your offer to participate as a formal cooperating agency for this effort.

As you know, both agencies work very closely together on hydro-system operations. We look forward to continuing to work together on the technical aspects of the Willamette Valley Project. Michele Palmer of BPA Environmental Planning and Analysis group (NEPA department) is available to assist as needed and serve as the NEPA contact at BPA for matters related to this project. Daniel Spear of BPA's Fish Operations Policy and Planning department continues to be available to assist as needed and serve as the technical lead contact for BPA for matters related to this project

If you have any questions or require additional information, please do not hesitate to contact me at 503-230-5136, BPA's NEPA lead, Michele Palmer at 503-230-5351, or Daniel Spear, BPA's technical lead at 503-230-3124

Sincerely,

SCOTT G. ARMENTROUT
Executive Vice President, Environment, Fish and Wildlife

becc:
S. Armentrout – E-4
D. Kennedy – EC-4
Official File

DKK:3769:https://portal.bud.bpa.gov/orgs/efw/KEC/kecrefs/All KEC Tracking/Correspondence Scott signs/Corps WVS Coop Agency response ltr.doc

Sent via Certified Mail:

1.3 Confederated Tribes of the Grand Ronde Community of Oregon

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch JAN 18 2019

The Honorable Cheryle A. Kennedy
Chairwoman, The Confederated Tribes of the Grand Ronde Community of Oregon
9615 Grand Ronde Rd,
Grand Ronde, OR 97347

Dear Chairwoman Kennedy:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting your tribe's participation as a cooperating agency for the EIS. This request is being made to ensure that we are aware of any concerns your tribe may have as it applies to your natural and cultural resources within the project area.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, your tribe would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges nor diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Siletz Indians, Cow Creek Band of Umpqua Tribe of Indians, Bonneville Power Administration, Bureau of Land Management, National Marine Fisheries Service, Bureau of Reclamation, U.S. Forest Service, U.S. Fish and Wildlife Service, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, Oregon Parks and Recreation Department, Oregon Department of Environmental Quality, Oregon Department of Land Conservation and Development, Oregon Department of State Lands, and Oregon Department of Agriculture.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

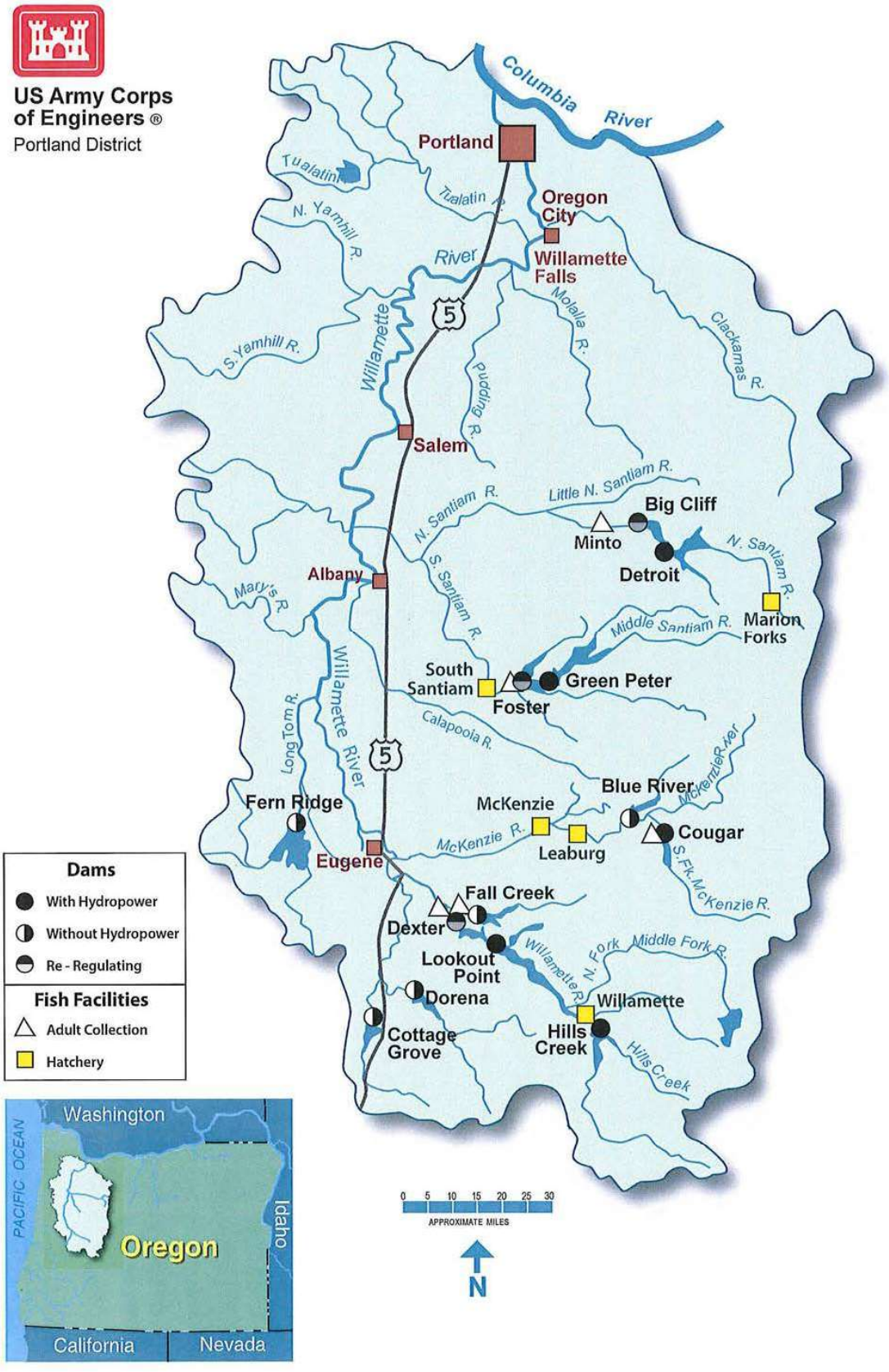
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Michael Karnosh, Ceded Lands Program Manager
Briece Edwards, Manager, Historic Preservation Office

The Willamette River Basin



1.4 Confederated Tribes of the Siletz Indians

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 18 2019

The Honorable Delores Pigsley
Chairman, The Confederated Tribes of Siletz Indians
P.O. Box 549
Siletz, OR 97380

Dear Chairman Pigsley:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting Confederated Tribes of Siletz Indians' participation as a cooperating agency for the EIS. This request is being made to ensure that we are aware of any concerns your tribe may have as it applies to your natural and cultural resources within the project area.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, your tribe would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges

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Sincerely,

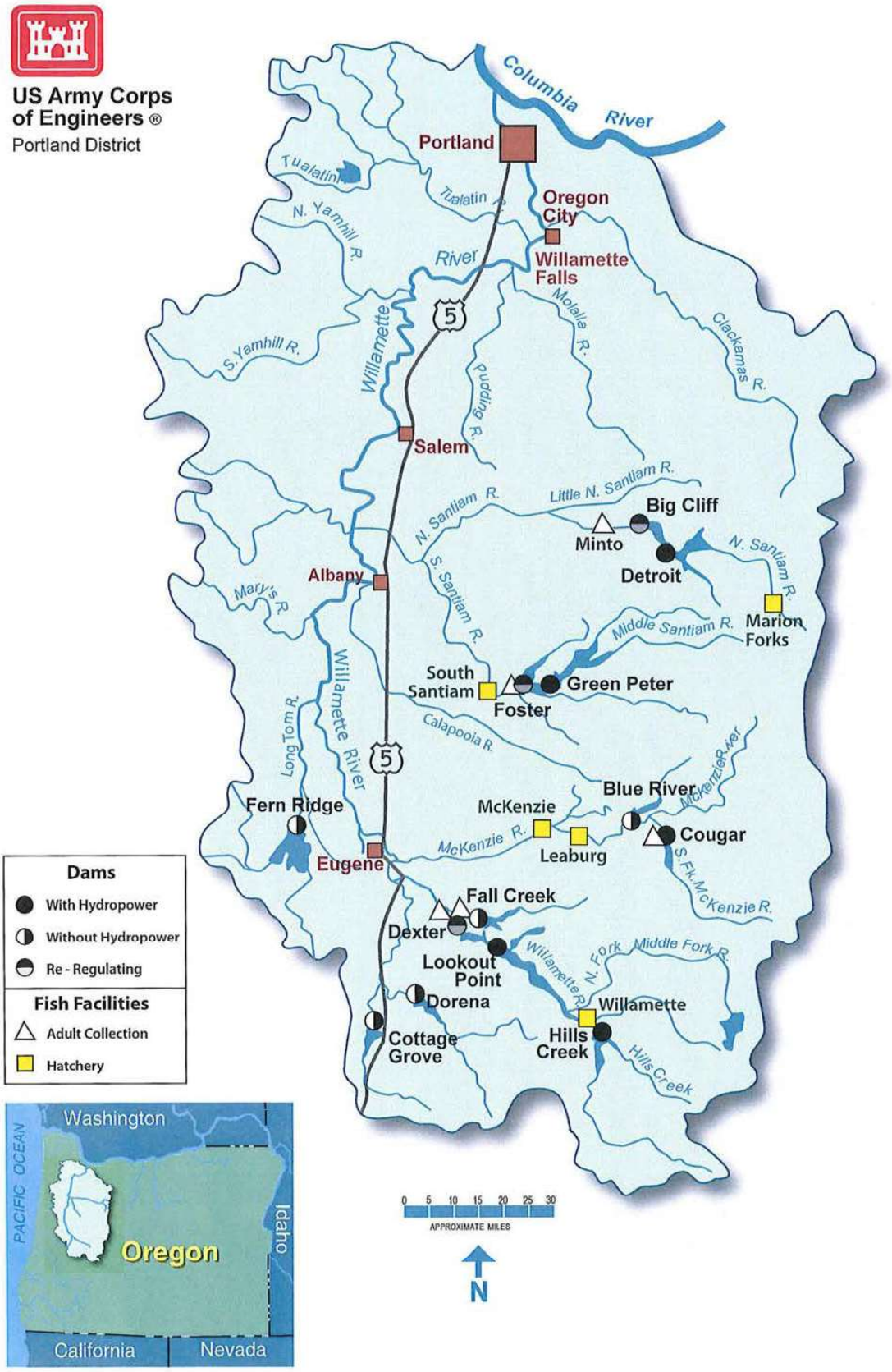


Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Robert Kentta, Cultural Resources Manager
Michael Kennedy, Natural Resources Manager

The Willamette River Basin



1.5 Confederated Tribes of the Warm Springs Reservation of Oregon

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch JAN 18 2019

The Honorable E. Austin Greene, Jr.
Chairman, Confederated Tribes of the Warm Springs Reservation of Oregon
P.O. Box C
Warm Springs, OR 97761

Dear Chairman Greene:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting your tribe's participation as a cooperating agency for the EIS. This request is being made to ensure that we are aware of any concerns your tribe may have as it applies to your natural and cultural resources within the project area.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, your tribe would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges nor diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

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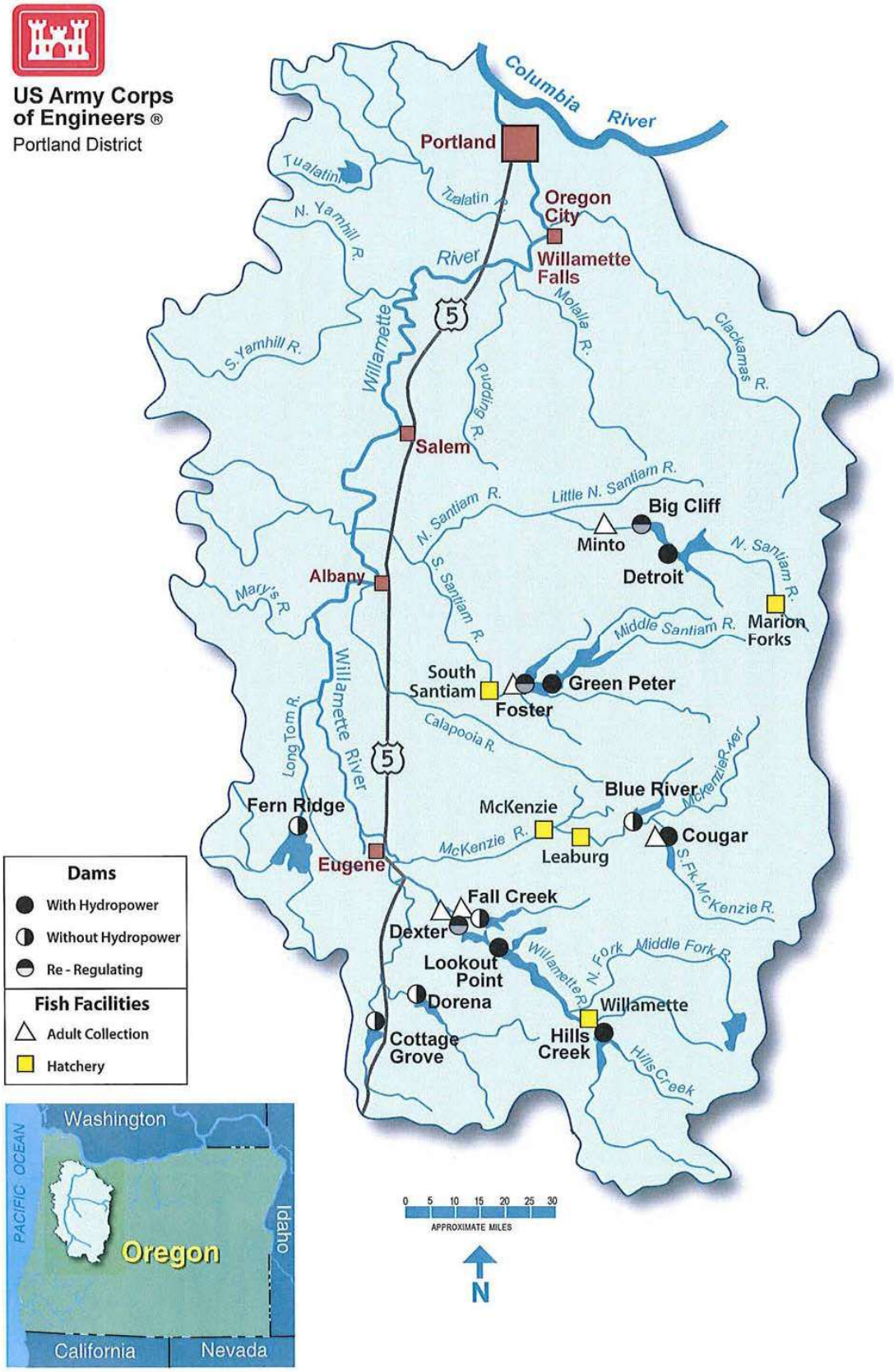
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Robert Brunoe, General Manager, Branch of Natural Resources and Tribal Historic Preservation Officer
Christian Nauer, Tribal Archaeologist

The Willamette River Basin



1.6 National Marine Fisheries Service

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 18 2019

Dr. Kim Kratz
Assistant Regional Administrator
National Marine Fisheries Service
1201 NE Lloyd Blvd., Suite 1100
Portland, OR 97232

Dear Dr. Kratz:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent NEPA evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting National Marine Fisheries Service (NMFS) participation as a cooperating agency for the EIS. This request is being made because of NMFS's jurisdiction by law and/or special expertise related to ESA-listed species.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, NMFS would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges nor diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Cow Creek Band of Umpqua Tribe of Indians, Bonneville Power Administration, Bureau of Reclamation, U.S. Forest Service, U.S. Fish and Wildlife Service, Bureau of Land Management, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, Oregon Parks and Recreation Department, Oregon Department of Environmental Quality, Oregon Department of Land Conservation and Development, Oregon Department of State Lands, and Oregon Department of Agriculture.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

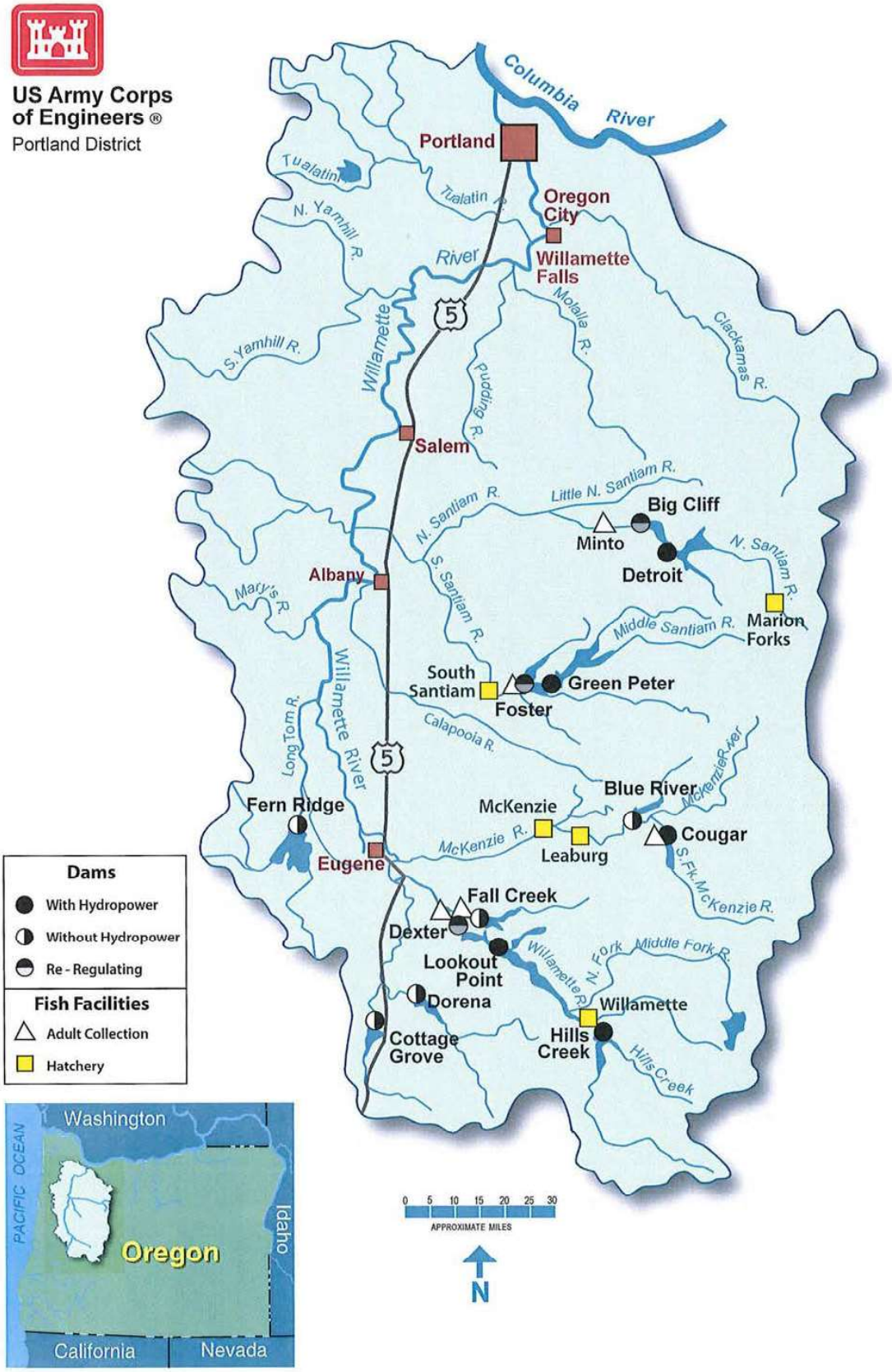
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Marc Liverman, Willamette Branch Chief

The Willamette River Basin



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232

March 6, 2019

Amy Gibbons
Environmental Resources Branch
Corps of Engineers, Portland District
PO Box 2946
Portland, Oregon 97208-2946

Re: Request for NMFS Participation as Cooperating Agency for Development of an EIS for the Operation and Maintenance of the Willamette Valley System

Ms. Gibbons:

Thank you for inviting the National Marine Fisheries Service (NMFS) to participate as a cooperating agency in the development of an environmental impact statement (EIS) for the operation and maintenance of the Willamette Valley System (WVS).

We accept your invitation and look forward to working with the Army Corps of Engineers, Portland District (Corps) on this project in accordance with the National Environmental Policy Act (NEPA)(42 U.S.C. §§ 4321-4361), Regulations for Implementing the National Environmental Policy Act (40 CFR 1500-1508), NOAA Administrative Order Implementing NEPA (NAO 216-6A), and a Companion Manual to the NAO entitled Policy and Procedures for Compliance with the National Environmental Policy Act and Related Authorities ("Companion Manual") that provides additional, specific policies pursuant to NEPA and related authorities.

It is our understanding that as lead agency, the Corps will:

1. Have primary responsibility for meeting requirements of NEPA, including preparation of the draft and final EIS with sufficient information to address state and federal compliance requirements.
2. Consult with NMFS on issues of concern, the range of alternatives, mitigation measures to be analyzed in the EIS, and responses to public comments.
3. Provide NMFS with copies of preliminary drafts of the EIS and interim work products, such as individual EIS sections, maps, and public meeting materials, in a timely manner.
4. Revise preliminary drafts of the EIS in response to comments, concerns, or issues identified by NMFS.
5. Ensure that NMFS receives copies of all comments received on the draft and final EIS during the public comment periods, and provide an initial identification of those comments pertaining to NMFS expertise or regulatory authority, including any that may require NMFS to prepare a written response for inclusion in the EIS.
6. Ensure that the draft and final EIS cover pages identify NMFS as a cooperating agency.

Similarly, to the extent that our resources allow, NMFS will:

1. Actively participate in the development of the EIS by serving as the agency of expertise with regard to protected anadromous species and other marine species, and climate change.
2. Assist the Corps with analyses of the biological and ecological impacts of the proposed action, and climate change, on those species.
3. Review preliminary and final documents, including scoping documents and effects analyses, and provide comments to the Corps consistent with agreed upon timelines.
4. Participate in development of information to support public outreach, and to assist in delivering that information at public meetings.

The principal point of contact for NMFS as a cooperating agency during the development of the EIS will be Diana Dishman, at 503.736.4466 or diana.dishman@noaa.gov. Please continue to provide background materials and a schedule for development milestones when available, and prior to further public scoping.

Sincerely,

Marc Liverman /for

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

1.7 Oregon Department of Agriculture

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 18 2019

Ms. Lisa Charpilloz Hanson
Deputy Director
Oregon Department of Agriculture
635 Capitol St NE
Salem, OR 97301

Dear Ms. Hanson:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting Oregon Department of Agriculture's (ODA) participation as a cooperating agency for the EIS. This request is being made because of ODA's special expertise as it relates to irrigation water demand in the Willamette Valley Basin.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, ODA would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges nor

diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Cow Creek Band of Umpqua Tribe of Indians, Bonneville Power Administration, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, U.S. Forest Service, Bureau of Land Management, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, Oregon Parks and Recreation Department, Oregon Department of Environmental Quality, Oregon Department of State Lands, and Oregon Department of Land Conservation and Development.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

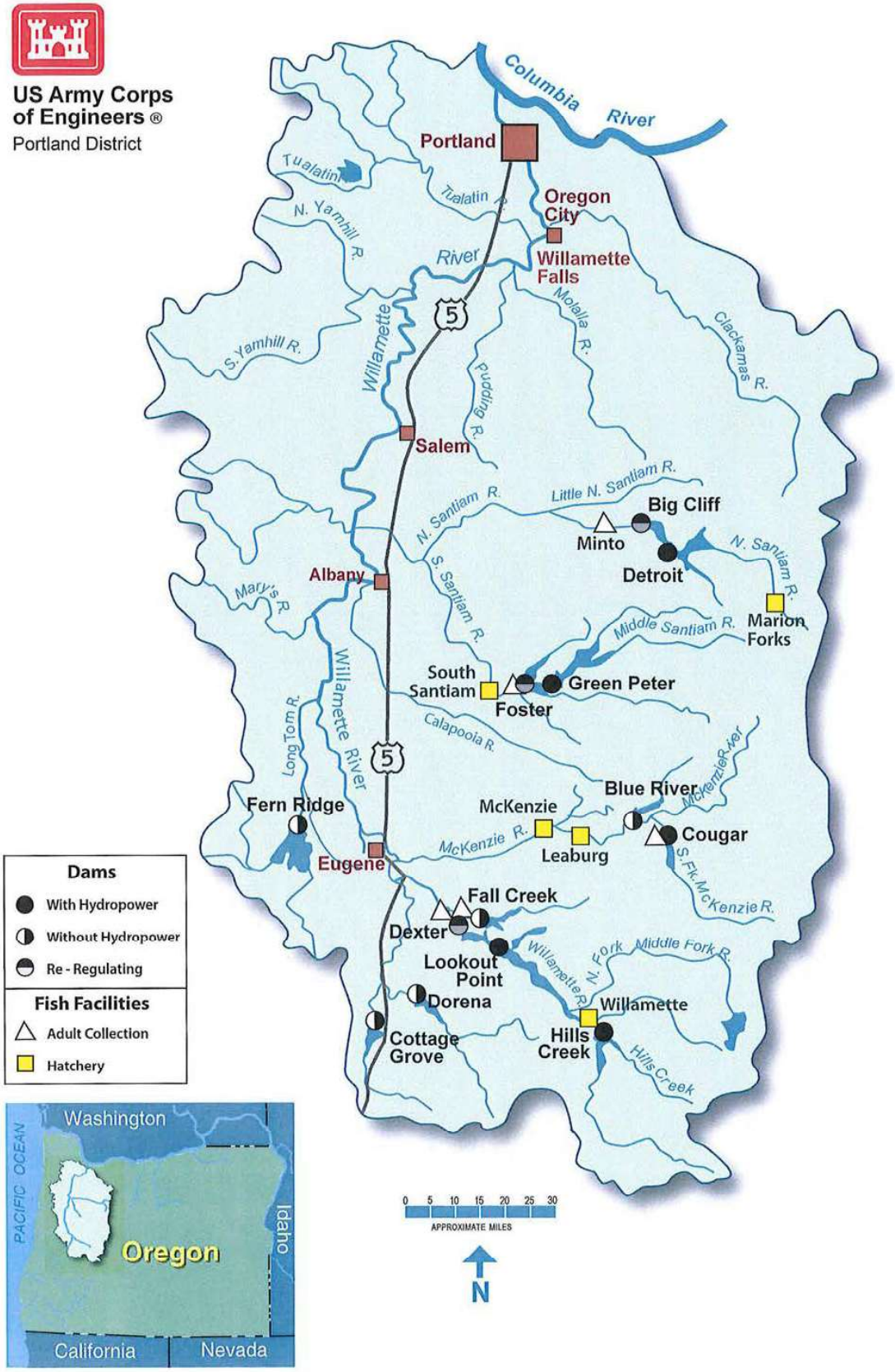
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Stephanie Page, Director of Natural Resources Program Area

The Willamette River Basin



1.8 Oregon Department of Environmental Quality

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 18 2019

Ms. Leah Feldon
Deputy Director
Oregon Department of Environmental Quality
700 NE Multnomah Street, Suite 600
Portland, OR 97232-4100

Dear Ms. Feldon:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting Oregon Department of Environmental Quality's (ODEQ) participation as a cooperating agency for the EIS. This request is being made because of ODEQ's special expertise and management of natural resources in the project area.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, ODEQ would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges

nor diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Cow Creek Band of Umpqua Tribe of Indians, Bonneville Power Administration, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, U.S. Forest Service, Bureau of Land Management, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, Oregon Parks and Recreation Department, Oregon Department of Agriculture, Oregon Department of State Lands, and Oregon Department of Land Conservation and Development.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

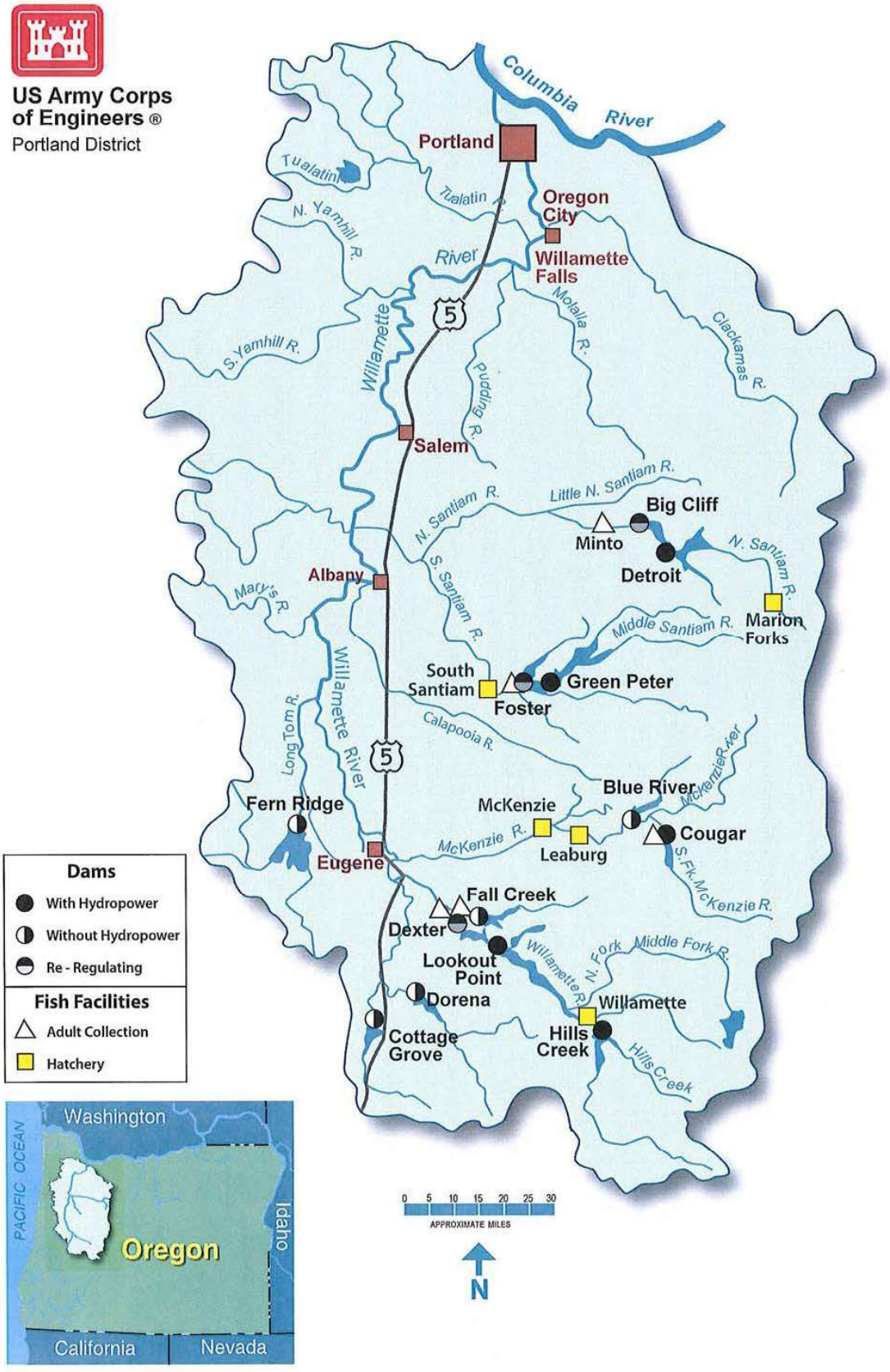
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Justin Green, Water Quality Division Administrator
Keith Andersen, Western Region Administrator

The Willamette River Basin



1.9 Oregon Department of Fish and Wildlife

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 18 2019

Mr. Steven Marx
Acting West Region Manager
Oregon Department of Fish and Wildlife
17330 S.E. Evelyn St., Clackamas, OR 97015

Dear Mr. Marx:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting Oregon Department of Fish and Wildlife's (ODFW) participation as a cooperating agency for the EIS. This request is being made because of ODFW's special expertise related to fish and wildlife species and because of ODFW's management of fish hatcheries in the WVS project area.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, ODFW would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges

nor diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Cow Creek Band of Umpqua Tribe of Indians, Bonneville Power Administration, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, U.S. Forest Service, Bureau of Land Management, Oregon Department of Environmental Quality, Oregon Water Resources Department, Oregon Parks and Recreation Department, Oregon Department of Agriculture, Oregon Department of State Lands, and Oregon Department of Land Conservation and Development.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

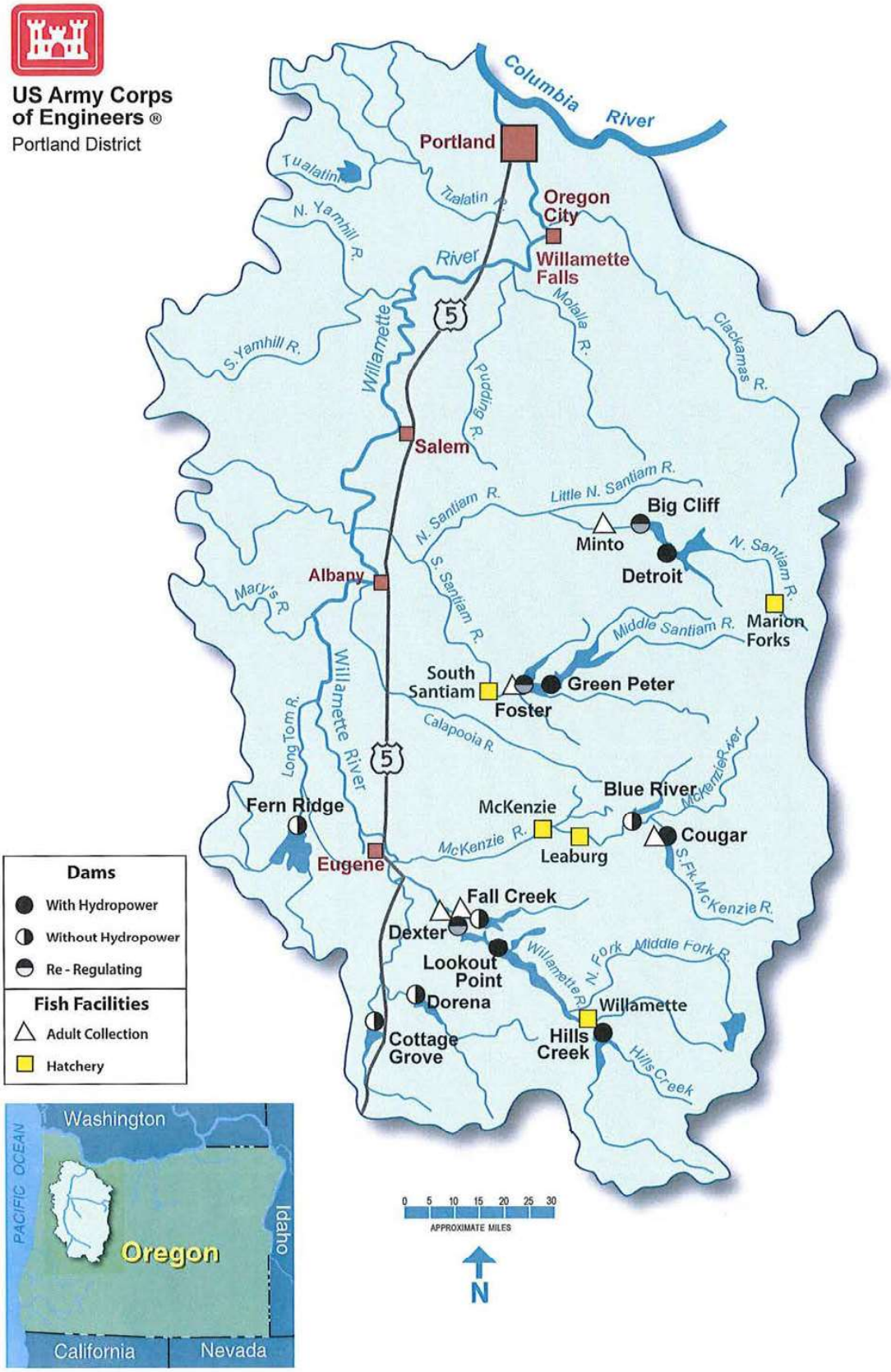
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: David Speten, Fern Ridge Wildlife Management Area Manager
Bruce McIntosh, Deputy Fish Division Administrator
Kelly Reis, Fish Biologist

The Willamette River Basin



1.10 Oregon Water Resources Department

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 18 2019

Mr. Doug Woodcock
Deputy Director
Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, OR 97301

Dear Mr. Woodcock:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting Oregon Water Resources Department (OWRD) participation as a cooperating agency for the EIS. This request is being made because of OWRD's special expertise as it relates to water supply in the project area.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, OWRD would work cooperatively with the Corps in the development of the EIS. Cooperating agency status is a major component of agency stakeholder involvement that neither enlarges

nor diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Cow Creek Band of Umpqua Tribe of Indians, Bonneville Power Administration, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, U.S. Forest Service, Bureau of Land Management, Oregon Department of Environmental Quality, Oregon Department of Land Conservation and Development, Oregon Parks and Recreation Department, Oregon Department of Agriculture, Oregon Department of State Lands, and Oregon Department Fish and Wildlife.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

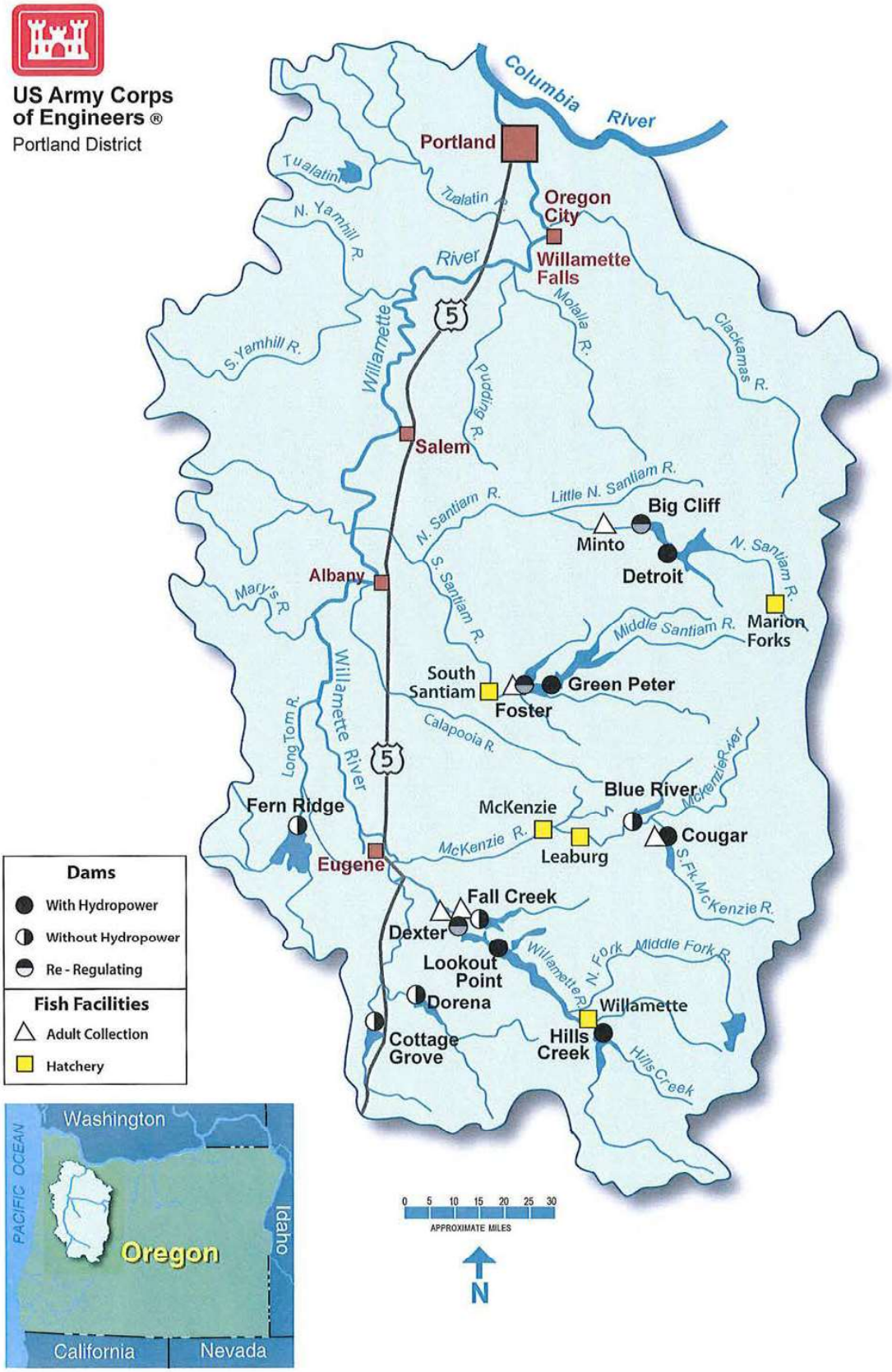
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Mike McCord, Northwest Region Manager

The Willamette River Basin



Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
725 Summer St NE, Suite A
Salem, OR 97301
Phone (503) 986-0900
Fax (503) 986-0904
www.wrd.state.or.us

February 14, 2019

Amy C. Gibbons, Chief
Environmental Resource Branch
Corps of Engineers
PO Box 2946
Portland, OR 97208-2946

Re: Request for Oregon Water Resources participation as EIS cooperator

Dear Ms. Gibbons,

Oregon Water Resources Department (Department) accepts the offer to be a cooperating agency in the development of the Willamette Valley System environmental impact statement. The Department has an interest in Willamette reservoir management and its potential impacts to water rights, both instream and out-of-stream rights. To that end we would like to assist the Corps in the development of that document.

The Department understands the responsibilities of a cooperator, and further recognizes the Department's staffing limitations to undertake the broad body of work ahead. In short, we will assist however we are able.

Mr. Mike McCord, Northwest Region Manager, will be the Department point of contact for this project (Mike.L.McCord@oregon.gov; (503) 986-0893).

Thank you for reaching out to the agency.

Sincerely,

Douglas Woodcock
Deputy Director

1.11 U.S. Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 155
Seattle, WA 98101-3123

JUL 1 0 2019

REGIONAL
ADMINISTRATOR'S
DIVISON

U.S. Army Corps of Engineers, CENWP-PME-E
Attn: Suzanne Hill
P.O. Box 2946
Portland, Oregon 97208-2946

Dear Ms. Hill:

Thank you for your letter of June 7, 2019, requesting the U.S. Environmental Protection Agency to participate as a cooperating agency in the preparation of an Environmental Impact Statement to address the continued operations and maintenance of the Willamette Valley System (EPA Project Number 19-0023-COE). We accept your offer to be a cooperating agency on this project, to the extent resources allow.

Our overall goal in serving as a cooperating agency will be to provide perspective and expertise that will contribute to a high-quality environmental impact analysis process. We agree the effort will entail early engagement in the NEPA process and the development of information and environmental analysis for areas which the EPA has special expertise. We recognize that this request is being made because of the EPA's special expertise related to contamination clean up actions in the Willamette Basin. We look forward to further discussing roles and responsibilities related to the preparation of this EIS.

Please note that the EPA's status as a cooperating agency does not affect our independent responsibilities under Section 309 of the Clean Air Act to review and comment publicly on all Draft Environmental Impact Statements. Participation as a cooperating agency does not imply endorsement of the proposed projects, nor can it be used to obligate or commit funds or as a basis for the transfer of funds. Please reference this acceptance letter in, or incorporate it into, the Draft and Final Environmental Impact Statements.

I have asked Erik Peterson of my staff to be the EPA's primary point of contact on this project. He can be reached at 206-553-6382 or peterson.erik@epa.gov.

Sincerely,

Andrew Baca

Andrew Baca
Director

1.12 U.S. Fish and Wildlife Service

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

JAN 18 2019

Dr. Paul Henson
State Supervisor
U.S. Fish & Wildlife Service
Oregon State Office
2600 SE 98th Avenue, Suite 100
Portland, OR 97266

Dear Dr. Henson:

The U.S. Army Corps of Engineers, Portland District (Corps) is hereby notifying your agency of our intent to prepare an environmental impact statement (EIS) to address the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects in the Willamette River Basin in Oregon, and hatchery programs to mitigate for effects of the project on fish habitat. The most recent National Environmental Policy Act (NEPA) evaluation for the overall WVS operations and maintenance was an EIS completed in 1980; NEPA evaluations since that time have been project specific. Since 1980, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively, these changes have resulted in a need for implementation of actions to meet authorized project purposes and ESA obligations. The EIS will be prepared in accordance with NEPA, the Council on Environmental Quality's (CEQ) NEPA regulations (40 C.F.R. parts 1500-1508), and the Corps' NEPA regulations (33 C.F.R. part 230). The Corps will be the lead agency, with responsibility for preparation of the EIS.

In accordance with the CEQ regulations found at 40 C.F.R. § 1501.6, the Corps is formally requesting U.S. Fish and Wildlife Service's (USFWS) participation as a cooperating agency for the EIS. This request is being made because of USFWS' jurisdiction by law and special expertise for ESA-listed species within the project area.

A cooperating agency, as described in 40 C.F.R. § 1501.6(b)(1-5), participates in the NEPA process at the earliest possible time; develops information; prepares environmental analysis for which the agency has special expertise; and makes available staff support at the lead agencies' request. As a cooperating agency, USFWS would work cooperatively with the Corps in the development of the EIS. Cooperating agency

status is a major component of agency stakeholder involvement that neither enlarges nor diminishes the decisionmaking authority of any agency or entity involved in the NEPA process.

The Corps intends to issue a notice of intent (NOI) in the Federal Register and conduct public scoping for this EIS in spring 2019, including a series of public meetings. Prior to the NOI, the Corps is inviting Tribes, and federal and state agencies to participate as cooperating agencies for this EIS; emphasizing the need for early cooperation in the NEPA process. The Corps has also invited the following Tribes and federal and state agencies to participate as cooperating agencies for the EIS: Confederated Tribes of Warm Springs, Confederated Tribes of Grand Ronde, Confederated Tribes of Siletz Indians of Oregon, Cow Creek Band of Umpqua Tribe of Indians, Bonneville Power Administration, National Marine Fisheries Service, Bureau of Reclamation, U.S. Forest Service, Bureau of Land Management, Oregon Department of Fish and Wildlife, Oregon Water Resources Department, Oregon Parks and Recreation Department, Oregon Department of Environmental Quality, Oregon Department of Land Conservation and Development, Oregon Department of State Lands, and Oregon Department of Agriculture.

In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not participate as a cooperating agency, we would still engage with you throughout the NEPA process, as appropriate, in accordance with your agency's area of expertise and include your agency on distribution lists for review and comment on the NEPA public documents. Should you decide to participate as a cooperating agency, we will coordinate with your agency's designated point of contact to schedule an initial coordination meeting to discuss roles and responsibilities related to the preparation of the EIS. Therefore, we request that a primary point of contact be designated for coordination throughout the development of the EIS. If you have any questions regarding this letter or need additional information, please contact Environmental Resources Specialist, Suzanne Hill at (503) 808-4767, or by e-mail at suzanne.hill@usace.army.mil.

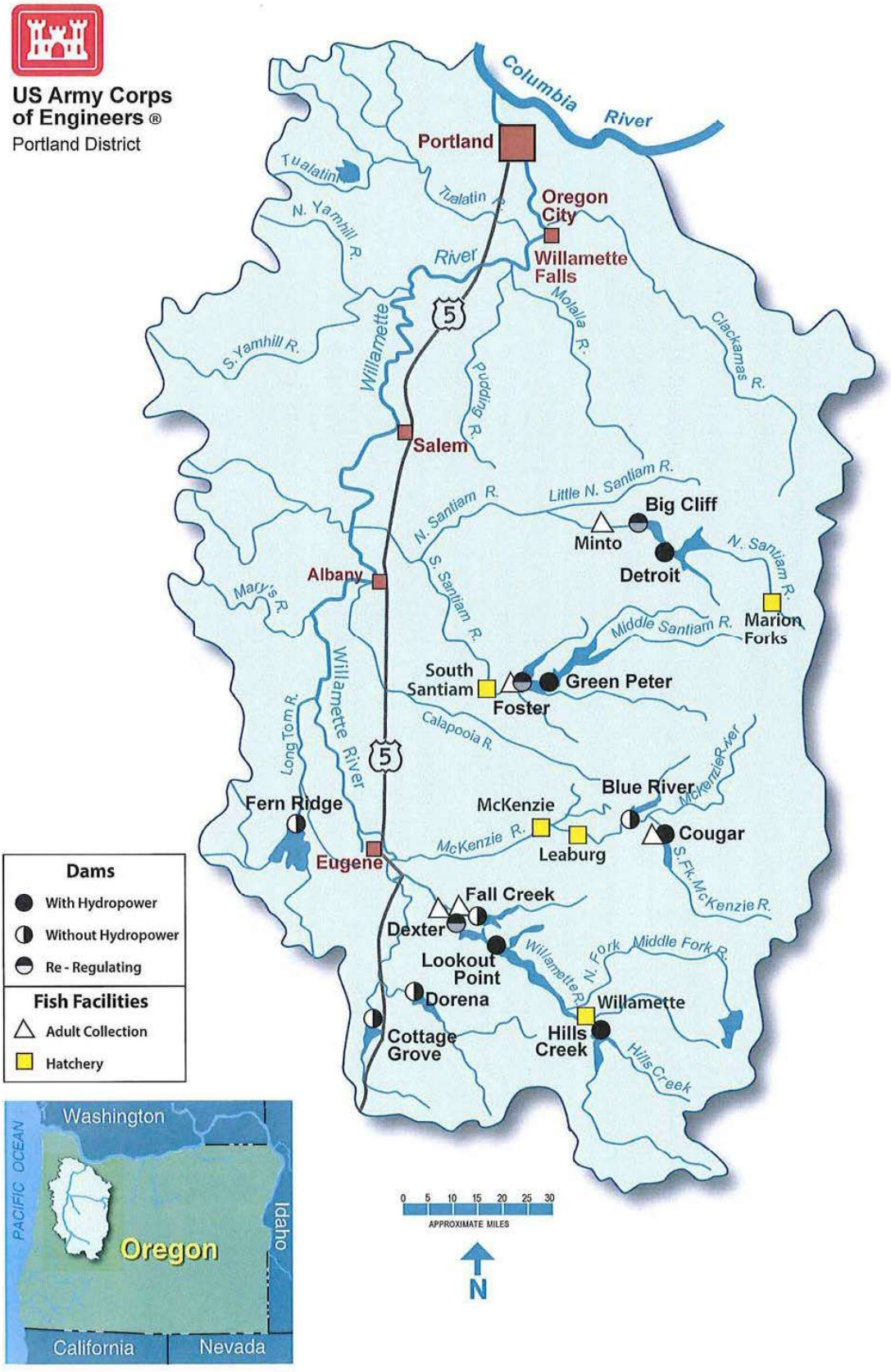
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Michael Hudson, Fish Biologist, U.S. Fish and Wildlife Service

The Willamette River Basin



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Columbia River Fish and Wildlife Conservation Office
1211 SE Cardinal Court, Suite 100
Vancouver, Washington 98683-9658

February 11, 2019

Amy C. Gibbons
Chief, Environmental Resources Branch
Corps of Engineers, Portland District
PO Box 2946
Portland, OR 97208

Dear Ms. Gibbons:

The U.S. Fish and Wildlife Service (Service) appreciates and accepts your offer to participate as a cooperating agency in the NEPA process for the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized purposes per your letter dated January 18, 2019. The Service has statutory authority for multiple species that rely upon the water resources of the Willamette River basin, and therefore, considers participation in this process in alignment with, and important to, our mission. Our interest is in ensuring these species are fully considered in the assessment of environmental impacts from operation of the WVS. As a cooperating agency, the Service will assist, to the extent possible, in finding a balance that supports current and future water supply needs in the Willamette River basin.

As you move forward with this process, please include Mike Hudson as the Service primary point-of-contact. He can be reached at our Columbia River Fish and Wildlife Conservation Office by phone (360-604-2575) or email (michael_hudson@fws.gov).

Thank you for the opportunity to participate as a cooperating agency. We look forward to working with you.

Sincerely,

Kyle Hanson
Acting Project Leader

EC: Paul Henson, USFWS
Suzanne Hill, USACE

TAKE PRIDE IN AMERICA

2 NEPA Alternatives Development Meetings

2.1 Measures Development Charette Day 1, December 3, 2018

U.S. Army Corps of Engineers, Portland District

Willamette Valley System Operations EIS and ESA Consultation

Measures Development Charette (4 & 6 December 2018)

AGENDA

A charette is a structured, collaborative session in which a group comes together to develop a solution to a problem.

Location:
East Atrium 3rd Floor

Purpose: To gather team members from Portland District to advance the Willamette Valley System Operation and Maintenance Environmental Impact Statement.

Objectives:

- Achieve a common understanding of the Willamette EIS purpose and needs, objectives and constraints.
- Identify robust initial list of measures to address Willamette EIS objectives and opportunities.
- Draft screening criteria upon which to complete future evaluation of measures and alternatives.
- Provide training on organizing measures into alternatives.

Please bring: Paper, pen land/or pencil, coffee cup, and snacks to keep you energized.

Agenda: Please see the following pages.

Willamette Valley Charette Agenda

Day 1: Tuesday, December 4, 2018

INTENDED OUTCOMES FOR DAY 1:

1) **Common understanding of the purpose and desired outcomes of the charette.**
2) **Common understanding of overall system operations, the 2008 BiOp, the Willamette Basin System Review, and bank revetment.**
3) **Clear understanding of the NEPA and ESA processes will be integrated for the proposed act**
4) **Clear understanding of the NEPA process and how the Charette results fit into NEPA.**
5) **Common understanding of the Willamette EIS purpose, needs, objectives, and constraints.**
6) **Identify conceptual measures to address Willamette EIS objectives for each mission area (i.e., authorized project purpose.**

TIME	Duration	ACTION	WHO
0830 – 0845	15 minutes	Welcome, Introductions Overview of the Willamette Valley EIS and charge to the PDT.	Mike Turaski, Project Manager, Portland District Eric Petersen, Operations
0845 – 0915	30 minutes	Charette Orientation	Suzy Hill & Tanis Toland,
0915 - 0930	15 minutes	PRESENTATION: System Operations Overview	Mary Karen, System Operations SME
0930 - 0945	15 minutes	PRESENTATION: 2008 BiOp Overview	Rich Piaskowski, BiOp SME
0945 -1000	15 minutes	PRESENTATION: Willamette Basin Review	Kathryn Warner
1000 – 1015	15 minutes	PRESENTATION: Bank Revetment	Shane Cline
1015 – 1030	15 minutes	**BREAK**	
1030 – 1100	30 minutes	PRESENTATION: NEPA Basics & Where the PDT is in the Process.	Kelly Janes and Suzy Hill
1100 – 1115	15 minutes	PRESENTATION: Objectives and Constraints	Suzy Hill
1115 - 1200	45 minutes	MINI-TRAINING: Measures – What they are and how to identify and develop them	Kelly Janes
1200 – 1245	45 minutes	**LUNCH**	
1245 – 1300	15 minutes	ACTIVITY: Brain Stretch	Tanis Toland, Facilitator
1300 – 1500	1 hour	ACTIVITY: Identify Concept Measures to address Willamette EIS Objectives – Individual Brainstorm	Tanis Toland, Facilitator
1400 - 1500	1 hour	ACTIVITY: Identify Concept Measures to address Willamette EIS Objectives for each mission – Small Group	
1500 – 1515	15 minutes	**BREAK**	
1515 – 1600	45 minutes	ACTIVITY: Continue to Identify Measures	Tanis Toland, Facilitator
1600 – 1630	30 minutes	PRESENTATION: Small Group Reports – (1) Number of Concept Measures Most interesting measure, (2)	Spokesperson for each Small Group
1630 – 1700	30 minutes	REVIEW DAY 1, PLAN DAY 2	Tanis Toland, Facilitator

Willamette Valley Charette Agenda

<u>Day 2</u>: Thursday, 6 December 2018

INTENDED OUTCOMES FOR DAY 2:

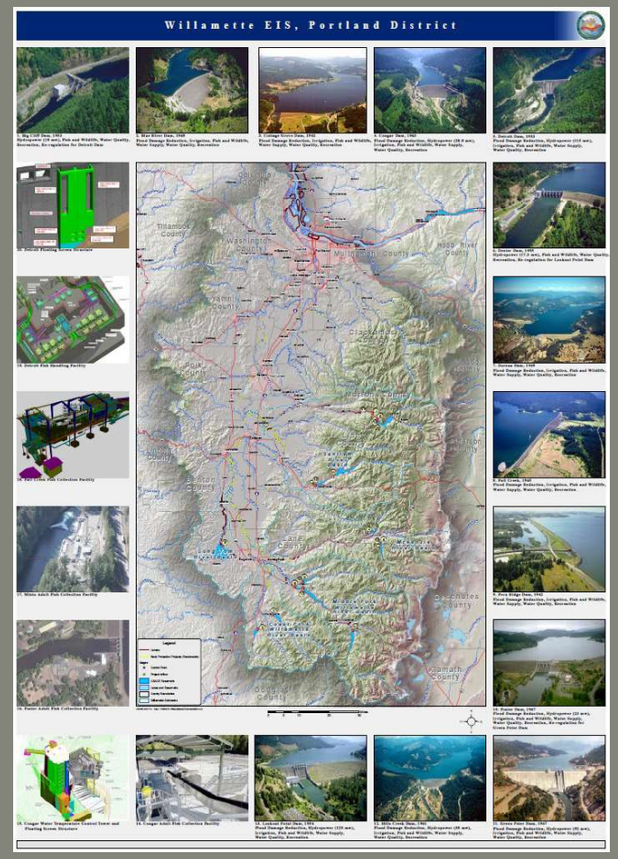
1) **Develop Conceptual Measures into Full Measures.**
2) **Identify next steps for the PDT on this study.**

TIME	DURATION	ACTION	WHO
0830 – 0845	15 minutes	Guest Speaker	Welcome
0845 – 0900	15 minutes	Housekeeping Logistics REVIEW DAY 2	Suzy Hill & Tanis Toland, Facilitator
0900 – 1000	45 minutes	ACTIVITY: Develop Measures	Tanis Toland, Facilitator
1000 – 1230	2 hrs 30 min	**BREAK (Town Hall & Lunch)**	
1230 – 1430	2 hours	ACTIVITY: Continue to Develop Measures	Tanis Toland, Facilitator
1430 – 1445	15 minutes	**BREAK**	
1445 – 1515	30 minutes	ACTIVITY: Small Groups wrap-up measures development and prepare for report out.	Tanis Toland, Facilitator
1515 – 1545	30 minutes	PRESENTATIONS: Small Group Reports	Spokesperson for each Small Group
1545 – 1615	30 minutes	ACTIVITY: Identify next steps and key information needs	Tanis Toland, Facilitator
1615 – 1630	15 minutes	Wrap-up – Charette outcomes	Tanis Toland, Facilitator Mike Turaski, Project Manager

WILLAMETTE VALLEY SYSTEM OVERVIEW

CENWP-ENC-HR
Mary Karen Scullion

December 5, 2018



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AGENDA

System wide operations – when do they occur
Flood Risk Reduction season
historic peaks at Salem – reduced after completion of WVP
Comparison of peaks to Oceanic Nino Index
Storage Comparisons in WVP reservoirs
Documentation for current operations - Water Control manuals / updates
How we "do" Flood Risk Management at the Dam
How Flood Risk Management looks downstream
Flood Inundation Associated with 10 Year Recurrence Interval
Flood risk recurrence intervals
Conservation Season system operations
Conservation Season Annual Variability and Communication
Forecasting Reservoir Operations during the Conservation Release Season
Observed Project Elevations and Salem Flows from 2008-2018
Final Thoughts

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2

SYSTEM WIDE OPERATIONS – WHEN DO THEY OCCUR

Flood Risk Reduction season	(November – February/March)
Conservation Release Season	(June – October)
	(with Biop mainstem flows April – October)

Smaller system operations include:

Green Peter / Foster / Foster fish weir

Cougar / Cougar adult fish collection facility / Cougar temp tower

Fall Creek / FC adult fish collection facility / FC temp ops

Hills Creek / Lookout Point / Dexter

Detroit / Big Cliff / Detroit temp ops

Fern Ridge / Irrigation demands to Monroe

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FLOOD RISK REDUCTION SEASON



1894 Flood - downtown Portland



1964 Flood - Albany

All reservoirs store water to avoid downstream flooding



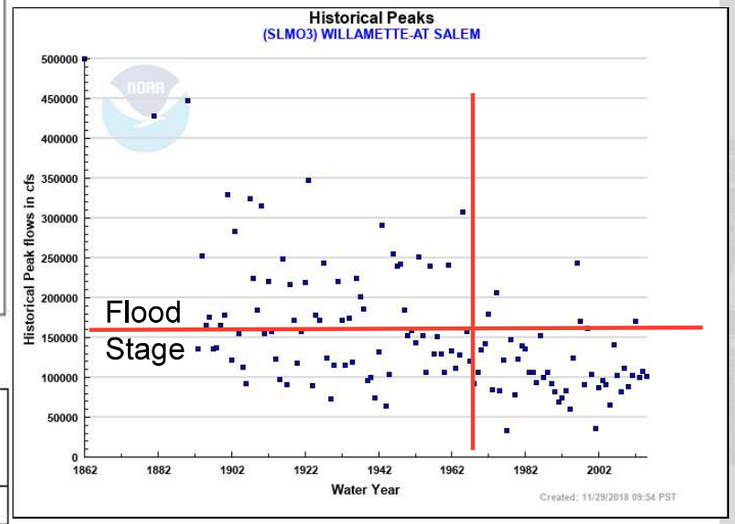
1943 Willamette Valley Flood

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HISTORIC PEAKS AT SALEM – REDUCED AFTER COMPLETION OF WVP

Dam Name	Drainage Area (square miles)	Location	Completion Date
Big Cliff	452	River mile 60.9 (from Santiam mouth) on the North Santiam River	1953
Blue River	88	River mile 1.8 on Blue River	1968
Cottage Grove	104	River mile 29.7 of the Coast Fork Willamette River	1942
Cougar	208	River mile 4.4 of the South Fork McKenzie River	1963
Detroit	438	River mile 58.1 (from Santiam mouth) on the North Santiam River	1953
Dexter	996	River mile 16.8 on the Middle Fork Willamette River	1955
Dorena	265	River mile 7.5 on Row River	1949
Fall Creek	184	River mile 7.9 on Fall Creek	1965
Fern Ridge	275	River mile 23.6 on Long Tom River	1941
Foster	494	River mile 38.5 on the South Santiam River	1967
Green Peter	277	River mile 4.7 on the Middle Santiam River	1967
Hills Creek	389	River mile 47.8 on the Middle Fork Willamette River	1961
Lookout Point	991	River mile 19.9 on the Middle Fork Willamette River	1954

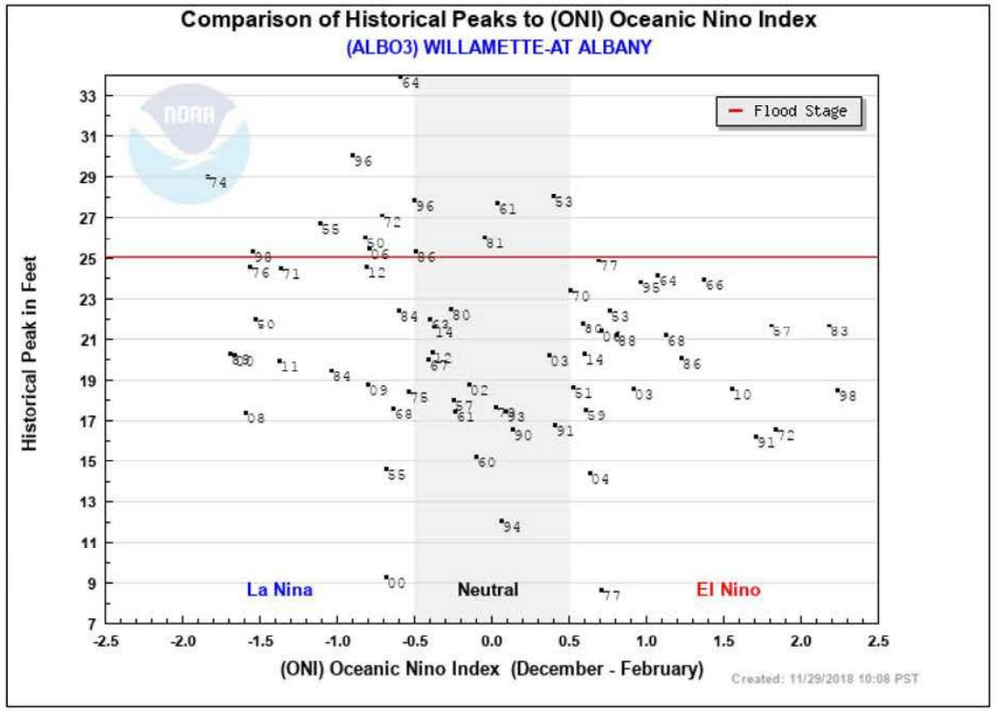


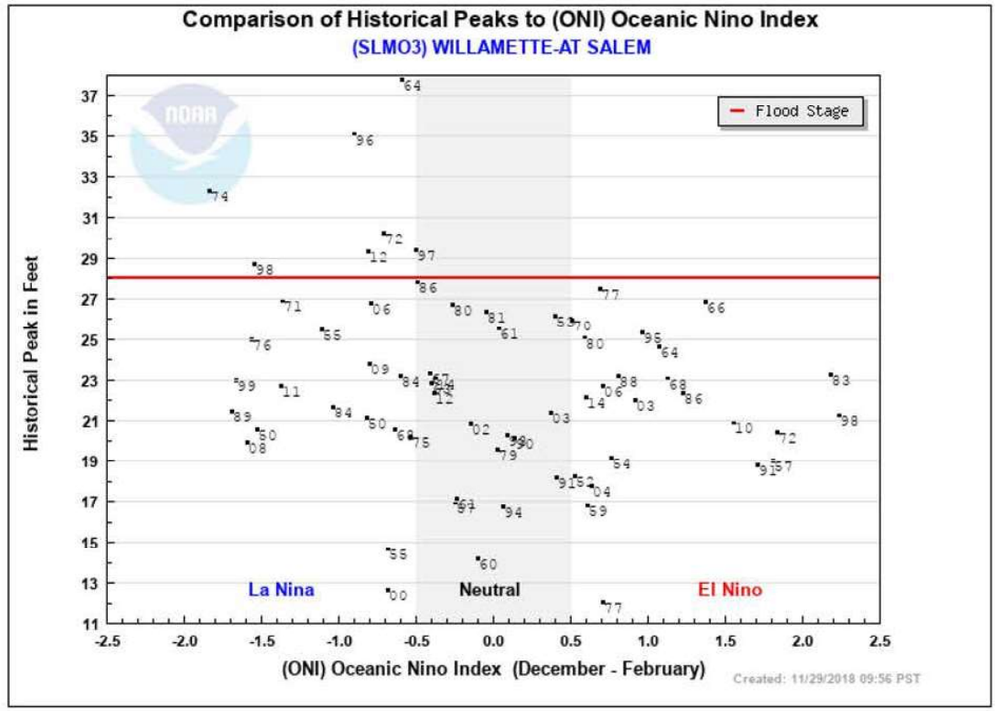
Ranked Observed Flood Flows of the Willamette River at Salem Since 1813

Ranking by Flow	Water Year	Date of Peak	Discharge cfs	Stage Feet - gage datum	Snow Contribution
1	1862	12/04/1861	500,000	47	yes
2	1890	02/05/1890	448,000	45.1	yes
3	1814	11-12/1813	--	45	unknown
4	1881	01/16/1881	428,000	44.3	yes
5	1845	11/23 to 11/29/1844[1]	--	42	yes
6	1850	12/27/1849	--	39	unknown
7	1843	01/05/1843	--	39	unknown
8	1923	01/08/1923	348,000	30.3	yes
9	1901	01/15/1901	329,000	31.5	yes
10	1907	02/06/1907	325,000	31.5	yes
(2)[2]	1965	12/24/1964	308,000 (463,000)[2]	37.8 (46)[2]	yes
(8)[2]	1996	02/08/1996	244,000 (375,000)[2]	35.1 (37)[2]	yes

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COMPARISON OF PEAKS TO OCEANIC NINO INDEX





WILLAMETTE--AT ALBANY (ALBO3)

State: Oregon County: LINN
Latitude: 44 38' 20" North Longitude: 123 6' 20" W
Elevation: 167 feet
Supporting WFO: Portland NWS Official River Forecast
Action Stage: 21.6' Flood Stage: 25'
Moderate Flood Stage: 30'
Major Flood Stage: 32'

Record Stage: 41' Record Flow: 340000 cfs
Date of Record: December 4, 1861

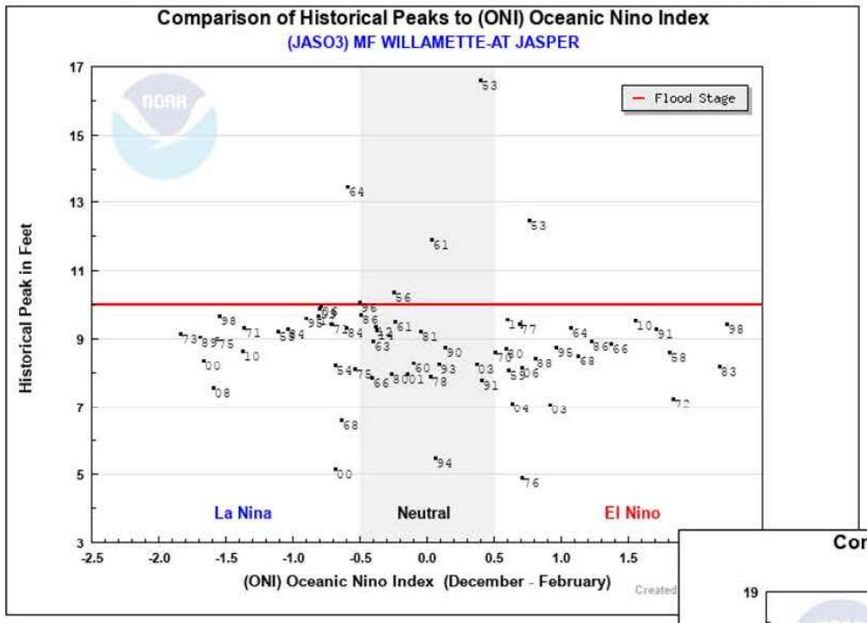
WILLAMETTE--AT SALEM (SLMO3)

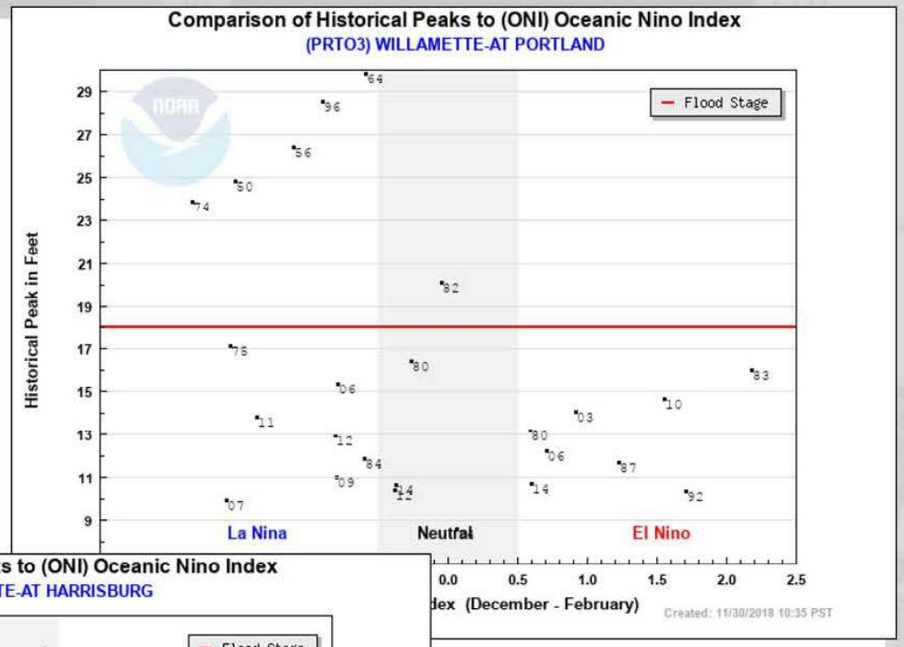
State: Oregon County: MARION
Latitude: 44 56' 39" North Longitude: 123 2' 30" W
Elevation: 106 feet
Supporting WFO: Portland NWS Official River Forecast
Action Stage: 21.2' Flood Stage: 28'
Major Flood Stage: 32'

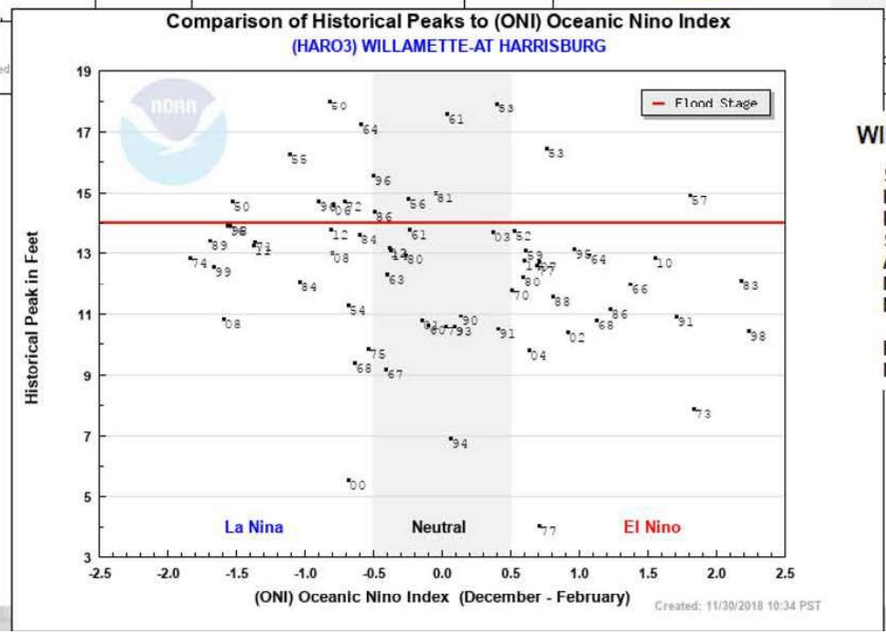
Record Stage: 47' Record Flow: 500000 cfs
Date of Record: December 4, 1861

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MF WILLAMETTE--AT JASPER (JASO3)

State: Oregon County: LANE
Latitude: 43 59' 54" North Longitude: 122 54' 20" W
Elevation: 513 feet
Supporting WFO: Portland NWS Official River Forecasts
Action Stage: 9.4' Flood Stage: 10'
Major Flood Stage: 15'

Record Stage: 17.4' Record Flow: 94000 cfs
Date of Record: November 23, 1909

WILLAMETTE--AT HARRISBURG (HARO3)

State: Oregon County: LINN
Latitude: 44 16' 13" North Longitude: 123 10' 21" W
Elevation: 288 feet
Supporting WFO: Portland NWS Official River Forecasts
Action Stage: 10.8' Flood Stage: 14'
Major Flood Stage: 17'

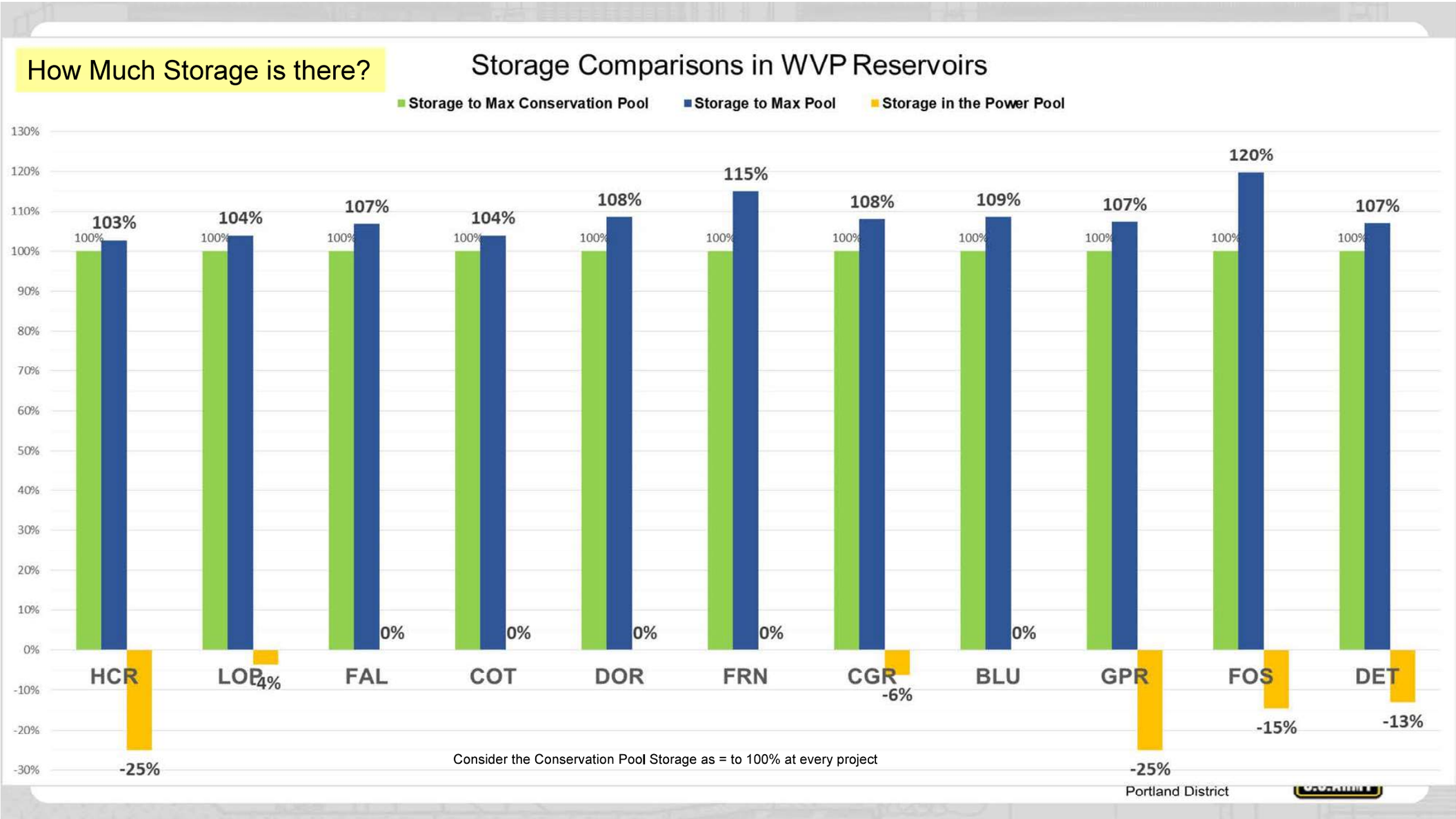
Record Stage: 23' Record Flow: 210000 cfs
Date of Record: December 29, 1945

WILLAMETTE--AT PORTLAND (PRTO3)

State: Oregon County: MULTNOMAH
Latitude: 45 31' 6" North Longitude: 122 40' 0" W
Elevation: 2 feet
Supporting WFO: Portland NWS Official River Forecas
Action Stage: 17' Flood Stage: 18'
Moderate Flood Stage: 24'
Major Flood Stage: 28'

Record Stage: 33'
Date of Record: June 7, 1894

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How Much Storage is there?
Storage Comparisons in WVP Reservoirs
Storage to Max Conservation Pool
Storage to Max Pool
Storage in the Power Pool
130%
120%
110%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
HCR
LOP
FAL
COT
DOR
FRN
CGR
BLU
GPR
FOS
DET
100%
103%
104%
107%
104%
108%
115%
108%
109%
107%
120%
107%
0%
-25%
-4%
-6%
-15%
-13%
Consider the Conservation Pool Storage as = to 100% at every project
Portland District

DOCUMENTATION FOR CURRENT OPERATIONS
WATER CONTROL MANUALS / UPDATES

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

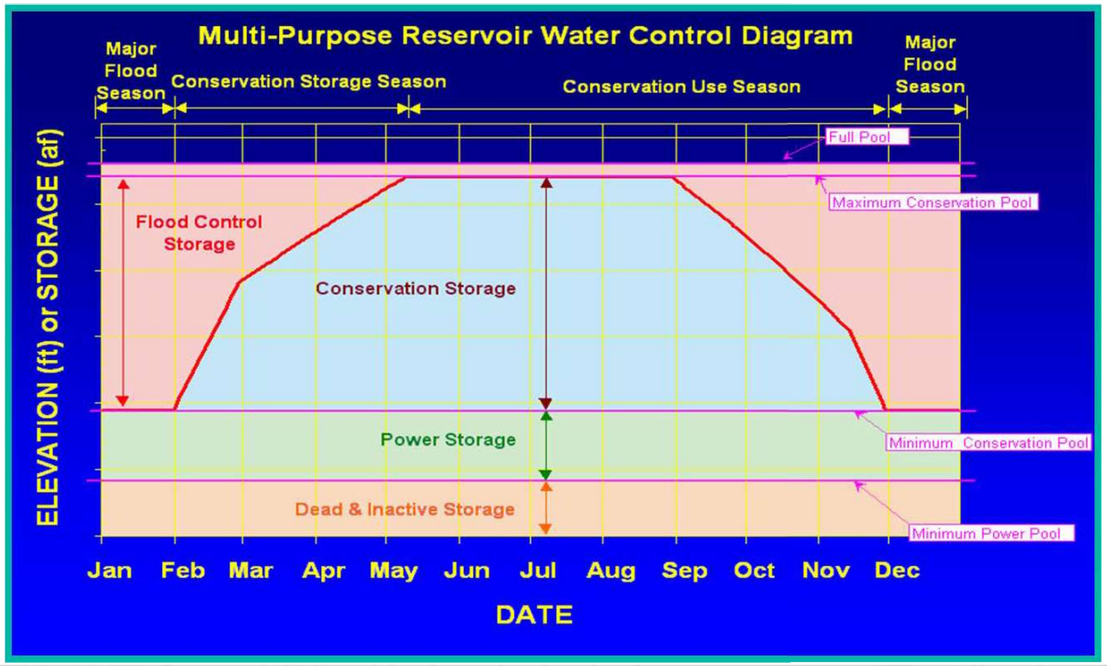
CECW-CE

ER 1110-2-8156

Regulation
No. 1110-2-8156

30 September 2018

Engineering and Design
PREPARATION OF WATER CONTROL MANUALS



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Appendix 1-J to Willamette Master Water Control Manual

Water Control Manual Hills Creek Lake

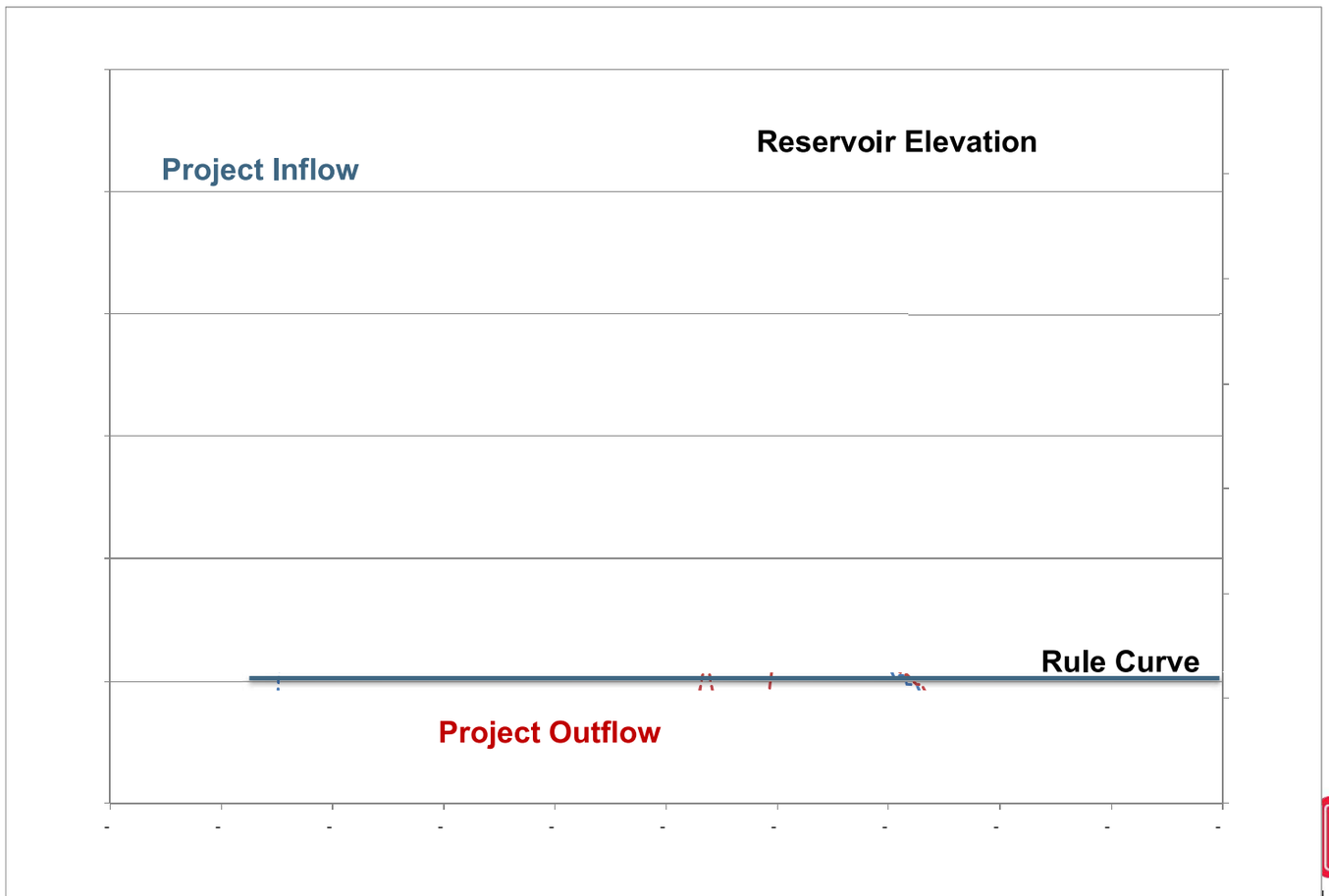
TABLE OF CONTENTS

CHAPTER 1 – INTRODUCTION
CHAPTER 2 – DESCRIPTION OF PROJECT
CHAPTER 3 – HISTORY OF PROJECT
CHAPTER 4 – WATERSHED CHARACTERISTICS
CHAPTER 5 – DATA COLLECTION AND COMMUNICATION NETWORKS
CHAPTER 6 – HYDROLOGIC FORECASTS
CHAPTER 7 – WATER CONTROL PLAN
CHAPTER 8 – EFFECT OF WATER CONTROL PLAN
CHAPTER 9 – WATER CONTROL MANAGEMENT

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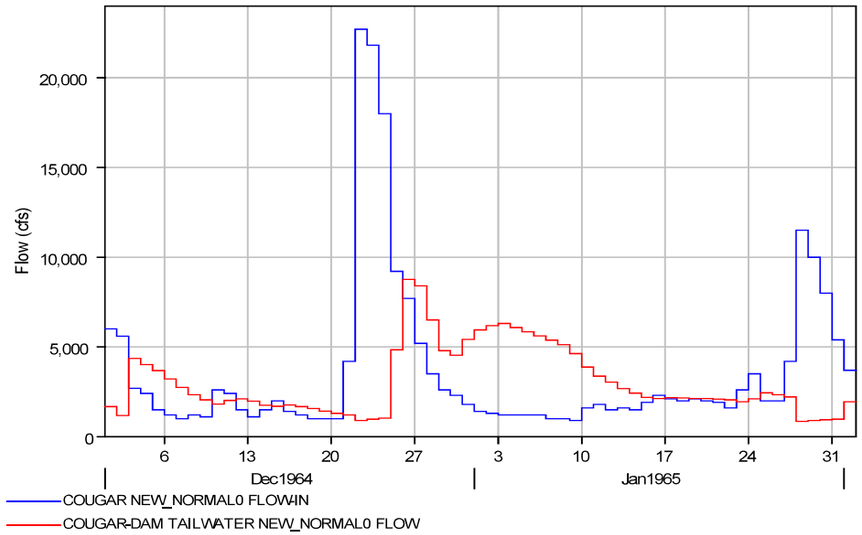
HOW WE "DO" FLOOD RISK MANAGEMENT AT THE DAM

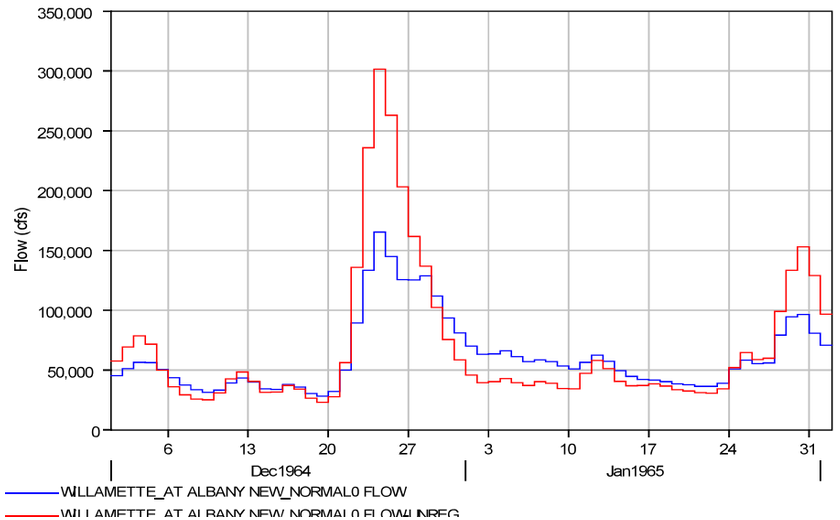


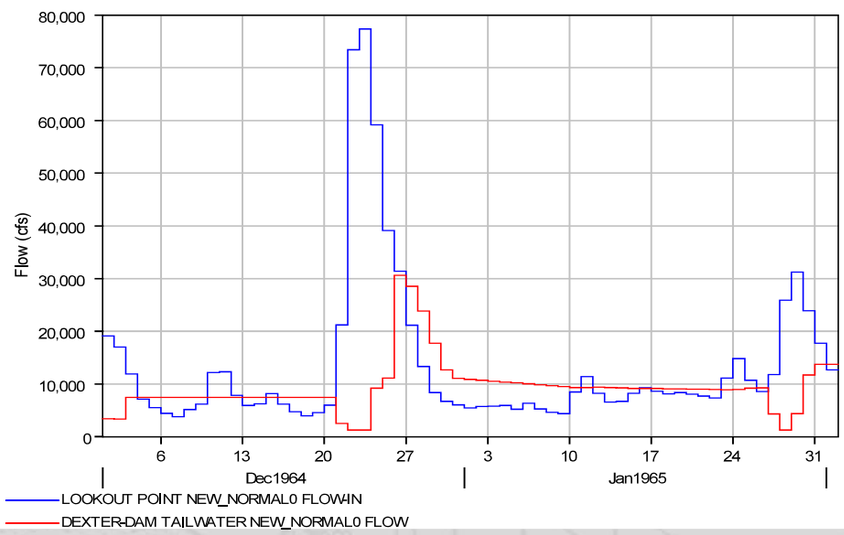
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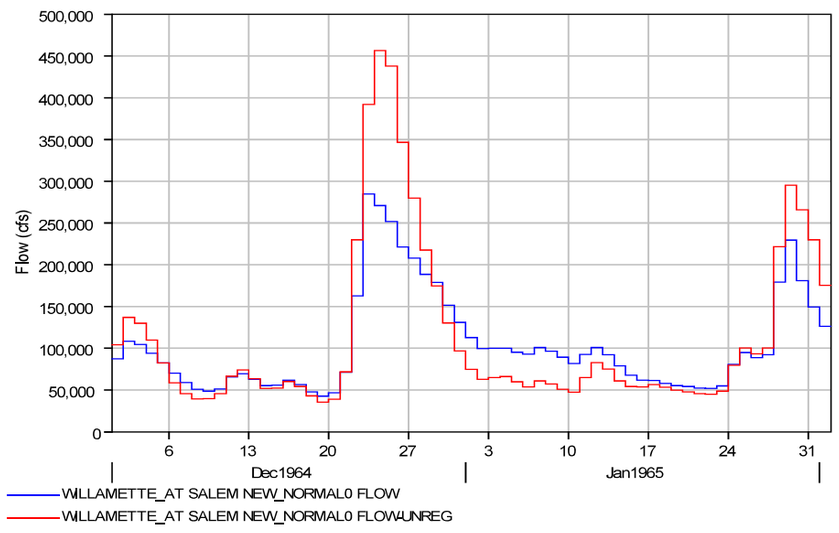
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HOW FLOOD RISK MANAGEMENT LOOKS DOWNSTREAM



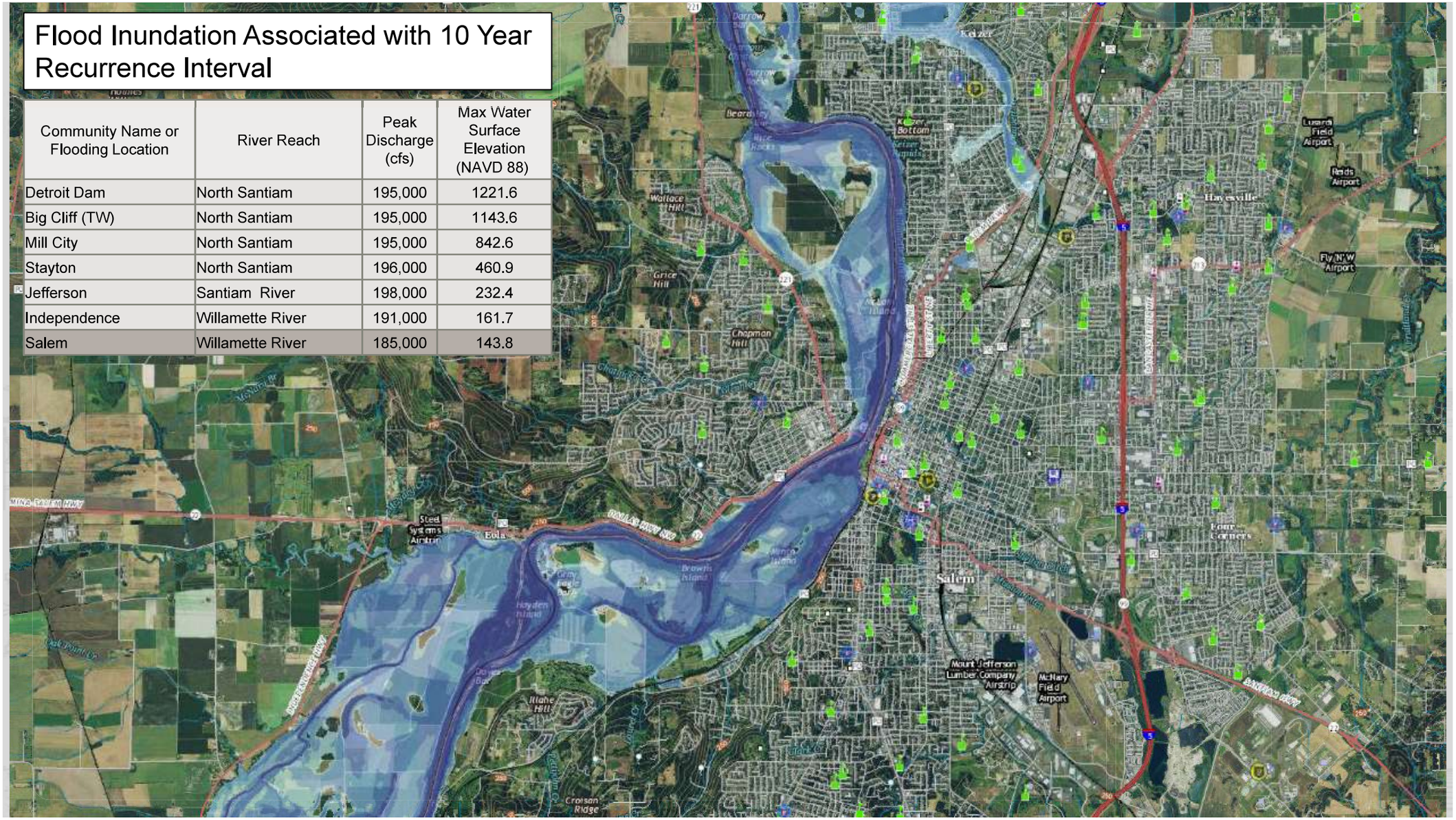






Flood Inundation Associated with 10 Year Recurrence Interval

Community Name or Flooding Location	River Reach	Peak Discharge (cfs)	Max Water Surface Elevation (NAVD 88)
Detroit Dam	North Santiam	195,000	1221.6
Big Cliff (TW)	North Santiam	195,000	1143.6
Mill City	North Santiam	195,000	842.6
Stayton	North Santiam	196,000	460.9
Jefferson	Santiam River	198,000	232.4
Independence	Willamette River	191,000	161.7
Salem	Willamette River	185,000	143.8



FLOOD RISK RECURRENCE INTERVALS

Regulated Flood Discharges with expected frequency of occurrence (2014 calculations)				Discharge, cfs					
				Recurrence Interval, years				Max Evacuation Rate	Flood Stage
USGS Gage	Stream	Location	Basin Area, mi²	10	50	100	500		
14148000	Middle Fork Willamette	Below Hills Creek	924	31,400	45,900	52,800	71,100	8,000	
14145000	Middle Fork Willamette	Below Dexter	991	15,100	22,100	26,200	38,000	15,000	
14151000	Fall Creek	Below Fall Creek	186	4,200	5,600	6,800	12,600	4,500	
14152000	Middle Fork Willamette	At Jasper	1340	21,400	32,000	39,000	57,000		23,000
14153500	Coast Fork Willamette	Below Cottage Grove Dam	104	3,500	6,500	8,500	12,600	3,000	
14155500	Row	Below Dorena Dam	270	6,800	12,500	18,900	39,000	5,000	
14157500	Coast Fork Willamette	Near Goshen	642	23,000	38,400	46,800	72,300		15,000
14159500	South Fork McKenzie	Below Cougar Dam	208	5,400	8,100	9,400	13,100	6,000	
14162200	Blue	Below Blue River Dam	88	3,700	4,600	5,600	9,500	3,700	
14162500	McKenzie	Near Vida	930	25,800	35,000	39,600	52,000		35,000
14166000	Willamette	At Harrisburg	3420	80,200	105,200	116,800	146,900		66,500
14170000	Long Tom	At Monroe	391	8,400	12,800	16,000	40,000		6,800
14174000	Willamette	At Albany	4840	102,700	151,100	177,000	254,100		84,000
14180500	North Santiam	Below Detroit Dam	453	14,600	20,800	23,800	40,000	17,000	
14152500	North Santiam	At Mehama	665	25,800	50,200	58,200	95,000		30,500
14186700	South Santiam	Below Foster Dam	494	18,900	34,700	39,500	50,000	18,000	
14187500	South Santiam	At Waterloo	640	21,100	41,500	54,600	90,000		25,700
14189000	Santiam	At Jefferson	1970	75,600	136,900	153,700	190,000		56,000
14191000	Willamette	At Salem	7280	182,700	247,000	274,700	340,800		154,000

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Portland District

ANY QUESTIONS ABOUT WINTER SYSTEM OPERATIONS?

15

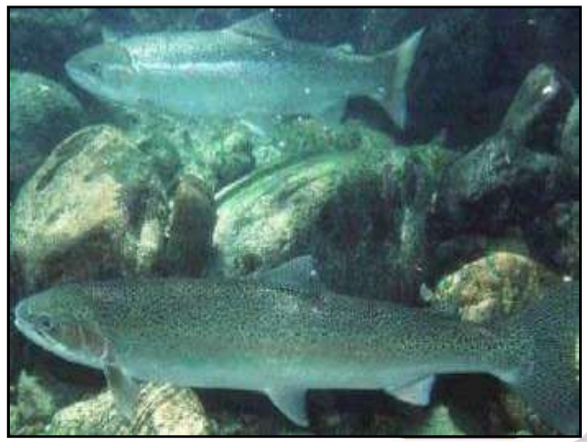
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CONSERVATION SEASON SYSTEM OPERATIONS

- Refill in Spring so there is sufficient water to meet authorized purposes.
- Operate to facilitate maintenance and project improvements at the dams
- Fisheries Specific Goals
  - Meet Biological Opinion requirements
  - Minimize stranding and dewatering of eggs
    - » Daily and hourly ramping release rates
  - Operate for downstream juvenile passage (spill or deep drawdown of a reservoir for passage thru RO)
  - Operate for downstream water temperatures at Cougar, Detroit and Fall Creek (with limited success)
  - Provide spawning, incubation and rearing flows





CONSERVATION SEASON
ANNUAL VARIABILITY

- Reliability of refill
- BiOp implementation
- Competition for water
- Construction / Maintenance
- Availability of specific outlets



Foster





Cougar

CONSERVATION SEASON
WATER MANAGEMENT COMMUNICATION

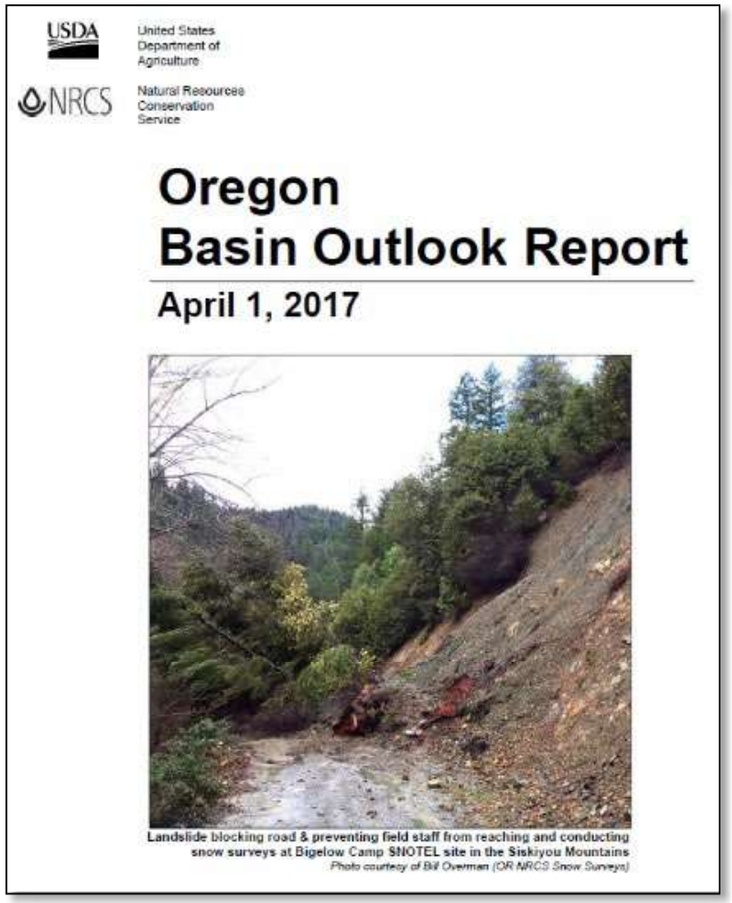
- U.S. Army Corps of Engineers
- National Oceanic & Atmospheric Administration
  - National Weather Service - River Forecast Center
  - National Marine Fisheries Service
- National Resource Conservation Service
- Bonneville Power Administration
- U.S. Geological Survey
- U.S. Bureau of Reclamation
- U.S. Fish & Wildlife
- U.S. Forest Service
- OR Department of Fish & Wildlife
- OR Water Resources Department
- OR Department of Environmental Quality
- OR Department of Agriculture
- The Nature Conservancy
- County government
- Elected officials
- Hatcheries
- OR State Marine Board
- OR State University
- City of Corvallis, Eugene, Salem, Springfield, Cottage Grove, Oakridge

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CONSERVATION SEASON
WATER SUPPLY FORECAST

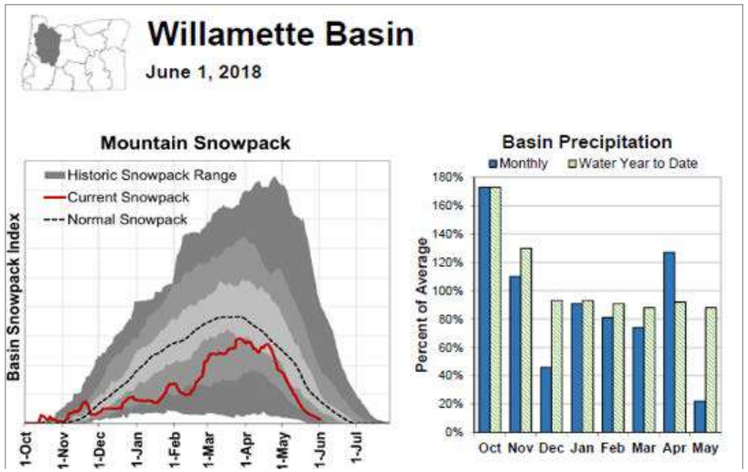


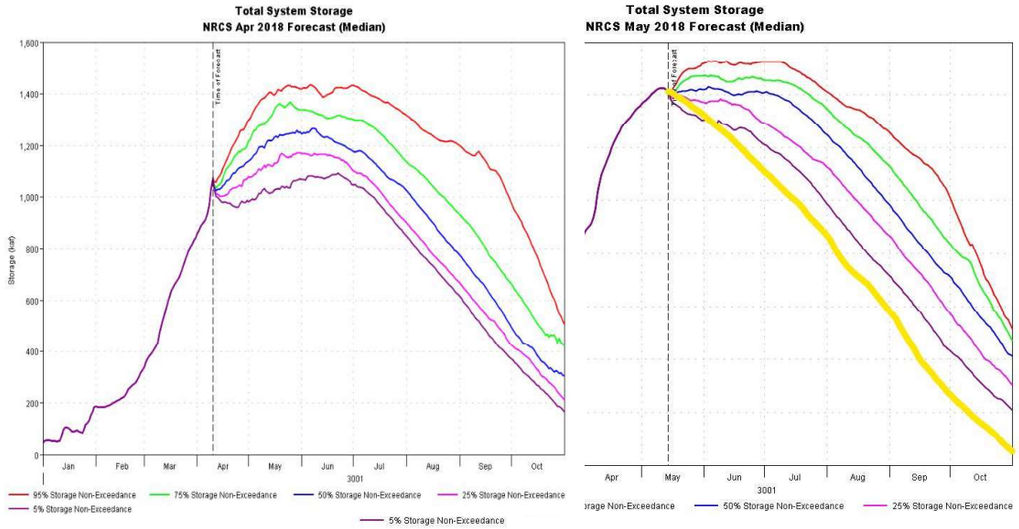
- Water year type determined by mid-May NRCS Water Supply Forecast
- Prescribes mainstem Willamette at Salem & Albany and tributary minimum flow targets

Characteristics of Water Year Types	Abundant	Adequate	Insufficient	Deficit
Mid-May storage (MAF)[1]	≥ 1.48	1.20 to 1.47	0.90 to 1.19	< 0.90
Frequency	58%	17%	9%	16%
Meet all mainstem flow objectives?	Yes	Yes	No	No
Alternative flow targets below objectives	N/A	N/A	Linear sliding scale based on flow targets used during 2001 water year[2]	Balance seasonal flows to retain some control of discharge[2]
Likely status of priority recreational reservoirs[3]	Full throughout most or all of recreation season	Full through most of recreation season	May fill; unlikely to remain full throughout season	Unlikely to fill
Likely Status of Other Reservoirs	Likely to fill; drafted as necessary to meet mainstem flows	May fill; unlikely to remain full throughout season	Unlikely to fill	Unlikely to fill

What happened this year?

2018 CONSERVATION SEASON





WY18 Mid-May System Storage >1.2 MAF BiOp "Adequate"

Minimum flow objectives below Willamette Basin dams

Minimum Flow (cfs)										
	BCL	FOS	DEX	HCR	FAL	CGR	BLU	FRN	COT	DOR
January 1	1200	1100	1200	400	50	300	50	30	50	100
February 1	1000	800	1200	400	50	300	50	50	75	190
March 1	1000	800	1200	400	50	300	50	50	75	190
March 16	1500	1500	1200	400	50	300	50	50	75	190
April 1	1500	1500	1200	400	80	300	50	50	75	190
May 1	1500	1500	1200	400	80	300	50	50	75	190
May 16	1500	1200	1200	400	80	300	50	50	75	190
June 1	1300	1200	1200	400	80	400	50	50	75	190
July 1	1300	800	1200	400	80	300	50	30	50	100
July 16	1000	800	1200	400	80	300	50	30	50	100
September 1	1500	1500	1200	400	200	300	50	30	50	100
October 16	1200	1000	1200	400	50	300	50	30	50	100
December 1	1200	1000	1200	400	50	300	50	30	50	100

Minimum Mainstem Threshold Flows in 2018 for Operational Purposes (based on a 7-day moving average)

Period	ALBANY Minimum Instantaneous Flow (cfs)	SALEM Minimum Flow Threshold (cfs)	SALEM Minimum Instantaneous Flow (cfs)
April	Not defined	17,800	14,300
May	Not defined	15,000	12,000
1-15 June	4,500	13,000	10,500
16-30 June	4,500	8,700	7,000
July	4,500	6,000	Not defined
1-15 August	5,000	6,000	Not defined
16-31 August	5,000	6,500	Not defined
September	5,000	7,000	Not defined
October	5,000	7,000	Not defined

FLOW AND RAMP RATE OBJECTIVES



	General Flow Guidelines					
	Minimum Flow	Max when augmenting for mainstem flows	Increase	Decrease		
			Increase per hour	Night-time Decrease per hour	Day-time Decrease per hour	Daily Decrease (max decrease in a 24 hour period)
Hills Creek	400 cfs		200 cfs	From 400 to 1700 cfs, 100 cfs/hour. Outflow above 1700 cfs is reduced 0.1 ft/hour at HCRO	0.2 ft/hour at HCRO	WCM - 1.5 ft/day Biop - lesser of 1 ft/day at HCRO or 50% flow volume
Dexter	1200 cfs		0.2 ft / hour and 0.5 ft/day at DEXO	0.1 ft/hour at DEXO	0.2 ft/hour at DEXO	WCM - 0.5 ft/day Biop - lesser of 1 ft/day at DEXO or 50% flow volume
Fall Creek	Feb - Mar: 50 cfs April - Aug: 80 cfs Sep 1-Oct 15: 200 cfs Oct 16-Jan 30: 50 cfs		200 cfs	From 50 to 500 cfs, 50 cfs/hour. Outflow above 500 cfs is reduced 0.1 ft/hour at FALO	From 50 to 300 cfs, 50 cfs/hour. Outflow above 300 cfs is reduced 0.2 ft/hour at FALO	lesser of 1 ft/day at FALO or 50% flow volume
Cottage Grove	Feb-Jun: 75 cfs Jul-Oct: 50 cfs Nov-Jan: Inflow		100 cfs per hour 500 cfs max per day	From 50 to 800 cfs, 50 cfs/hour. Outflow above 800 cfs is reduced 0.1 ft/hour at COTO	From 50 to 300 cfs, 50 cfs/hour. Outflow above 300 cfs is reduced 0.2 ft/hour at COTO	lesser of 1 ft/day at COTO or 50% flow volume
Dorena	Feb-Jun: 150 cfs Jul-Oct: 100 cfs Nov-Jan: Inflow		200 cfs per hour 500 cfs max per day	From 100 to 1000 cfs, 100 cfs/hour. Outflow above 1000 cfs is reduced 0.1 ft/hour at DORO	From 100 to 1000 cfs, 100 cfs/hour. Outflow above 1000 cfs is reduced 0.2 ft/hour at DORO	lesser of 1 ft/day at DORO or 50% flow volume
Fern Ridge (see comment)	Feb-Jun: 50cfs Jul-Nov: 30cfs (at MWRC) Dec-Jan: Inflow		200 cfs	From 30 to 200 cfs, 40 cfs/hour. Outflow above 300 cfs is reduced 0.1 ft/hour at FRNO	From 30 to 80 cfs, 40 cfs/hour. Outflow above 300 cfs is reduced 0.2 ft/hour at FRNO	lesser of 1 ft/day at FRNO or 50% flow volume
Cougar	July 1 - May 30: 200 cfs June 1-30: 400 cfs		200 cfs	From 300 to 1200 cfs, 150 cfs/hour. Outflow above 2400 cfs is reduced 0.1 ft/hour at CGRO	0.2 ft/hour at CGRO	lesser of 1 ft/day at CGRO or 50% flow volume
Blue River	50 cfs		50 - 100cfs : 50 cfs 100-500cfs : 100 cfs 500-1000cfs : 200 cfs 1000-2000cfs : 400 cfs 2000-3700cfs : 600 cfs	From 50 to 700 cfs, 100 cfs/hour. Outflow above 2300 cfs is reduced 0.1 ft/hour at BLUO	From 50 to 500 cfs, 100 cfs/hour. Outflow above 500 cfs is reduced 0.2 ft/hour at BLUO	lesser of 1 ft/day at BLUO or 50% flow volume
Foster	Feb 1-Mar 15: 800 cfs Mar 16-May 15: 1500 cfs May 16-Jun 30: 1100 cfs Jul 1-Aug 31: 800 cfs Sep 1-Oct 15: 1500 cfs Oct 16-Jan 31: 1100 cfs	Mar 16 - May 15 3000 cfs	300 cfs	0.1 ft/hour at SSFO	0.2 ft/hour at SSFO	lesser of 1 ft/day at SSFO or 50% flow volume
Big Cliff	Feb 1-Mar 15: 1000 cfs Mar 16-May 31: 1500 cfs Jun 1-Jul 15: 1200 cfs Jul 16 - Aug - 31: 1000 cfs Sep 1-Oct 15: 1500 cfs Oct 16-Jan 31: 1200 cfs	Mar 16 - May 31 3000 cfs	0.3 ft / hour and 0.5 ft/day at BCLO	0.1 ft/hour at BCLO	0.2 ft/hour at BCLO	WCM - 0.5 ft/day Biop - lesser of 1 ft/day at BCLO or 50% flow volume

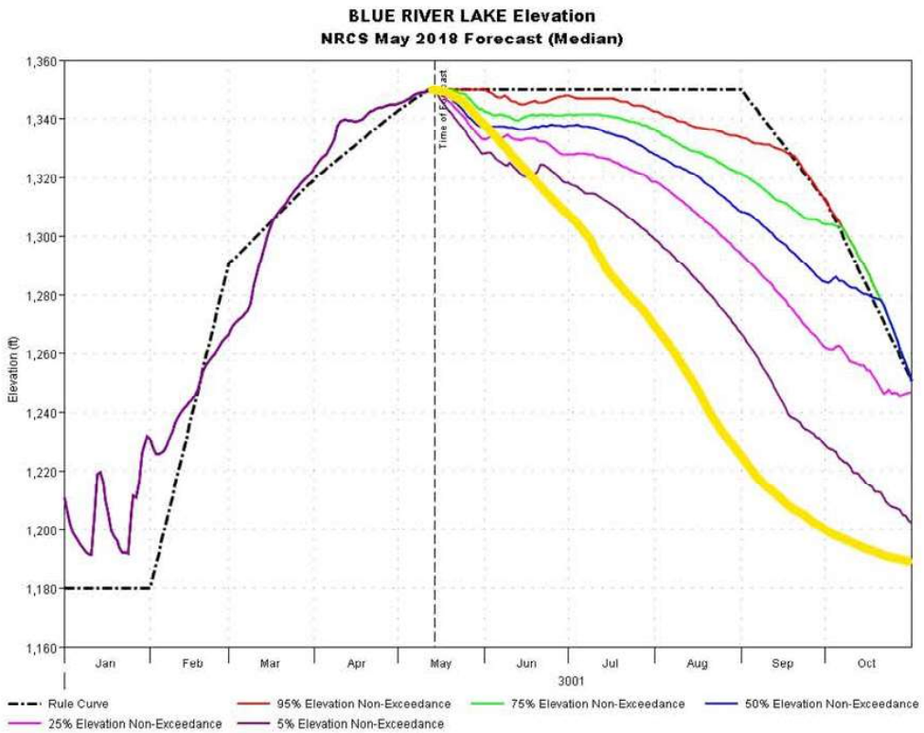
Things that are defined in detail by the Biop that we do each year in the regulation of the WVP:

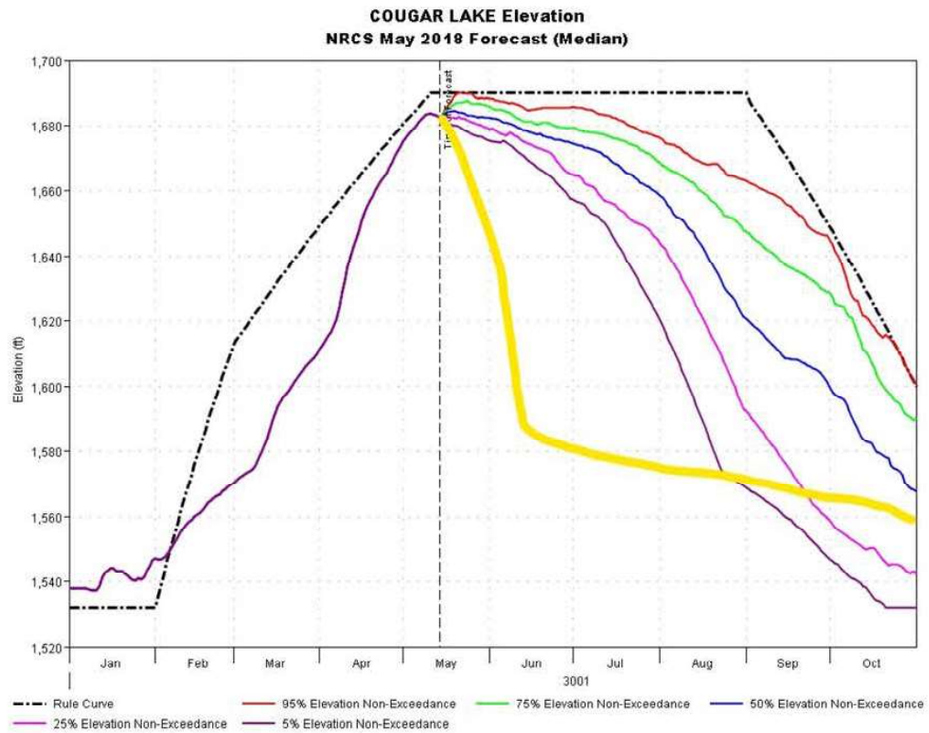
- Minimum Project Outflow all year
- Maximum Project Outflow during spring and fall
- Ramp rates to reduce stranding of juvenile fish
- Temperature control below Detroit and Cougar
- Deep Drawdown of Fall Creek for downstream fish passage
- Minimum flow at Salem and Albany from April – October
- Lower drawdown priority at Detroit, Fern Ridge and Fern Ridge for recreation and Green Peter for Ch spawning flow
- E-Flows in the N Santiam, McKenzie, and Middle Fork rivers
- Spread spill to reduce TDG
- Foster Fish Weir operations
- Prioritize Outages of Units (for fish)

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2018 Conservation Season – End Game vs May Forecast

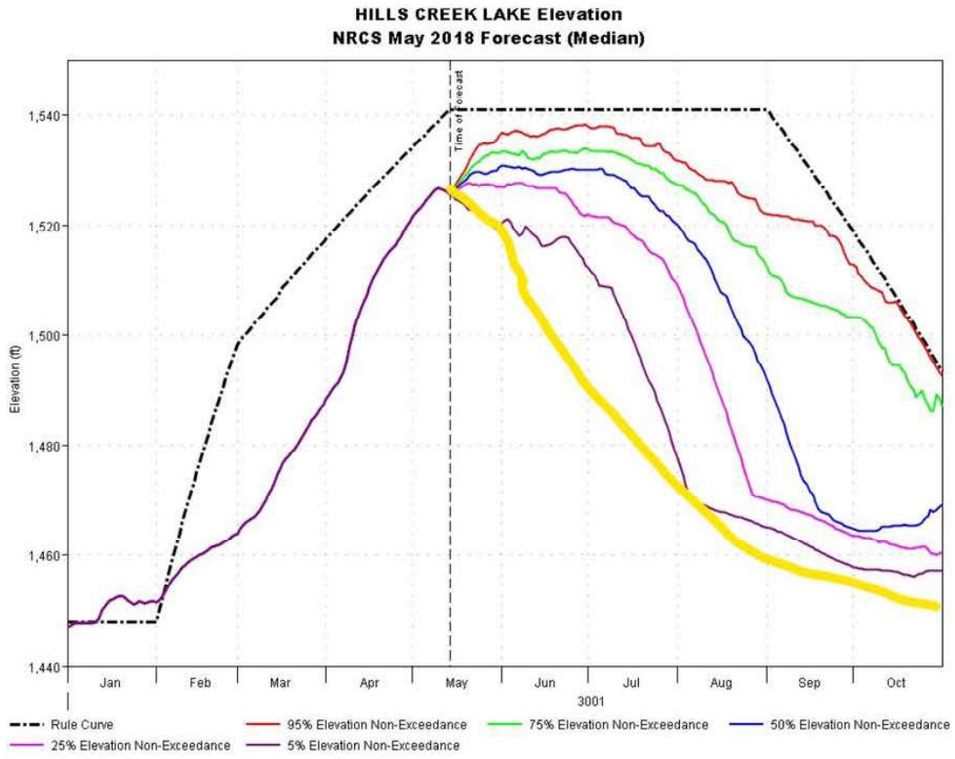


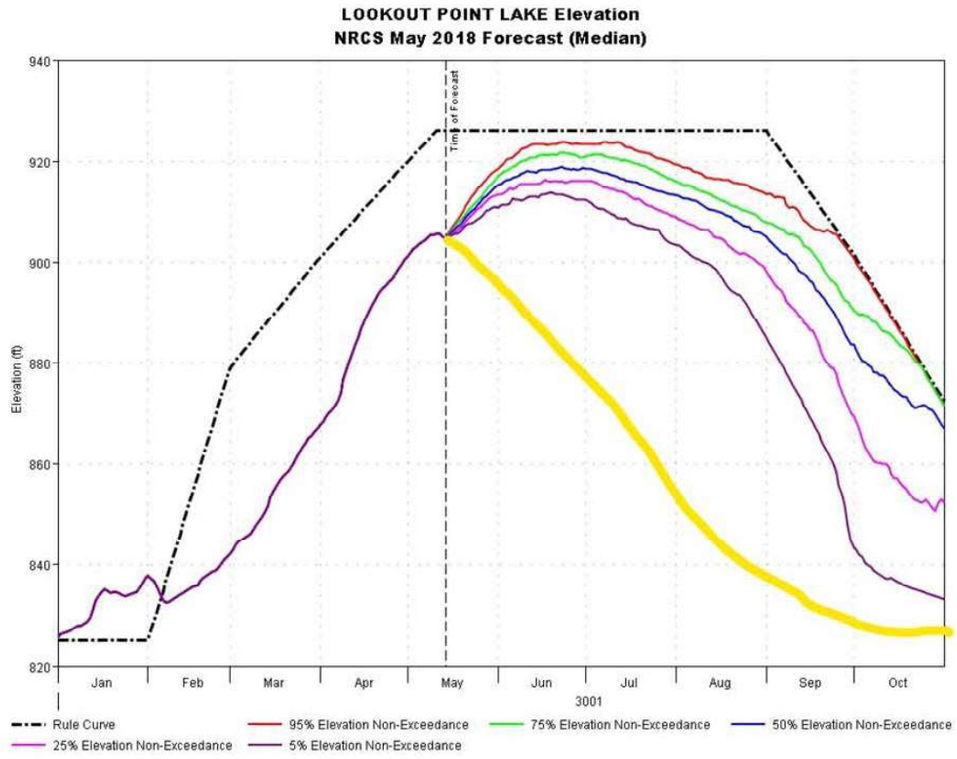


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2018 Conservation season – Results from April Forecast

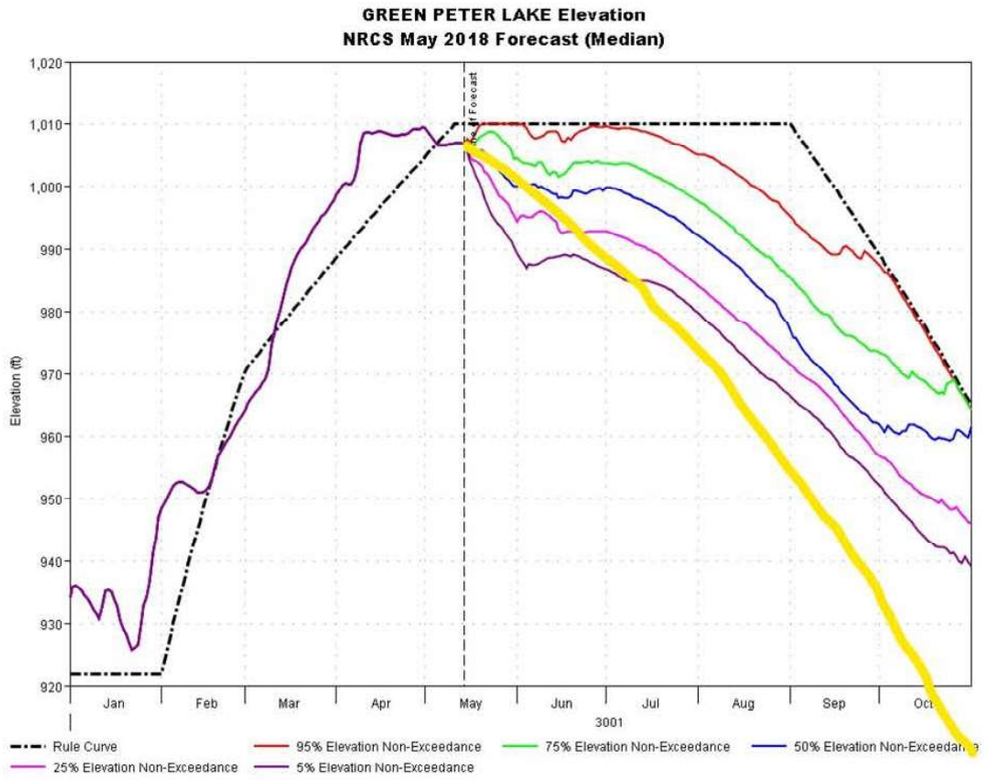


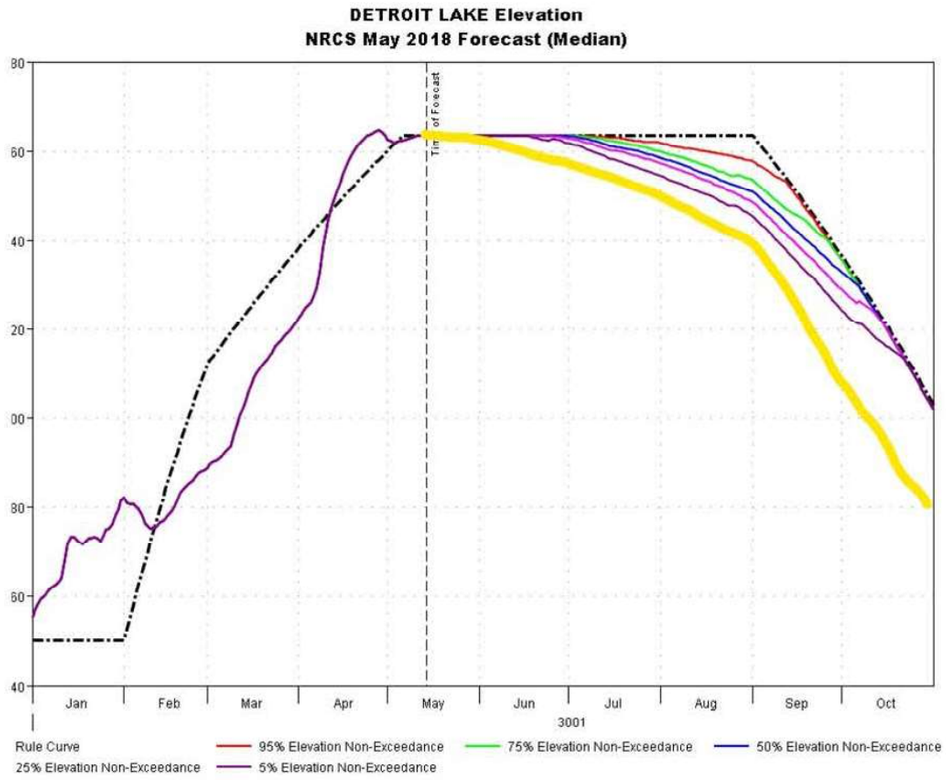


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2018 Conservation season – Results from April Forecast

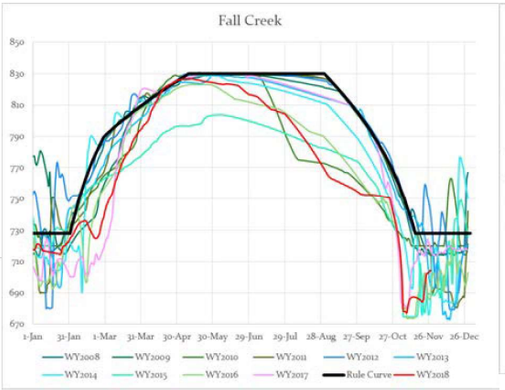


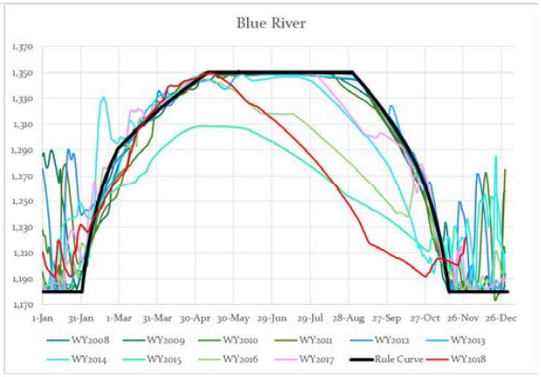


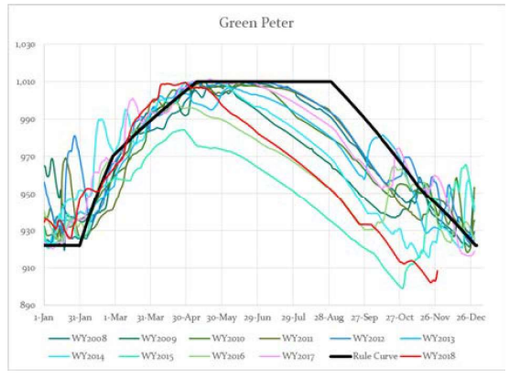
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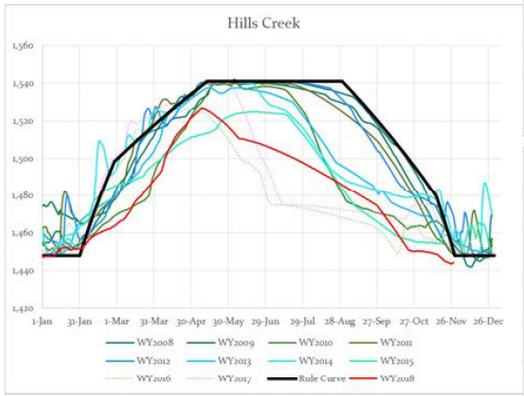
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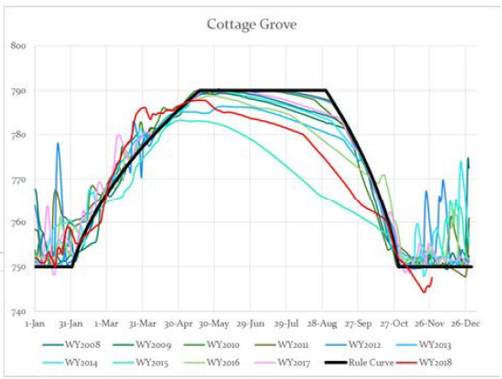
Annual Variability
2008-2018
Biop Implementation Years
(red is current year)

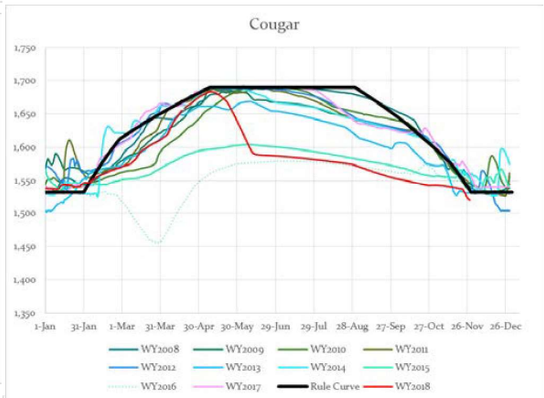


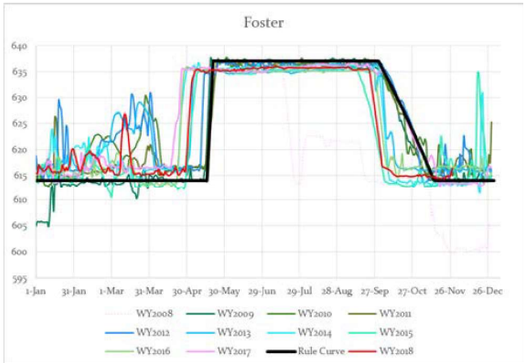


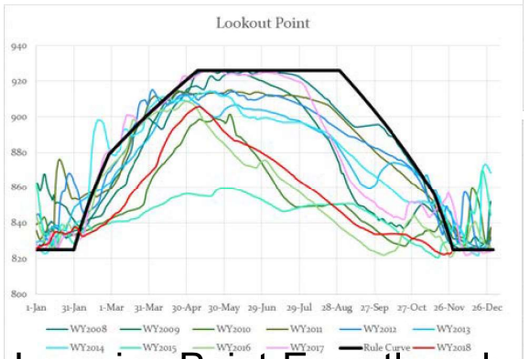


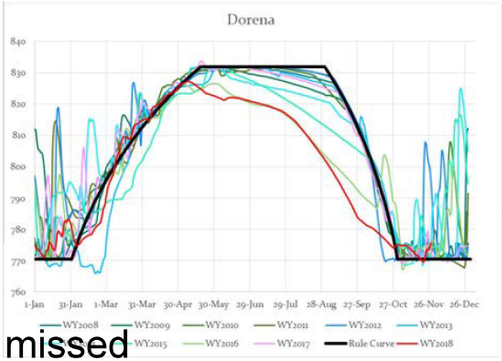


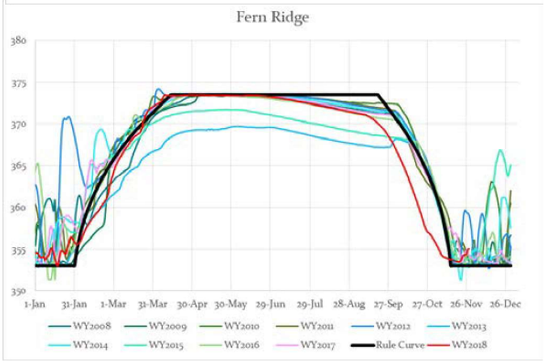


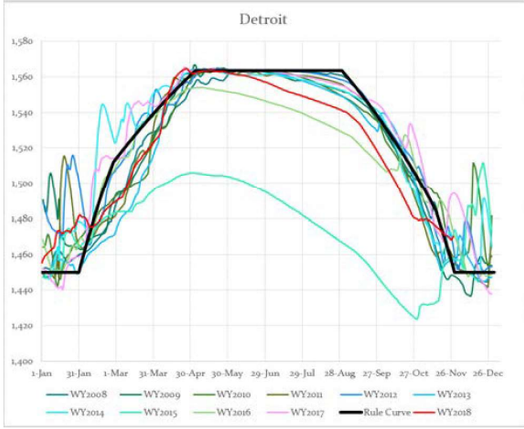






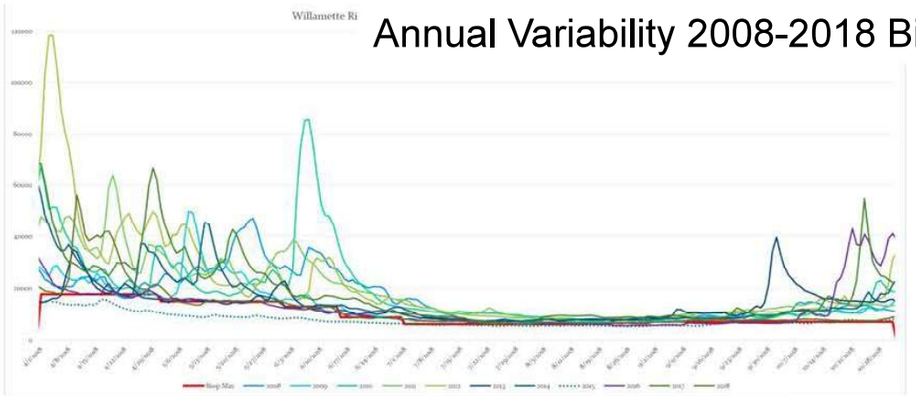


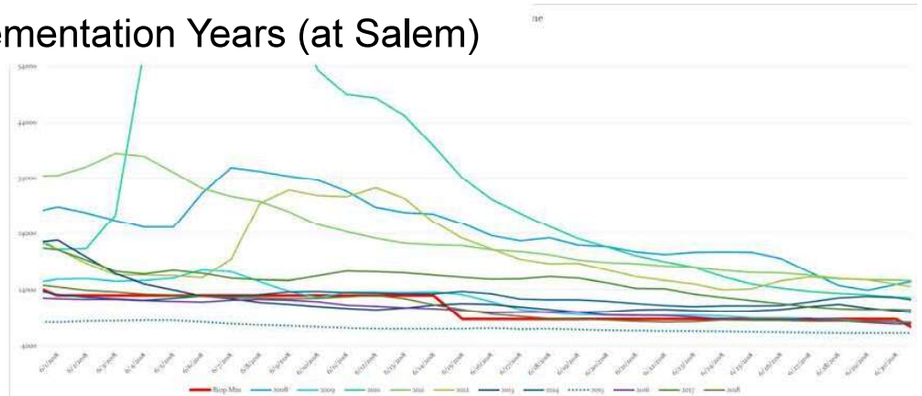


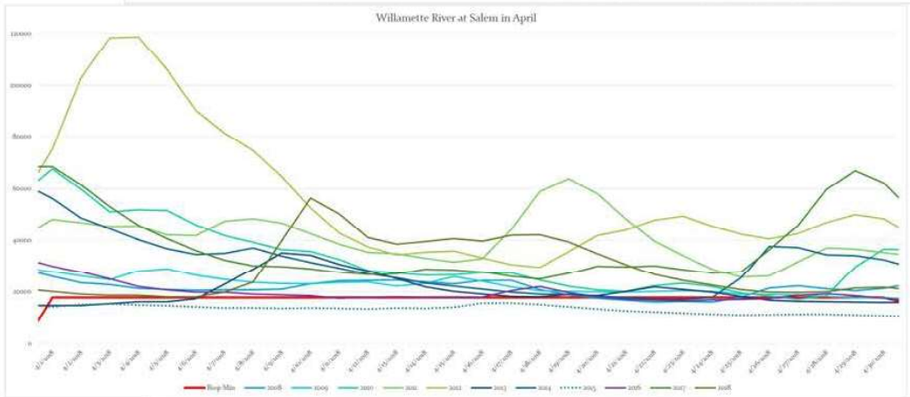


Learning Point-Even though the reservoirs fill in May the Biop flow targets may be missed in fall due to lack of storage

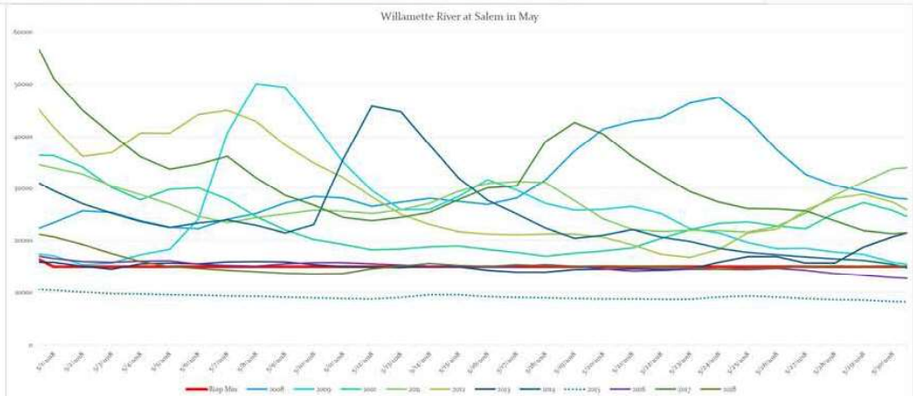
Annual Variability 2008-2018 Biop Implementation Years (at Salem)

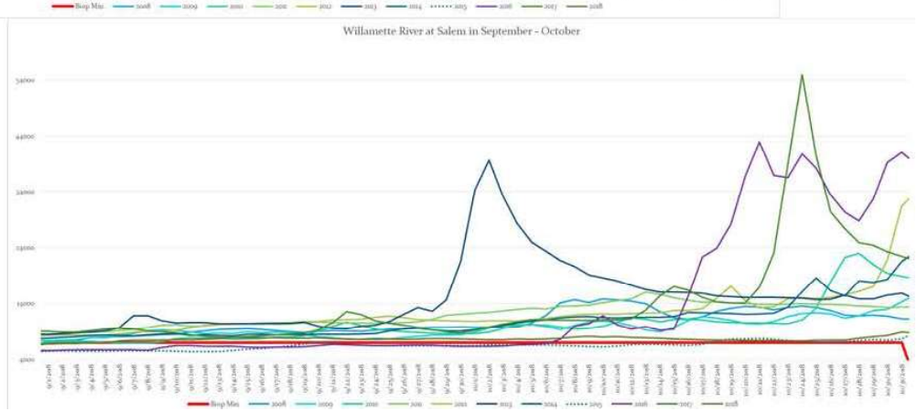












ANY QUESTIONS ABOUT SPRING THRU FALL SYSTEM OPERATIONS?

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HOPEFULLY THIS PRESENTATION HAS PROVIDED SOME INSIGHT INTO OUR CURRENT OPERATIONS AND CHALLENGES!

Meaningful Messages For Reservoir Operations in the Willamette Valley:

There is unpredictability in spring rain and the amount of time that snowpack lasts. The variability in winter and spring rain has increased in the past decade.

Willamette Basin Reservoir refill is primarily based on rain – not snow.
Reservoirs with a variable rule curve have measurable stored inflow (snowpack).

Meaningful rain seems to end by early July, at the latest – you cannot count on more rain to store until after the rainfall begins again in October or November or even December. Oregon has a summer drought every year, but there is variability to when it begins and ends.

Fisheries Ramp rates are used for all flow changes

Special Operations for new construction (Cougar and Detroit), repair of existing facilities (RO, SW, wire ropes, trashrack cleaning, and turbine repair) occur each year – they may affect the maximum fill level of the specific project.

Green Peter only has enough storage to meet summer/fall Biop Min flow after refill. It cannot augment for mainstem flow in the spring.

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USEFUL LINKS

About the Corps: (Portland District web site)
www.nwp.usace.army.mil

Portland District Water Management Reservoir Regulation and Water Quality Section http://www.nwd-wc.usace.army.mil/nwp/wm/

Videos of the Willamette system:
http://www.youtube.com/user/PortlandCorps

Water Data (DBQuery): http://nwp-wmlocal2.nwp.usace.army.mil/common/dbquery/www/index.html

River Flow (real time and forecasted)
water.weather.gov and https://www.nwrfc.noaa.gov/rfc/

Text Message Alerts
https://inws.ncep.noaa.gov/



QUESTIONS?

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ADDRESSING EFFECTS OF THE WILLAMETTE PROJECT DAMS ON SPRING CHINOOK SALMON AND WINTER STEELHEAD – NMFS 2008 BIOP ACTIONS

Rich Piaskowski
Environmental Resources Branch
Portland District
U.S. Army Corps of Engineers
Portland, OR

Willamette System EIS – Charrette
4 December, 2018



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ESA- listed anadromous fish in the Willamette Basin



Upper Willamette River Spring Chinook salmon

- *Adults spawn in tributaries of Willamette River*
- *Juveniles migrate to ocean for part of their life*
- *Return to same stream where they were born*

National Marine Fisheries Service (NMFS) jurisdiction

Upper Willamette River winter steelhead



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ESA- LISTED RESIDENT FISH IN THE WILLAMETTE BASIN

Oregon chub



US Fish and Wildlife Service (USFWS) jurisdiction

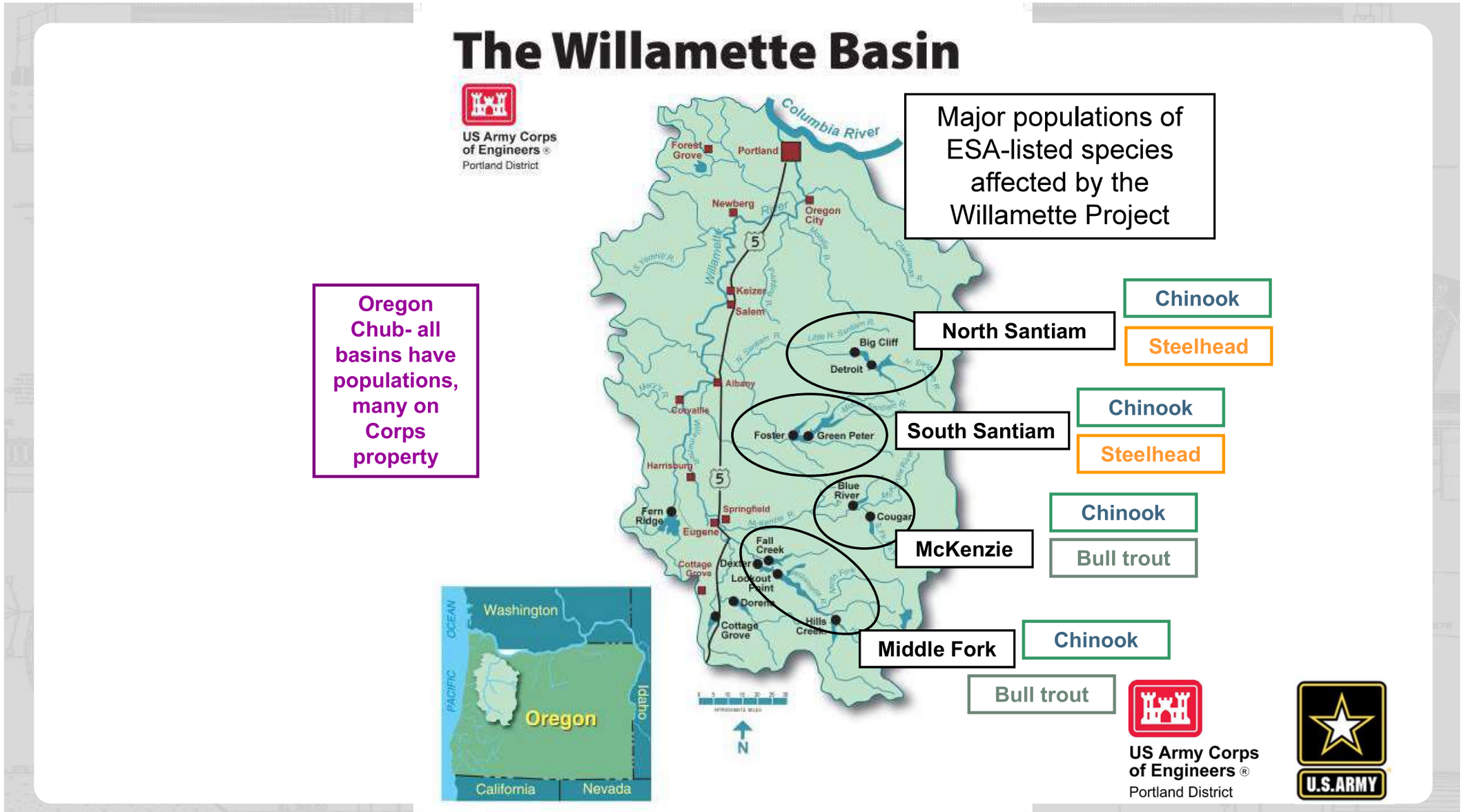
Bull trout



Resident fish spend entire lifecycle in fresh water

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The Willamette Basin
US Army Corps of Engineers
Portland District
Major populations of ESA-listed species affected by the Willamette Project
Oregon Chub- all basins have populations, many on Corps property
Columbia River
Portland
Forest Grove
Newberg
Oregon City
Keizer
Salem
Albany
Corvallis
Harrisburg
Springfield
Eugene
Fern Ridge
Cottage Grove
Dexter
Lookout Point
Fall Creek
Dorena
Hills Creek
Big Cliff
Detroit
Foster
Green Peter
Blue River
Cougar
North Santiam
Chinook
Steelhead
South Santiam
Chinook
Steelhead
McKenzie
Chinook
Bull trout
Middle Fork
Chinook
Bull trout
Washington
Oregon
California
Nevada
Idaho
PACIFIC OCEAN
N
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WILLAMETTE PROJECT BIOLOGICAL OPINIONS:

CONSULTATION UNDER THE ESA

Federal Action Agencies prepare Biological Assessments (BA) describing effects of actions on ESA-listed fish

↓

NMFS and USFWS issue Biological Opinions ("BiOps") that tell Action Agencies how to reduce impacts

↓

Two biological opinions (NMFS and USFWS) issued on July 11, 2008 after eight years of "ESA Consultation"

–Biological Opinions cover 15 years (through 2023)

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PRIMARY EFFECTS OF WILLAMETTE PROJECT ON FISH

Habitat isolation/disconnectivity

- Dams blocked access to spawning habitat (i.e., no fish passage)
  - In some basins 90% of spawning habitat upstream of dams

Effects on remaining spawning and rearing habitat located downstream of dams

- flow availability and physical habitat
- hatchery fish interacting with wild fish
- Water quality (temperature, dissolved gas)

Significant data gaps regarding fish population status and extent of effects of dams on fish

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2011 RECOVERY PLAN APPROACH FOR THREATENED WILLAMETTE SALMON AND STEELHEAD

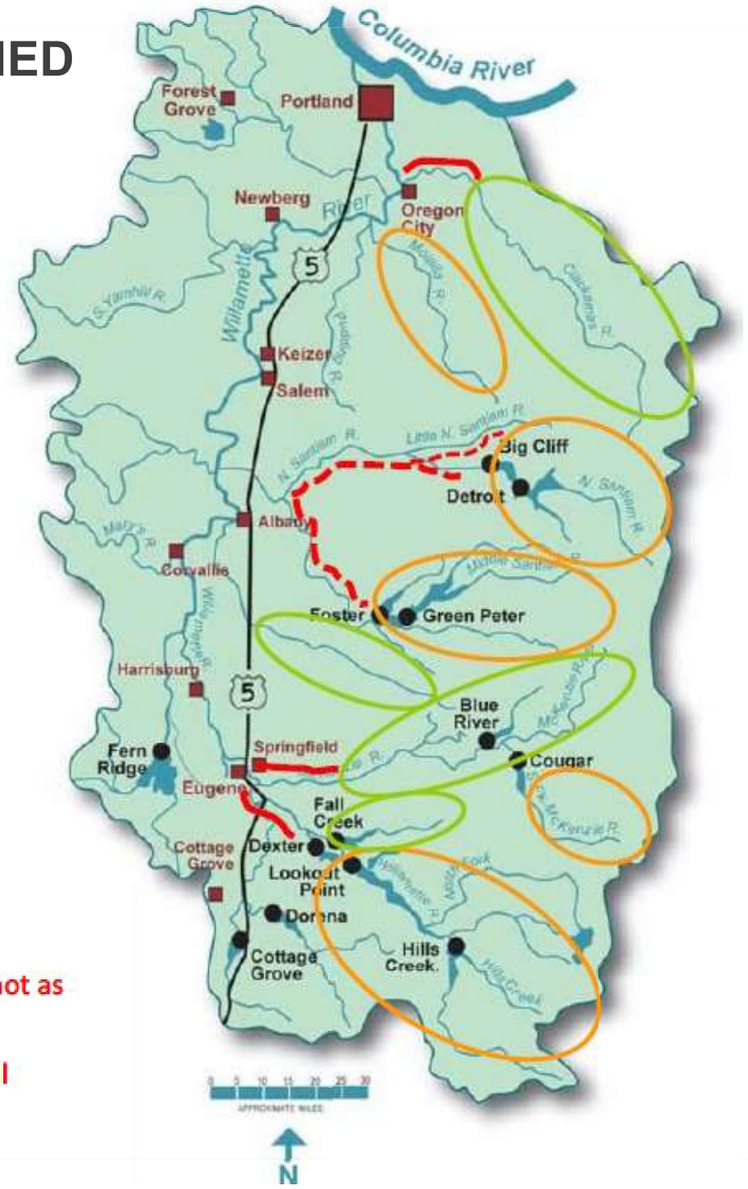
ODFW/NMFS, 2011

"Split-Basin" strategy

Wild fish above dams, maintain hatchery area below

- Highest priority: Up and downstream fish passage at key dams
- Reduce adult chinook pre-spawning mortality
- Improve habitat attributes downstream of dams
  - flows,
  - water temperatures
  - sediment loads,
  - large wood recruitment

- wild fish only (with varying degrees of success)
- reintroduction needed into historically productive habitat
- mitigation hatchery program area (long term). Natural production not as critical as upstream areas for meeting recovery goals.
- mitigation hatchery program area (long term), but significant natural production likely needed in this area to meet population goals.

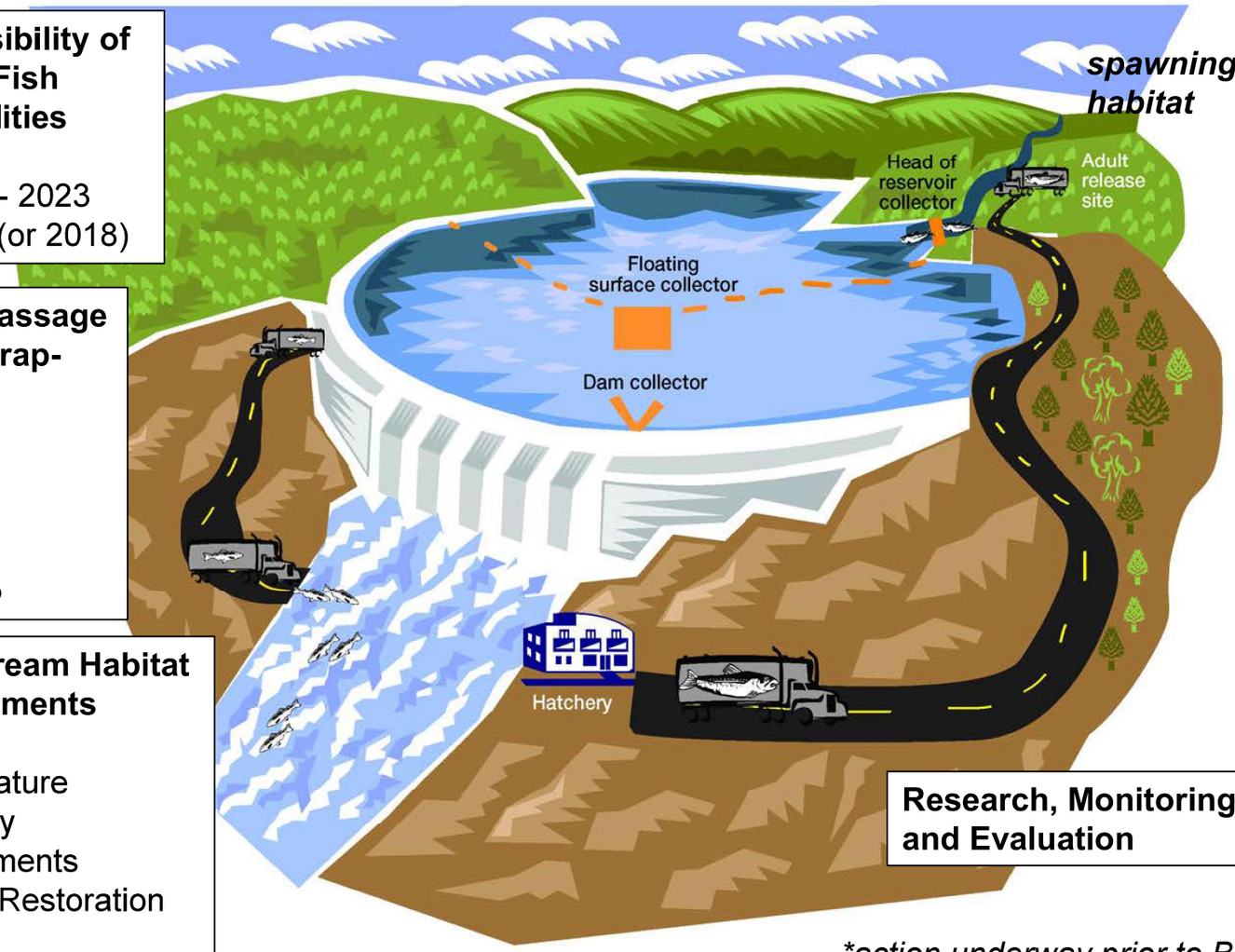


2008 Willamette BiOp Actions: A life-cycle approach

Evaluate Feasibility of Downstream Fish Passage Facilities
- Cougar- 2014
- Lookout Point- 2023
- Detroit- 2021 (or 2018)

Upstream fish passage for adults via "trap-and-haul"
- Cougar – 2010*
- Minto- 2012
- Foster- 2013
- Dexter- 2014
- Fall Creek- 2015

Downstream Habitat Improvements
- Flow
- Temperature
- Hatchery improvements
- Habitat Restoration Projects



Research, Monitoring, and Evaluation

**action underway prior to BiOp*

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gical Opinions

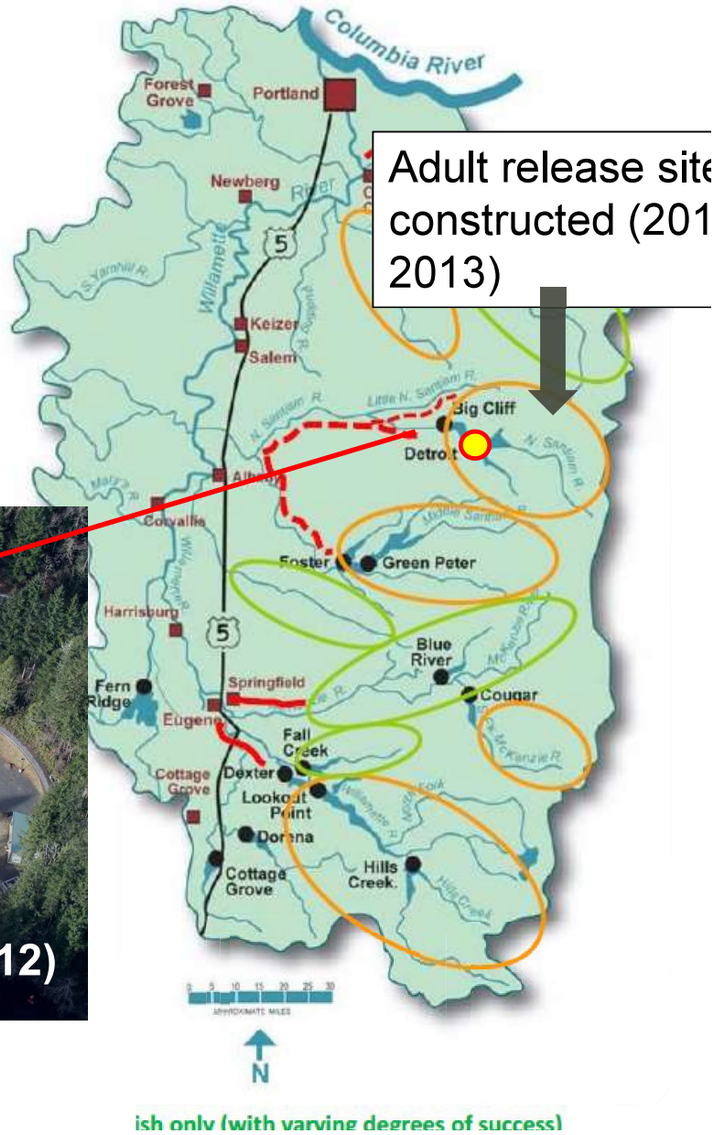
NORTH SANTIAM

Fish Passage Actions









Adult release site constructed (201 2013)

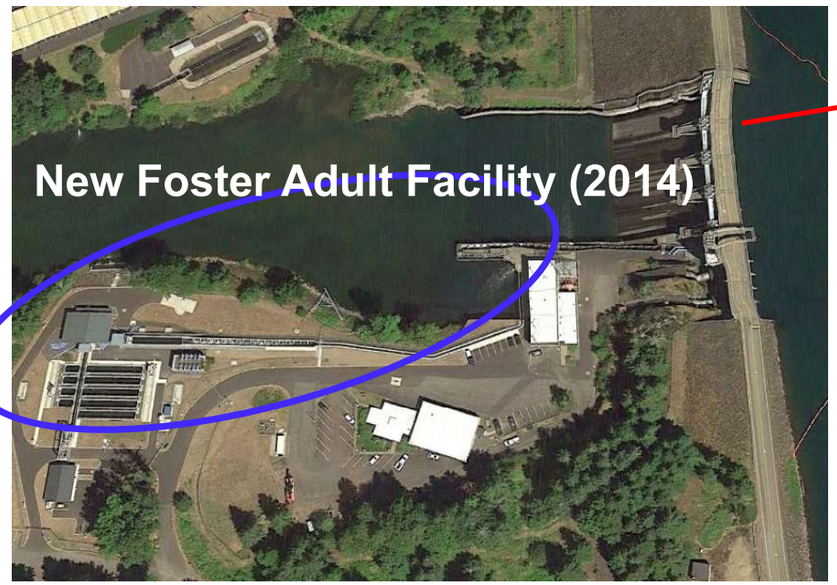
ish only (with varying degrees of success)

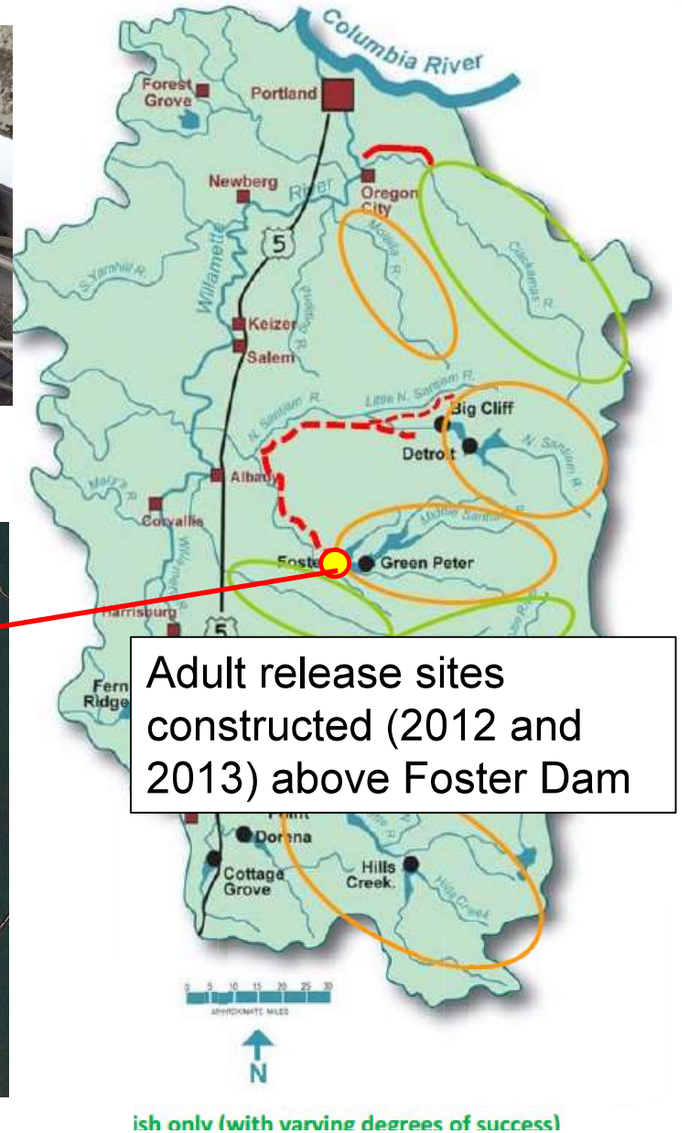
SOUTH SANTIAM

Fish Passage Actions

NMFS Biop did not include fish passage for Green Peter, but COP considered





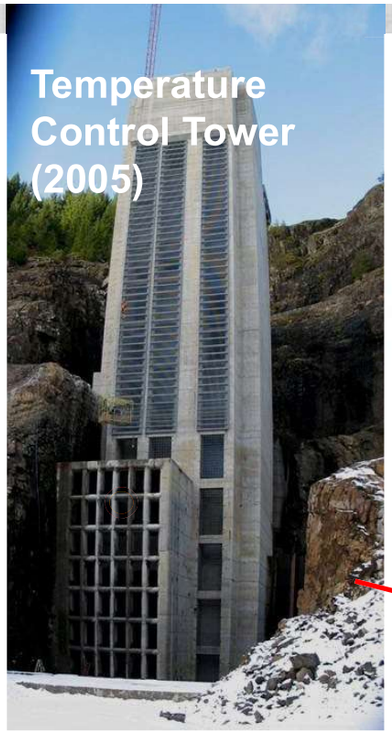


Adult release sites constructed (2012 and 2013) above Foster Dam

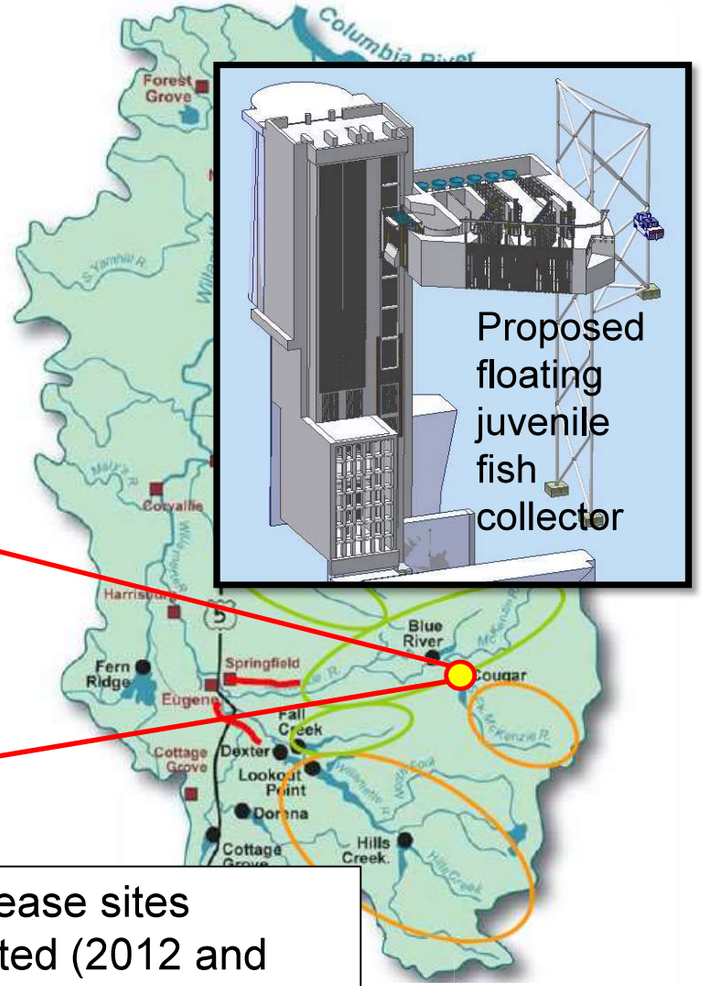
ish only (with varying degrees of success)

MCKENZIE

Fish Passage Actions







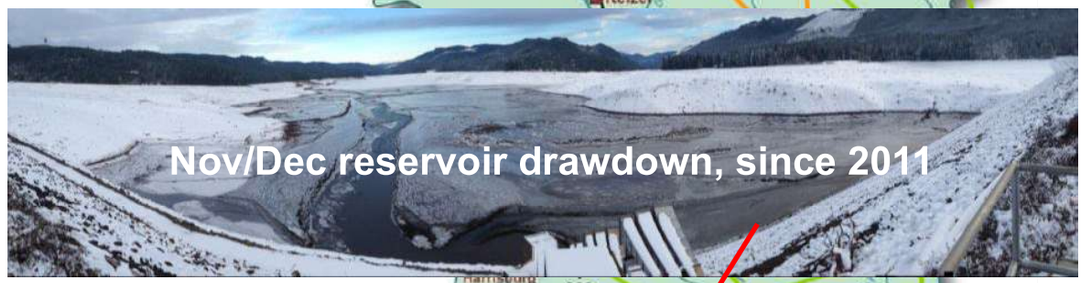
Adult release sites constructed (2012 and 2013) above Cougar Dam

11

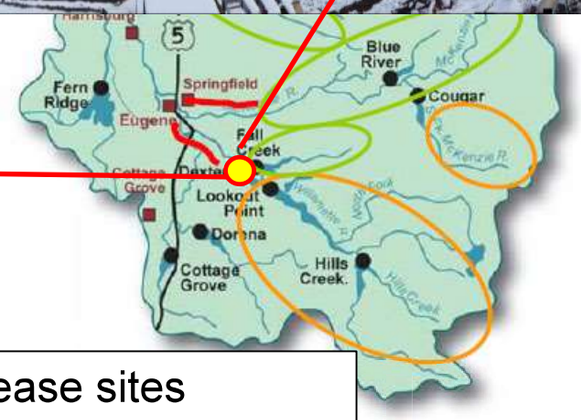
FALL CREEK - MIDDLE FORK SUB-BASIN

Fish Passage Actions









Adult release sites constructed (2012 and 2013) above Fall Cr Dam

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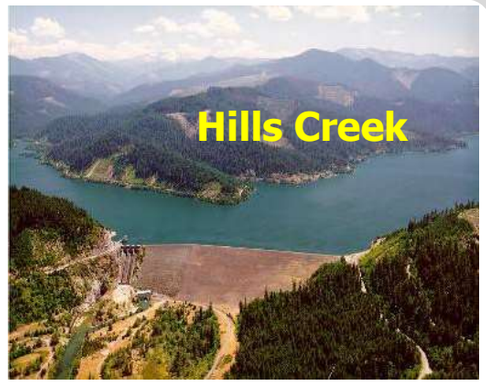
MIDDLE FORK SUB-BASIN

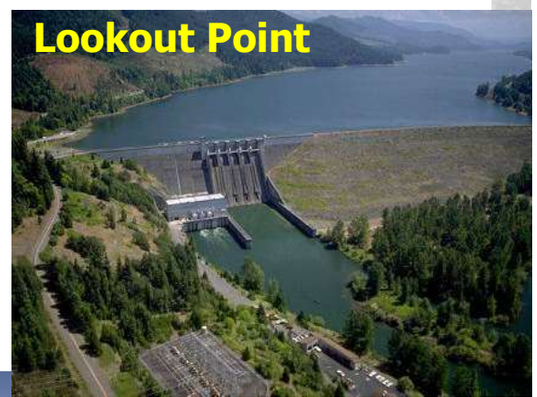
- Conditions in the MF pose the most fish passage challenges
  a) High Chinook salmon pre-spawn mortality (92% in Hills Creek, 2014)
  b) Challenging juvenile fish passage conditions (multiple large reservoirs and dams)

- Currently researching passage options and feasibility

Key questions

a) Can dam passage survival be sufficiently improved to support a sustainable spring Chinook Salmon population above Lookout Point Dam.
b) Which downstream fish passage strategy is likely best.
   - head-of-reservoir or in-tributary collection and bypass
   - alternative project operations
   - at-dam structure
   - combination







FLOW MANAGEMENT

- Minimum flow targets
- Ramping rates
- Temperature targets
- Sustainable Rivers Project (e-flows)

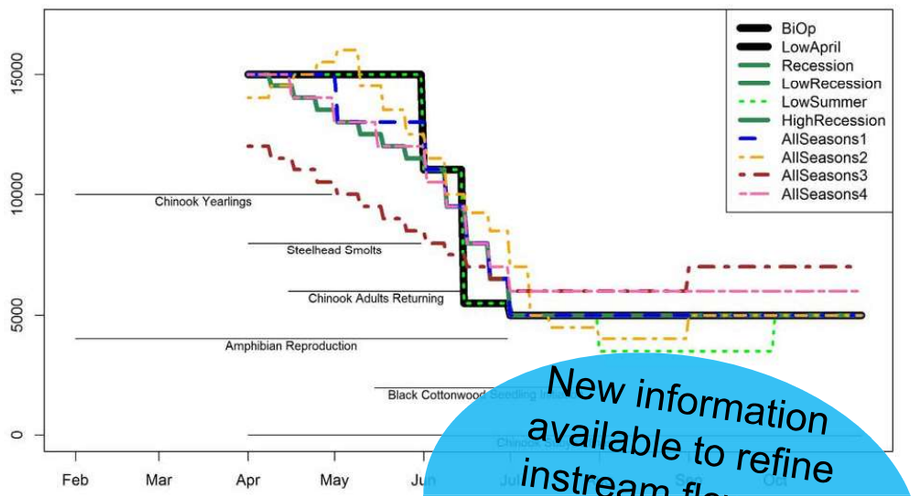
Minimum flow targets

Table 6
Mainstem BiOp Flow Objectives at Salem and Albany (cfs)

Period	Salem Flow Objectives (cfs)			Albany Flow Objectives (cfs)		
	Abundant & Adequate	Insufficient	Deficit	Abundant & Adequate	Insufficient	Deficit
Apr 1-30	*17,800	Salem flow objectives are linearly interpolated between Adequate and Deficit flow objectives based on mid-May system storage	*15,000	--	--	--
May 1-31	*15,000		*15,000	--	--	--
Jun 1-15	*13,000		*11,000	†4,500	†4,500	†4,000
Jun 16-30	*8,700		*5,500	†4,500	†4,500	†4,000
Jul 1-31	†6,000		†5,000	†4,500	†4,500	†4,000
Aug 1-15	†6,000		†5,000	†5,000	†4,500	†4,000
Aug 16-31	†6,500		†5,000	†5,000	†4,500	†4,000
Sep 1-30	†7,000		†5,000	†5,000	†4,500	†4,000
Oct 1-31	†7,000		†5,000	†5,000	†4,500	†4,000

* Seven-day moving average minimum flow
† Instantaneous minimum flow

Evaluations of instream flow needs



New information available to refine instream flow and temperature management for fish

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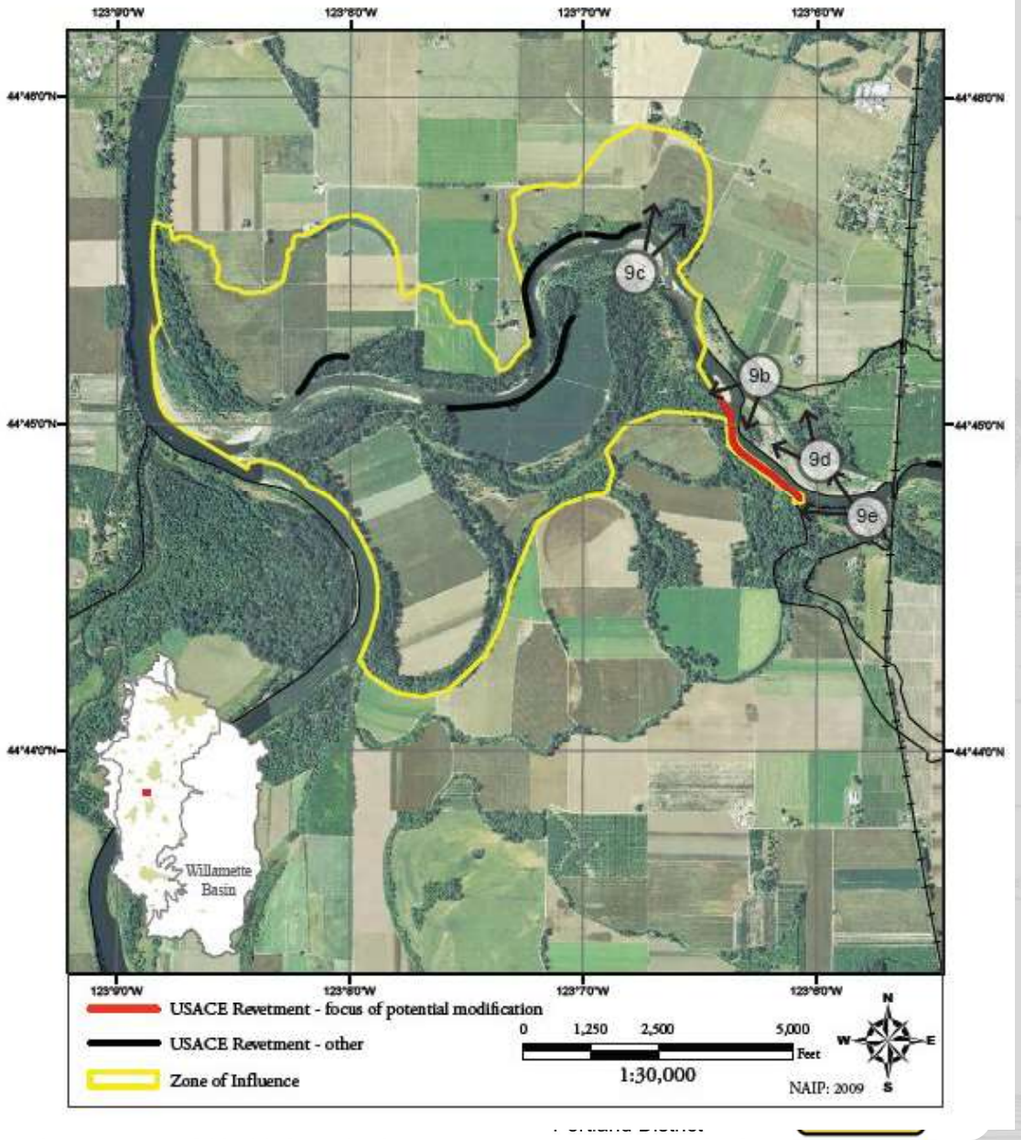
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HABITAT RESTORATION AND REVETMENT MODIFICATION

NMFS Biop RPA 7.1 Willamette River Basin Mitigation and Habitat Restoration: The purpose of the program is to
protect and restore aquatic habitat to address limiting habitat factors for ESA-listed fish.

NMFS Biop RPA 7.4 Restoration of Habitat at Revetments: undertake a comprehensive assessment of revetments placed or funded through the Willamette River Bank Protection Program.
The intent of this assessment is for the USACE to pursue implementation of the high
priority sites for restoration through existing authorities/programs.

Assessments completed.



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HATCHERIES

Mitigation Mission

- Purpose: offset fish production losses from blocked access to habitat, and relocation of some pre-existing hatcheries, due construction and operation Willamette Valley Projects
- House Document 531 provides the legal basis
- Intentionally vague to avoid disputes and promote conflict resolution.
- Spring Chinook, non-native summer steelhead, and rainbow trout produced

- As fish passage improved to address NMFS Biop RPA, plan to reduce mitigation program
  - Crediting and Transition plan needed

Conservation Mission

- Hatchery Chinook are being used to reintroduce species above Willamette Project dams.
- Include wild Chinook in hatchery brood stock to minimize genetic-based effects on natural populations

Hatchery Genetic Management Plans (HGMPs) in review by NMFS; describe hatchery goals & objectives



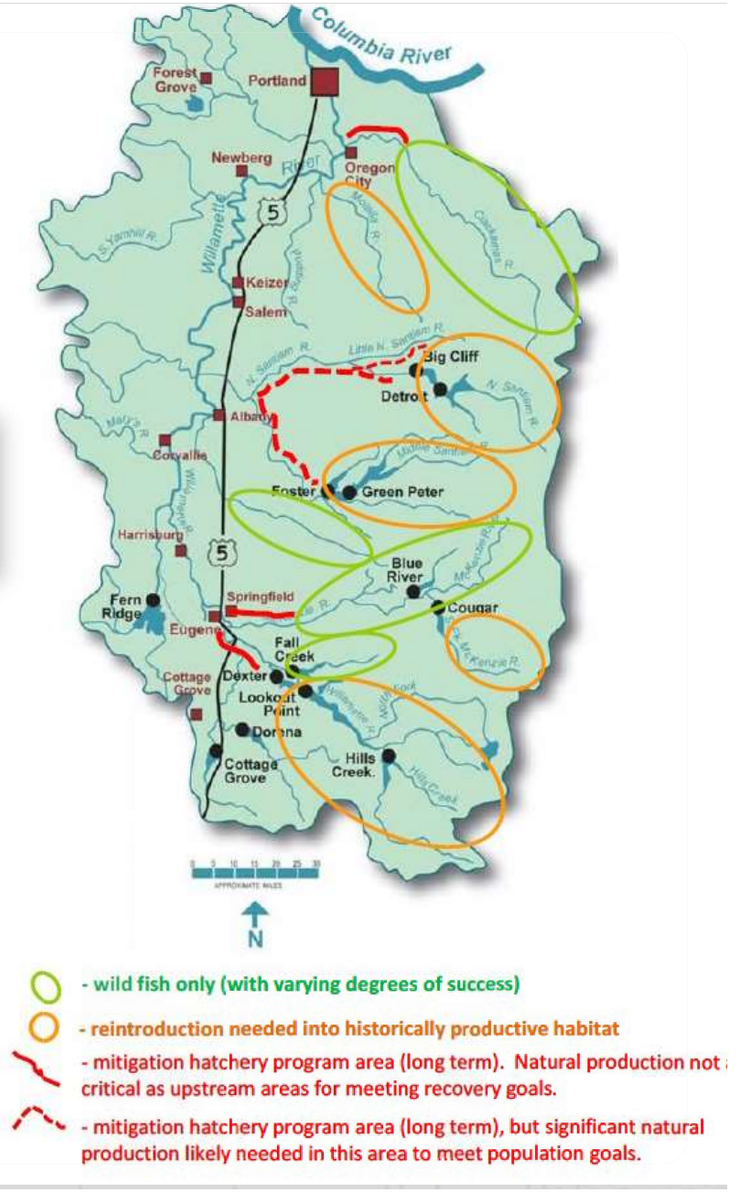
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STATUS & PLANS FOR REMAINING ACTIONS

	North Santiam	South Santiam	McKenzie	Middle Fork	
				Mainstem	Fall Creek
Upstream fish passage	Minto	Foster	Cougar	Continuing feasibility evaluations / alternative development	New adult facility 2018
Downstream fish passage	New collector 2028	New spill weir 2018	New collector 2023		Fall Creek Drawdown
Temperature	New tower 2023	NA	Cougar Tower		Operational
Streamflow & Ramping Rates					

Green = Implemented Orange = In progress

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WILLAMETTE BASIN REVIEW REALLOCATION STUDY

Kathryn Warner
4 December 2018



WILLAMETTE BASIN REVIEW
"Planning Today for Tomorrow's Water"

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STATE OF OREGON WATER RESOURCES DEPARTMENT WRD

OUTLINE

Background

Project status

Next steps



STUDY PURPOSE AND AUTHORITY

Purpose: Evaluate reallocation of joint-use storage behind Corps dams in the Willamette Valley to authorized purposes

House Committee on Public Works resolution for the Willamette Basin Review Study, adopted September 8, *1988, Exhibit 1 authorized the Chief of Engineers to determine:*
"..whether modifications to the existing projects are warranted and determine the need for further improvements with the Willamette River Basin (the Basin) in the interest of water resources improvements"

Flood Control Act of May 17, 1950 authorized plans contained in House Document 531 and pertinent language from that document states:
"The primary accomplishment of the proposed projects would be the provision of flood control and major drainage. Secondary accomplishments would be the generation of hydroelectric power; improvement of main stem Willamette for navigation; increase of water supplies for irrigation and domestic use; increase of low flows which would result in abatement of pollution and improved fish conditions for fish life; and improved recreational conditions at reservoirs and downstream." (page 1831)

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BACKGROUND

1991 Corps completes appraisal-level study

1994 Demands developed for municipal, industrial, and irrigation

1996 Study initiated, cost share agreement signed

1999 ESA listing of Upper Willamette Steelhead & Chinook

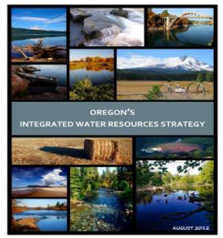
2000 STOP Agency partners place study on hold

2000 Willamette Biological Assessment

2007 Willamette Supplemental Biological Assessment

2008 Biological Opinions Completed

2012



2014 Coast Fork Willamette Surplus Report

2015 New Cost Share Agreement

2018 Chief's Report

STUDY DRIVERS

Within the watershed are most of the state's population (nearly 70% of the population), larger cities, and major industries.

The basin also contains some of Oregon's most productive agricultural lands and supports nationally and regionally important fish and wildlife species.

Groundwater limited or restricted areas

Surface water (live flow) not allowed for most new uses during summer months

Water quality & listed species

A need for supplemental or back-up water supplies

Today, access to federal storage is limited for irrigation, municipal and industrial, and instream uses

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SPONSOR AND STAKEHOLDERS

Non-federal sponsor is Oregon Water Resources Department
- 50/50 cost-share

Stakeholder Group: high interest expressed by State and communities.
- Federal: Bureau of Reclamation (BOR), National Marine Fisheries Service (NMFS) and US Fish and wildlife Service (USFWS)
- State of Oregon: Oregon Water Resources Department (OWRD), Oregon Department of Agriculture (ODA) and Oregon Department of Fish and Wildlife (ODFW)
- Tribes: Grand Ronde
- Other: League of Oregon Cities and other municipalities, Oregon Farm Bureau and other agricultural and nursery groups, Water Watch and other conservation groups

FOUO
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CONSTRAINTS AND CONSIDERATIONS

Constraints

- Maintain existing flood risk management benefits in the system
- Water reallocation options will fit within existing project rule curves
- Reservoir storage reallocation limited to existing 1.6 M acre-feet of conservation storage space
- Construction/modification of structural facilities not considered

Considerations

- 100% reliable stored water for all water year types and for all water users is not viable because reservoirs annually emptied for flood control purposes.
- Maintain operational ability to meet BiOp flow targets for ESA-listed fish
- Minimize negative impacts to existing reservoir and downstream recreation users
- Minimize impacts to hydropower generation at Willamette hydropower projects

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PROGRESS TO DATE

March 2016: Public scoping meetings

January 2017: Demand estimates for irrigation, municipal, industrial uses completed

April 2017: Analysis completed to quantify use of storage to meet the 2008 BiOp flow objectives

Late July: First version of full draft report completed

November 7, 2017: Release of draft integrated Feasibility Report-EA for concurrent review

March 19, 2018: Agency Decision Milestone completed

July 2, 2018: Biological Assessment sent to NMFS for consultation

October 2018: Formal ESA Consultation with NMFS underway

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ESTIMATING DEMANDS FOR STORED WATER

Peak Season Demands for 2070

Allocation Use Category	Peak Demands (acre-feet)	Portion of Total (percent)
Fish & Wildlife	1,590,000	76.5
Municipal & Industrial	159,750	7.7
Agricultural Irrigation	327,650	15.8
Total	2,077,400	100.0

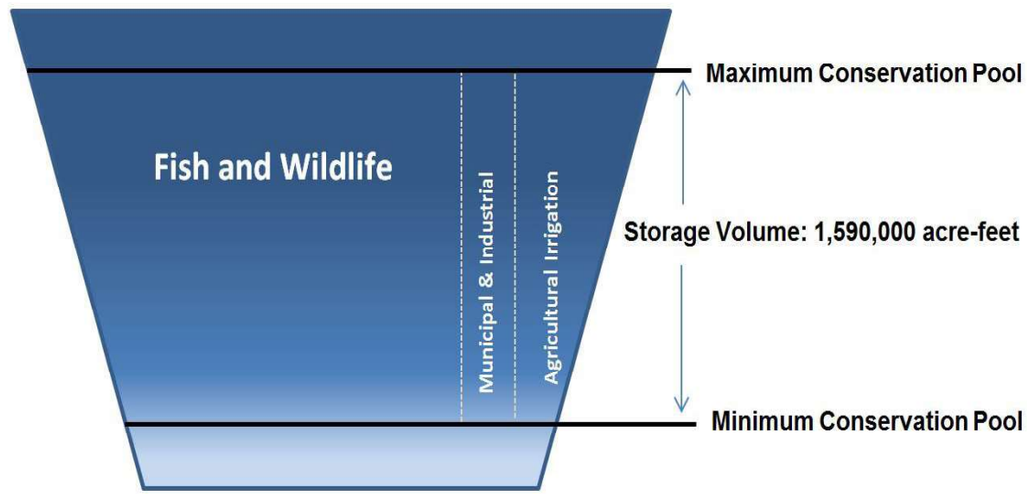
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PROPOSED REALLOCATION VOLUMES (ACRE-FEET)

Fish & Wildlife:	1,102,600
Municipal & Industrial:	159,750
Irrigation:	327,650
Total Allocation	**1,590,000**



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ADAPTIVE MANAGEMENT PLAN ALTERNATIVES

1. Proportionally reduce water use across all sectors in dry years; i.e., “share the shortfall”

2. Prioritize storage supply for fish & wildlife first, providing any remaining storage supply to other uses in dry years

3. Prioritize the storage supply for consumptive uses first, providing any remaining storage supply to fish and wildlife purposes in dry years

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CHALLENGES

Stakeholder concerns with allocation volumes proposed

Implementation details are being worked out with OWRD and BOR
- Management of individual water users
- "Contract" for protection of instream flows
- Change of use on storage certificate

Cost of M&I storage space
- Policy to use updated cost of storage
- Users concerned with paying update cost of storage AND Major Rehab/Dam Safety Modifications

Not proposing to reallocate storage specifically for climate change

ESA consultation is not completed in time

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WHAT HAPPENS AFTER THE REALLOCATION IS APPROVED BY CONGRESS?

Consumptive Uses

- BOR files a transfer application to change the character of use on storage certificates to include all three uses. All three uses maintain the priority date of original use.
- Water users seek storage agreements with Corps and Bureau of Reclamation for consumptive use and subsequently file secondary water right applications with the State of Oregon to use stored water

Instream Flows (F&W)

- Corps and State need to determine how to satisfy state law requirement that there is a contract/agreement with reservoir owner for storage releases for instream protection of flows for fish and wildlife
- OWRD converts MPSFs into instream water rights. State agencies need to determine process and volumes/rate of stored water to convert
- Update water control manuals and drought contingency plan to recognize new uses

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IMPLEMENTATION NEXT STEPS

Determine process for determining annual water availability

- Currently Corps makes initial water year type determination in March, using April 1 forecast of May refill volume
- Water Year type determination re-assessed May 1
- Reservoir refill does not necessarily peak in mid-May

- Yearly process for coordination with OWRD on water availability and current users
- Current BOR contracts currently state all contractees will share equally in water shortage
- Annual call for water for M&I and irrigation uses
- How will users make a “call” on water?

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NEXT STEPS

Schedule waiver approved to extend beyond 3 year period to allow time for consultation with NMFS
- Waiver approved by Assistant Secretary of the Army for Civil Works (ASA(CW))
- DCG-CEO Briefing (formerly Civil Works Review Board) Milestone was May 30, 2018; now November 26, 2018
- Chief's Report Milestone (ends Corps feasibility study phase) was August 18, 2018; now March 5, 2019

ESA consultation with NMFS
- Policy is 135 days for a BiOp after BA is accepted
- Held pre-consultation meetings for over a year
- Corps made an effects determination of May Affect, Not Likely to Adversely Affect in the Biological Assessment (BA)
  - Based on statistically insignificant flow changes in the driest of years and because this project provides benefits to fish and wildlife by facilitating protection of instream flows
- NMFS does not agree with the effects determination

State and Agency Review
- Last review prior to completion

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WILLAMETTE RIVER BANK PROTECTION (WRBP)
WILLAMETTE VALLEY EIS





Shane K. Cline, PE
Levee Safety Program Manager
Portland District
05 December 2018

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WILLAMETTE RIVER BANK PROTECTION (WRBP)

Purpose: Provide High level overview of the following

- Federal Inventory
- Authorizations
- Legal Obligations
- 2008 Biological Opinion
- Studies
- Path Forward

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WILLAMETTE RIVER BANK PROTECTION (WRBP)

Federal Inventory

Type	Number	Miles	Notes
Fed/Fed	116	48.3	Constructed before 1955
Fed/Non Fed	147	51.6	Constructed after 1955
Other			Unknown
Total	263	99.9	

Numbers differ slightly from 2008 BiOp



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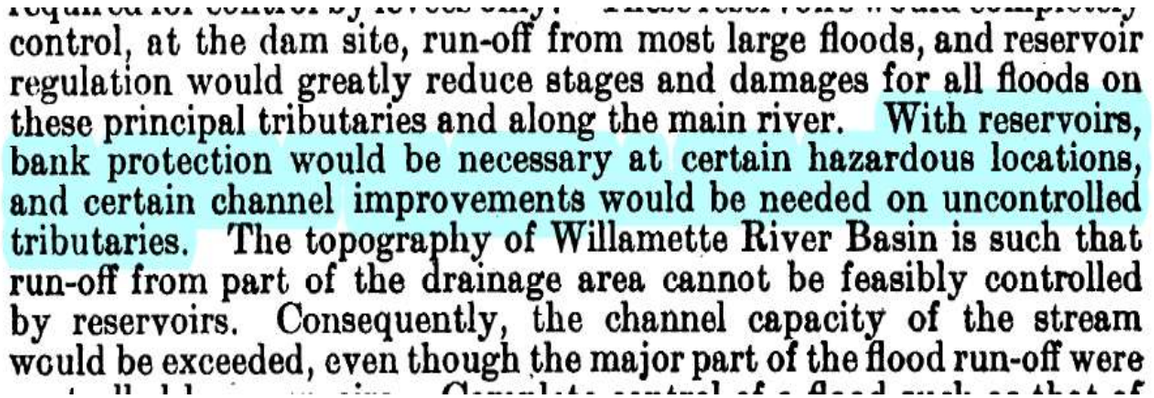
WILLAMETTE RIVER BANK PROTECTION (WRBP)

Federal Authorizations

- Flood Control Acts of 1936, 1938, and 1950
- Water Resources Development Act (WRDA) 1950 required local sponsor O&M.
- Program expanded in 1971 through Senate and House Committees on Public Works

USACE Obligations

- Limited ability to remove authorized revetments without de-authorization
- Cannot increase flood risk



control, at the dam site, run-off from most large floods, and reservoir regulation would greatly reduce stages and damages for all floods on these principal tributaries and along the main river. With reservoirs, bank protection would be necessary at certain hazardous locations, and certain channel improvements would be needed on uncontrolled tributaries. The topography of Willamette River Basin is such that run-off from part of the drainage area cannot be feasibly controlled by reservoirs. Consequently, the channel capacity of the stream would be exceeded, even though the major part of the flood run-off were

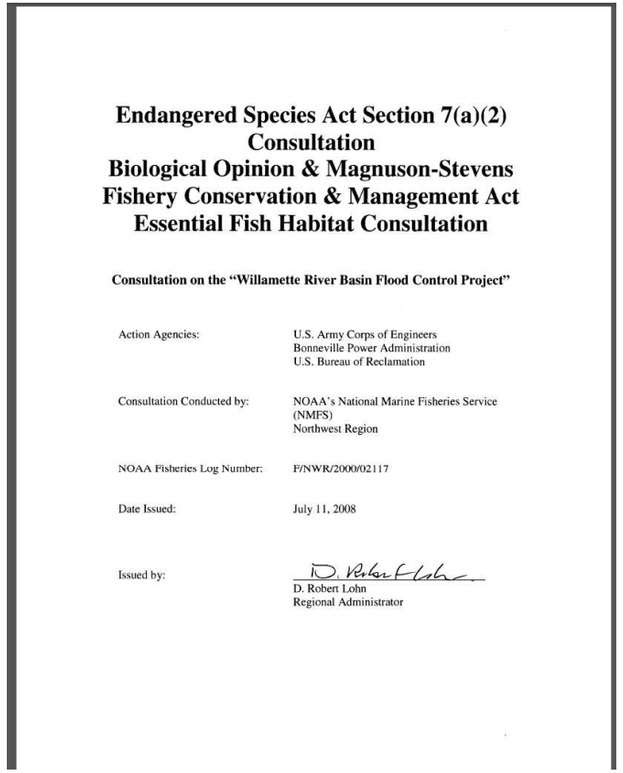
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WILLAMETTE RIVER BANK PROTECTION (WRBP)

2008 Willamette River BiOp
- Reasonable and Prudent Alternative 7.4
  - RPA 7.4 – Restoration of Habitat Revetments
    - …undertake a comprehensive assessment of revetments…
    - …identifying sites with potential for modification, by December 31, 2010.
    - …use applicable existing authorities and programs for funding habitat restoration…identified in this assessment



Endangered Species Act Section 7(a)(2) Consultation
Biological Opinion & Magnuson-Stevens Fishery Conservation & Management Act Essential Fish Habitat Consultation

Consultation on the "Willamette River Basin Flood Control Project"

Action Agencies:	U.S. Army Corps of Engineers Bonneville Power Administration U.S. Bureau of Reclamation
Consultation Conducted by:	NOAA's National Marine Fisheries Service (NMFS) Northwest Region
NOAA Fisheries Log Number:	F/NWR/2000/02117
Date Issued:	July 11, 2008
Issued by:	D. Robert Lohn Regional Administrator

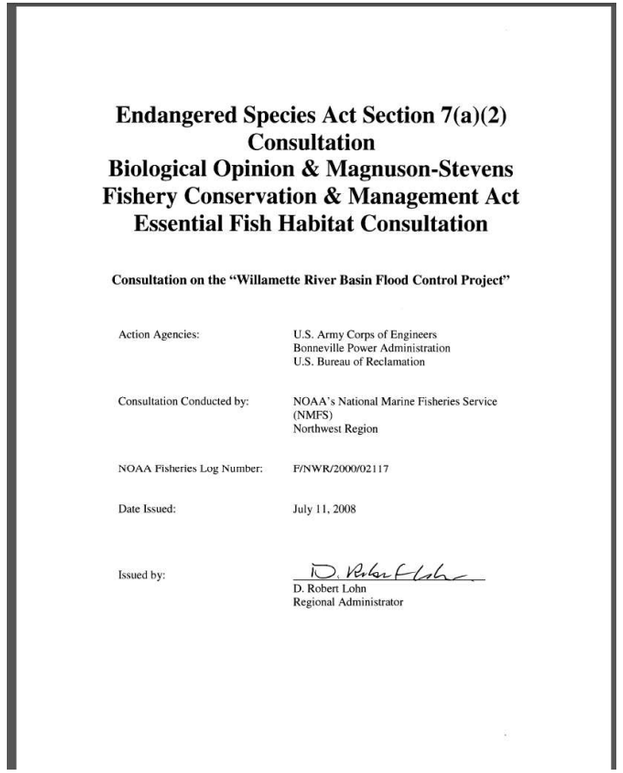
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WILLAMETTE RIVER BANK PROTECTION (WRBP)

2008 Willamette River BiOp
- Reasonable and Prudent Alternative 7.4
  - RPA 7.4 – Restoration of Habitat Revetments
    - …undertake a comprehensive assessment of revetments…
      - » Since 2007 continue program conducting regular inspections of Fed/Fed and Fed/NonFed revetments
    - …identifying sites with potential for modification, by December 31, 2010.
      - » Commissioned UofO Study assessing potential for improving ESA fish habitat at USACE revetments (June 14, 2013)
    - …use applicable existing authorities and programs for funding habitat restoration…identified in this assessment
      - » Ongoing



Endangered Species Act Section 7(a)(2) Consultation
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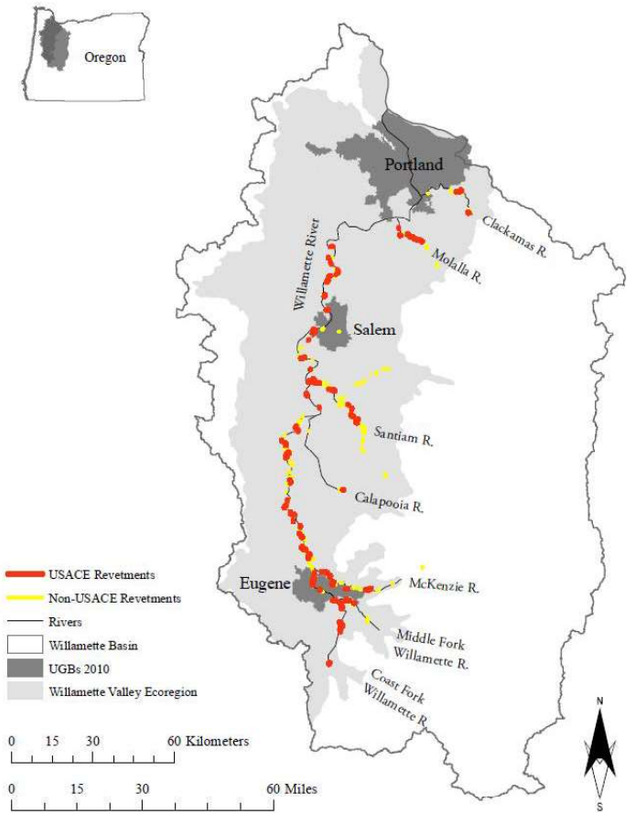
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WILLAMETTE RIVER BANK PROTECTION (WRBP)

2013 UofO Study

- States that the purpose of the revetment is to stabilize the land-water interface while protecting land based improvements
  - In other words, removal has the ability to de-stabilize
- Identified four USACE revetments for consideration
  - Cole Island
  - Horseshoe Lake, and
  - Harkens Lake (2)
- "…Where restoring natural river function is the goal, a prioritization process that denominates costs and benefits solely in dollars in unlikely to adequately address the biophysical processes that are central concern….
- Whichever individual revetments are ultimately chosen,…..requires active <u>participation by affected, willing landowners.</u>"



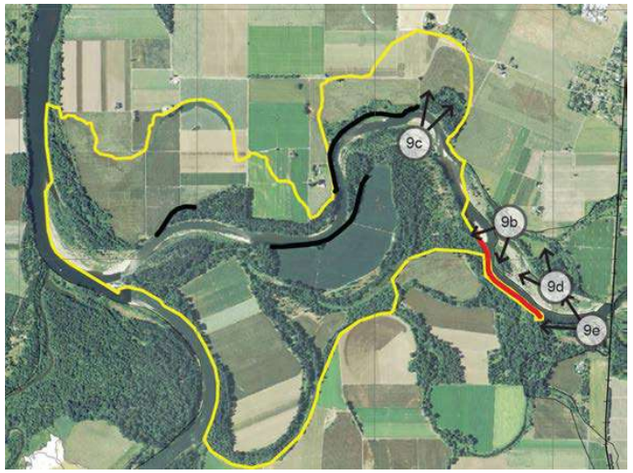
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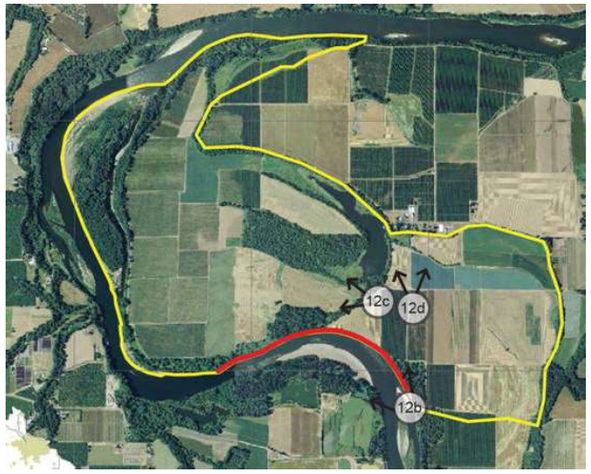
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WILLAMETTE RIVER BANK PROTECTION (WRBP)

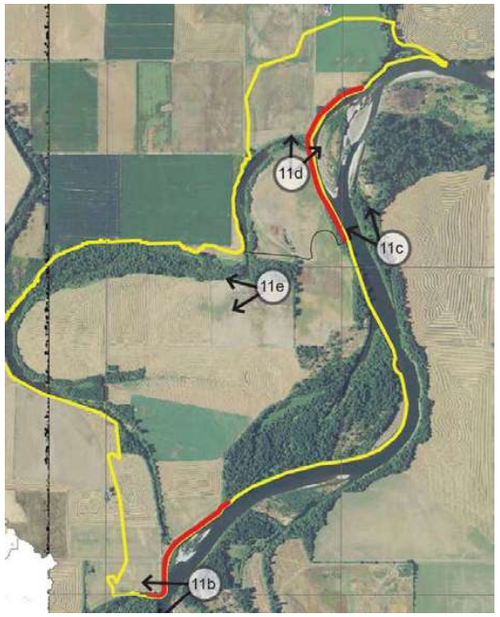
2013 UofO Study



Cole Revetment (Wilfert)



Horseshoe



Harkens Lake (Irish Bend)

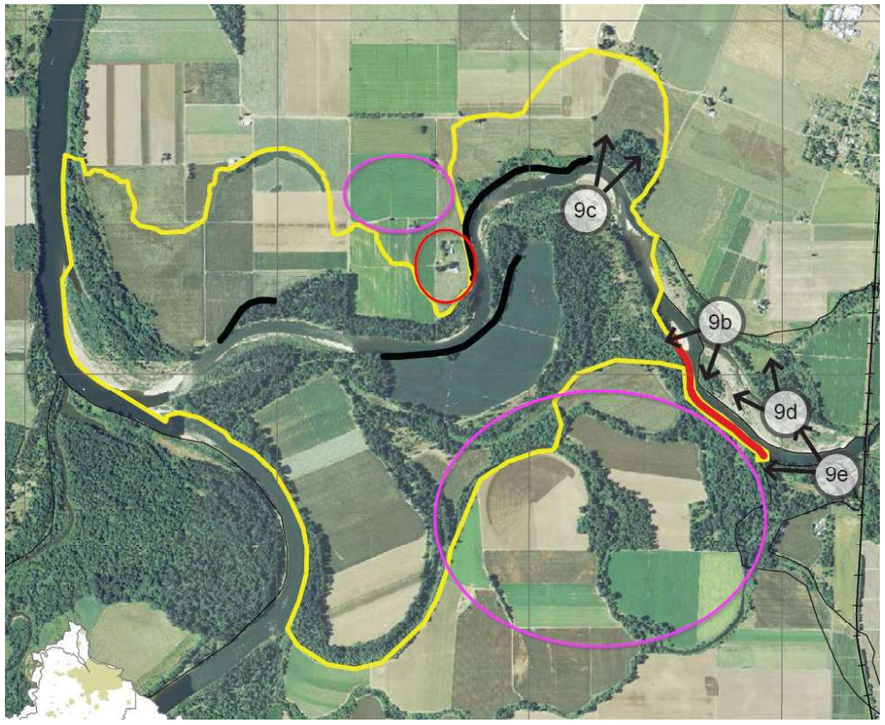
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2013 UofO Study – Cole Revetment



Uncertainties may impact private property and residences.

Need to reduce uncertainties

9

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WILLAMETTE RIVER BANK PROTECTION (WRBP)

2017 WRBP Inspection and Concept Plan

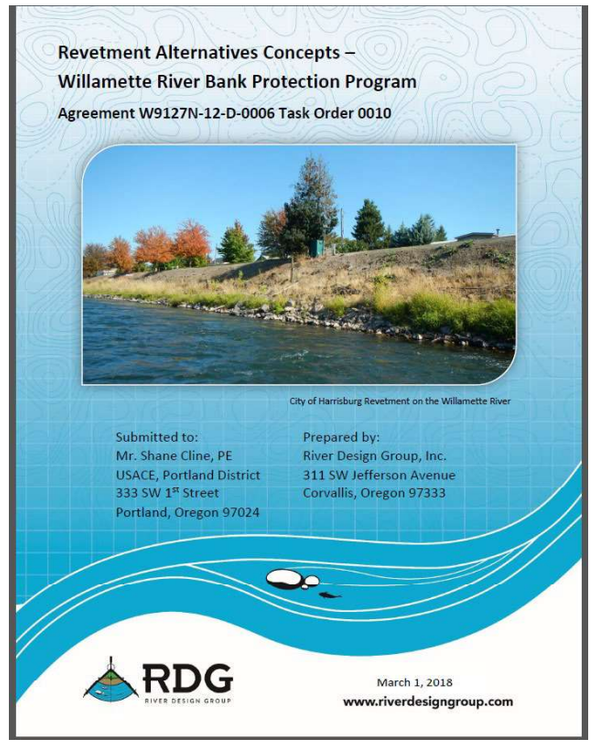
- Visually Inspected all FED/FED Revetments
- Developed conceptual alternatives for 34 revetment sites

Table 3-1. Revetment narrative scoring results. H = High, M = Medium, L = Low.

Revetment Name	Current Failure Potential	Potential Failure Consequence	Potential Habitat Value with Recommended Alternative
Lambert Slough	H	L	L
Stoutenberg	L	M	M
Keizer Rapids	L	H	L
Minto-Brown	L	L	H
Eola Bend	L	L	M
Eyerly Location	M	M	M
Wilfert	M	L	M
Wickham	H	H	M
Blakeley	H	L	M
Porter Right Bank	L	L	M
Porter Dam	L	L	H
Lower Bend	L	L	H
Irish Bend	L	M	H
City of Harrisburg	L	H	L
Location 8A	L	M	L
Fertile District (Loc 8)	L	M	L
Lower Goodpasture	L	H	L
Bauer Lane	L	H	L
Myers-Eyler	L	H	M
Hart	H	M	L
A.C. Clearwater	H	L	L
Evans	M	L	L
McCully Left Bank	L	M	H
McCully Right Bank	L	L	M

Table 3-2. Revetment scoring and group delineation.

Revetment Name	Current Failure Potential	Potential Failure Consequence	Potential Habitat Value with Recommended Alternative	Total Score
Minto-Brown	1	1	1	3
Porter Dam	1	1	1	3
Lower Bend	1	1	1	3
Eola Bend	1	1	2	4
Porter Right Bank	1	1	2	4
Irish Bend	1	2	1	4
McCully Left Bank	1	2	1	4
McCully Right	1	1	2	4
Stoutenberg	1	2	2	5
Wilfert	2	1	2	5
Eyerly Location	2	2	2	6
Blakeley	3	1	2	6
Location 8A	1	2	3	6
Fertile District	1	2	3	6
Myers-Eyler	1	3	2	6
Evans	2	1	3	6
Lambert Slough	2	1	3	6
Keizer Rapids	1	3	3	7
City of Harrisburg	1	3	3	7
Lower	1	3	3	7
Bauer Lane	1	3	3	7
A.C. Clearwater	3	1	3	7
Wickham	3	3	2	8
Hart	3	2	3	8



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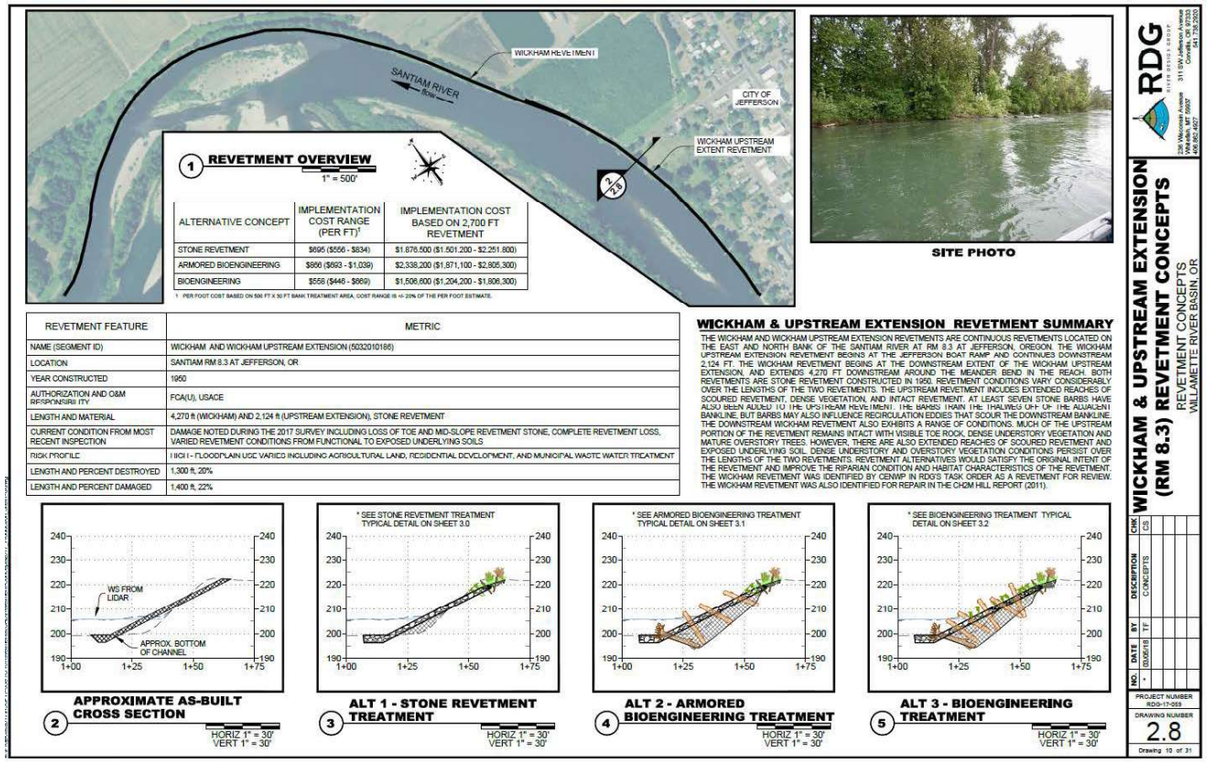
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WILLAMETTE RIVER BANK PROTECTION (WRBP)

2017 WRBP Inspection and Concept Plan

- Visually Inspected all FED/FED Revetments
- Developed conceptual alternatives for 24 revetment potential sites



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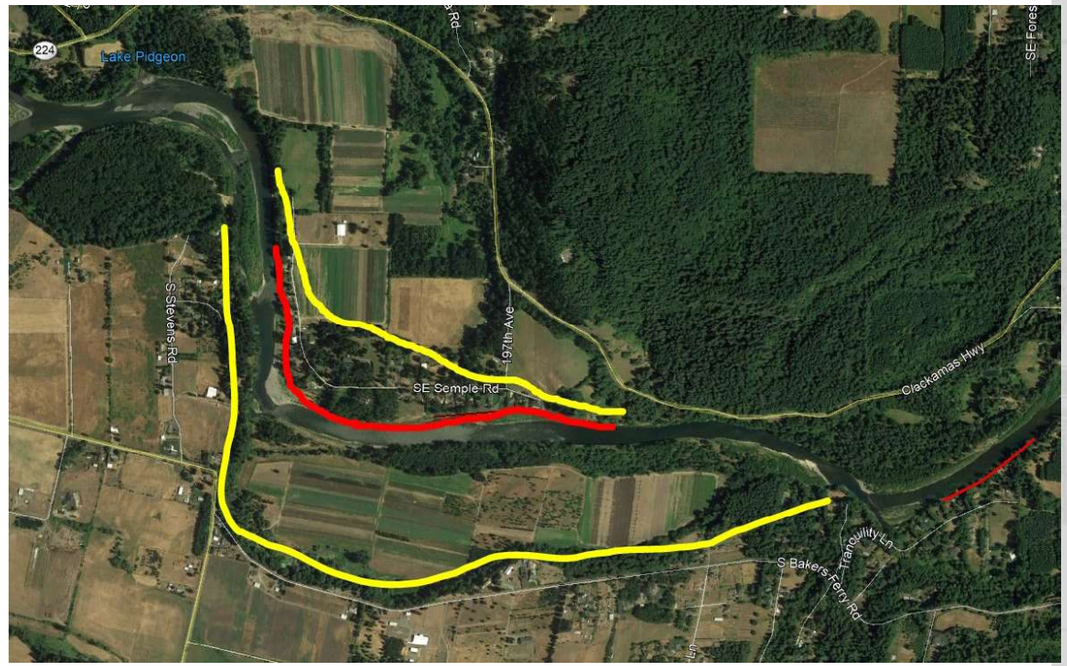
WILLAMETTE RIVER BANK PROTECTION (WRBP)

System Level Understanding

- Benefits to life and property from single revetment may not be obvious
- However system level assessment has not been done.
- Removal of revetments, may cause large unraveling of system.
- While not well understood, it would be anticipated that without revetments, channel would trend toward occupying entirety of Channel Migration Zone. Maybe even more.
- If revetments are removed without understanding system level stabilization, impacts to private lands, homes, critical infrastructure can be anticipated.

Path Forward

- Study of system level assessment to better understand systemic benefits.
- Based on understanding of systemic benefits, move to de-authorize certain revetments. This could allow for removal.
- Without de-authorization, projects will need to replace original purpose.
  - Vegetation (never been done)
  - Setback
  - Other
- Cannot increase flood risk



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WILLAMETTE RIVER BANK PROTECTION (WRBP)

Questions????

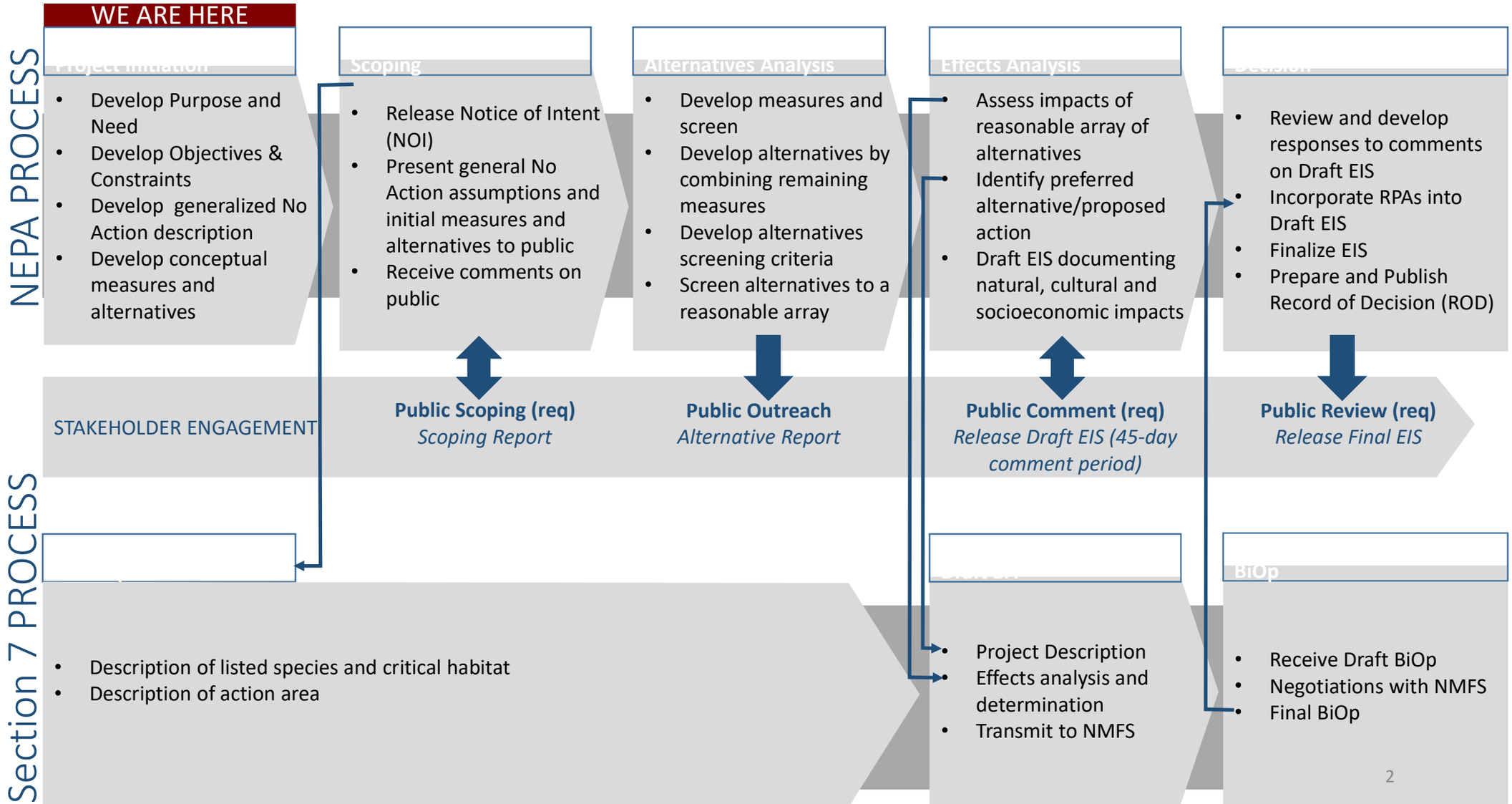
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NEPA Process Overview

NEPA is all about informed decision making by listening to the publics concerns about and *transparently* analyzing and communicating the risk, benefits, and impacts of a federal action.

The National Environmental Policy Act is the national charter for the protection of the environment. NEPA requires Federal agencies to consider environmental effects that include, among others, impacts on social, cultural, and economic resources, as well as natural resources. Federal agencies are required to prepare a detailed Environmental Impact Statement (EIS) for major federal actions significantly affecting the quality of the human environment and a Record of Decision (ROD).


WE ARE HERE
NEPA PROCESS
Project Initiation
Develop Purpose and Need
Develop Objectives & Constraints
Develop generalized No Action description
Develop conceptual measures and alternatives
Scoping
Release Notice of Intent (NOI)
Present general No Action assumptions and initial measures and alternatives to public
Receive comments on public
Alternatives Analysis
Develop measures and screen
Develop alternatives by combining remaining measures
Develop alternatives screening criteria
Screen alternatives to a reasonable array
Effects Analysis
Assess impacts of reasonable array of alternatives
Identify preferred alternative/proposed action
Draft EIS documenting natural, cultural and socioeconomic impacts
Decision
Review and develop responses to comments on Draft EIS
Incorporate RPAs into Draft EIS
Finalize EIS
Prepare and Publish Record of Decision (ROD)
STAKEHOLDER ENGAGEMENT
Public Scoping (req)
Scoping Report
Public Outreach
Alternative Report
Public Comment (req)
Release Draft EIS (45-day comment period)
Public Review (req)
Release Final EIS
Section 7 PROCESS
Description of listed species and critical habitat
Description of action area
Project Description
Effects analysis and determination
Transmit to NMFS
BiOp
Receive Draft BiOp
Negotiations with NMFS
Final BiOp
2

Step 1: Project Initiation | **Step 2: Scoping** | **Step 3: Alternatives Analysis** | **Step 4: Effects Analysis** | **Step 5: Decision**

Scoping

Ensures that problems are identified early and properly studied. Also used to help focus analysis on resources potentially impacted significantly by the action, i.e. define the "scope" of the EIS. Input during scoping used to develop and refine alternatives.

1

- Release NOI
- Present general No Action and preliminary measures and alternatives
- 30 – 60 day comment period

2

- Analyze Public Scoping Comments
  - Identify measures and alternatives solicited from various agencies and the community to be examined in the EIS
  - Identify issues and concerns of the various agencies and the community to be examined in the EIS

3

- Eliminate nonsignificant issues
- Develop detailed Affected Environment description
  - Includes all significant issues/resources (i.e. F&W, water supply, hydro, etc.) identified in scoping
- Develop the No Action Alternative description (baseline of comparison)
- Identify needed studies
- Identify methods to be used to evaluate the alternatives

3

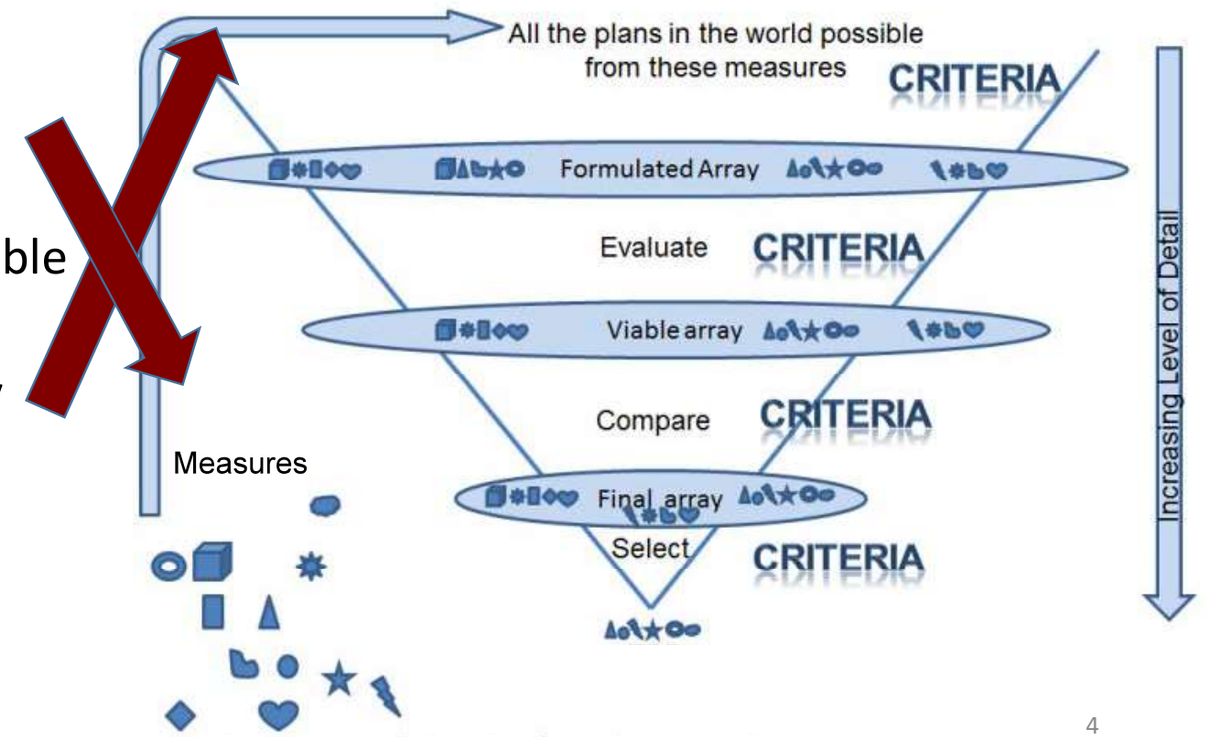
Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

Alternative Formulation Process 101

The process of building alternative alternatives from remaining measures that meet your objectives without violating your constraints. Each objective should be addressed by at least one alternative

General Steps

1. Develop as many measures as possible
2. Screen out those that are infeasible or don't meet P&N
3. Combine measures into as many alternatives as possible
4. Develop screening criteria
5. Screen alternatives
6. Iterate where needed



Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

Measures Screening

sneak peek for day 1 & 2 activities

Formulation (*today's activity*)

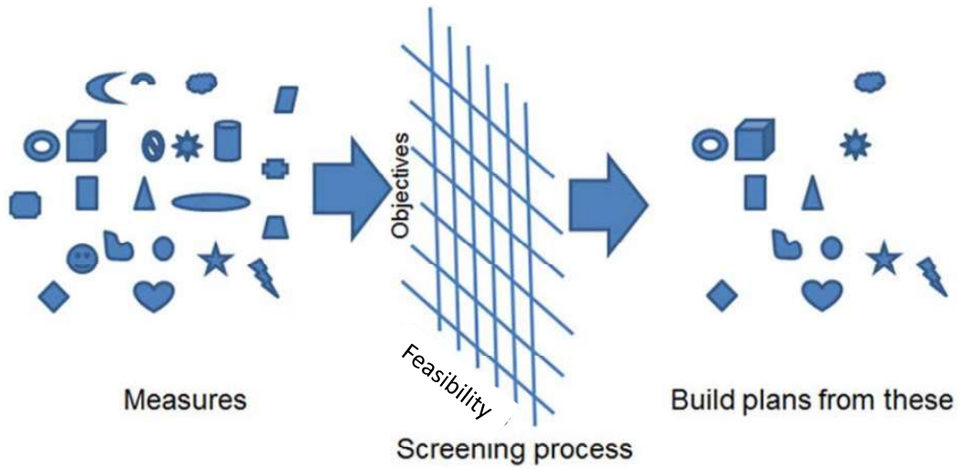
- Brainstorm as many measures as possible that meet one or more objectives.

Initial Screening

- Reality check - eliminates measures that do not have a realistic chance of being designed and built.

Comparative Screening

- Detailed look at measures to determine if some were clearly better than others.
- A qualitative (good/better/best) approach to categorize how measures meet the various objectives and identify which more effectively meet the purpose and need



Objective 1	Objective 2	Objective 3	Objective 4	Objective 5
Plan	Measures			
A				
B				
C				
D				
No Action				

5

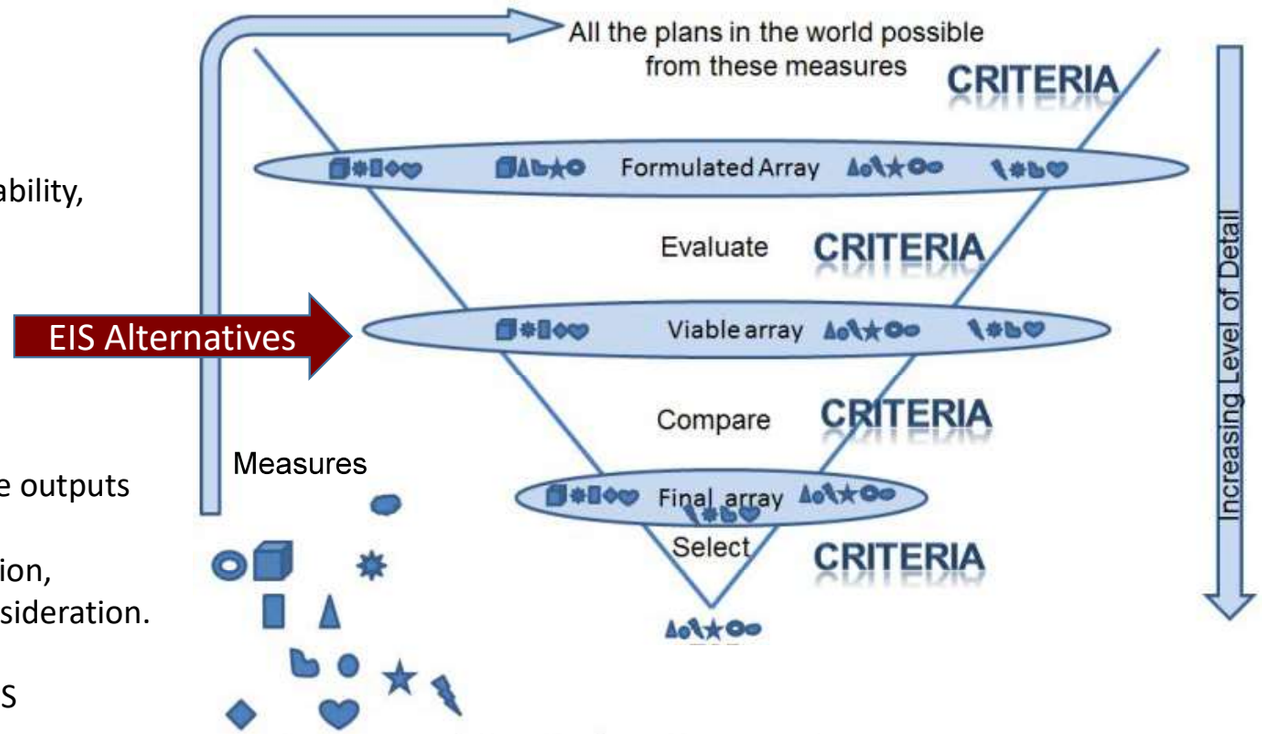
Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

Alternatives Screening

Initial Screening
Qualitative Evaluation
- Fatal Flaws
- Purpose and need agreement
- Complete – has all measures required, acceptability, effectiveness, and efficiency).
- Significant Environmental Impacts
- Practicality

Evaluation Screening
Qualitative/Semi Quantitative Evaluation
- Uses evaluation criteria to compare alternative outputs to no action
- Qualify each alternative for further consideration, reformulation, or dropping it from further consideration.

Comparison Screening - fully evaluated in the DEIS
Quantitative Evaluation
- Greater detailed analysis
- Uses large number of screening criteria for objectives & **<u>environmental impacts</u>**
- Cost analysis



Effects Analysis

Assesses impacts of each alternative to each of the resources (i.e. F&W, water supply, public safety, hydro, etc.) identified during scoping.

The effects analysis includes an assessment of the environmental consequences of the:

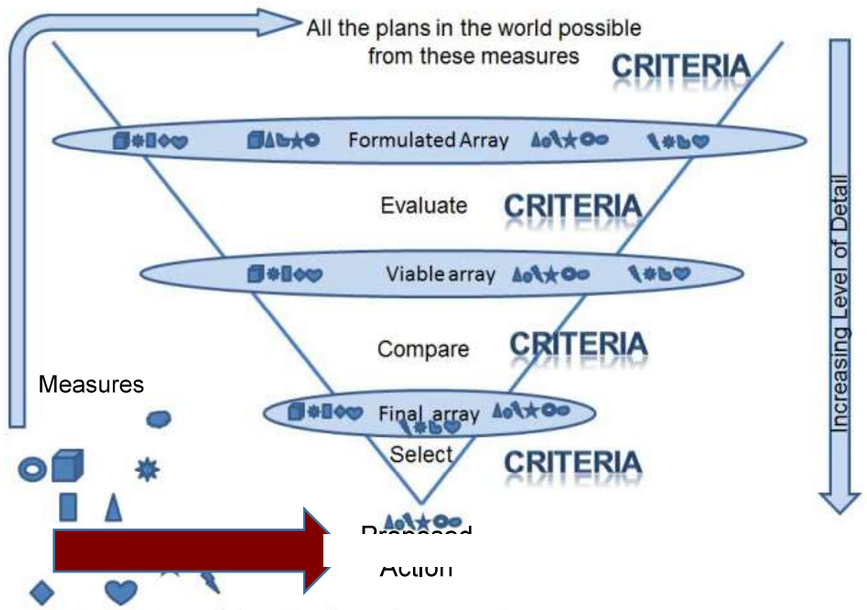
1. Direct effects: occur at the same time and in the same place as the action;
2. Indirect effects: occur later or at a location away from the action;
3. Intensity: The severity of effects is described as negligible, minor, moderate, and major. With a major impact indicating a significant impact; and
4. Cumulative Impacts for proposed action: "*the incremental impact of an action when added to other* ***past, present, and reasonably foreseeable future actions*** *regardless of what agency (federal or non-federal) or person undertakes such other actions*" (40 C.F.R. § 1508.7)

Decision

1
- Draft EIS released for public review
- 45 day minimum review period

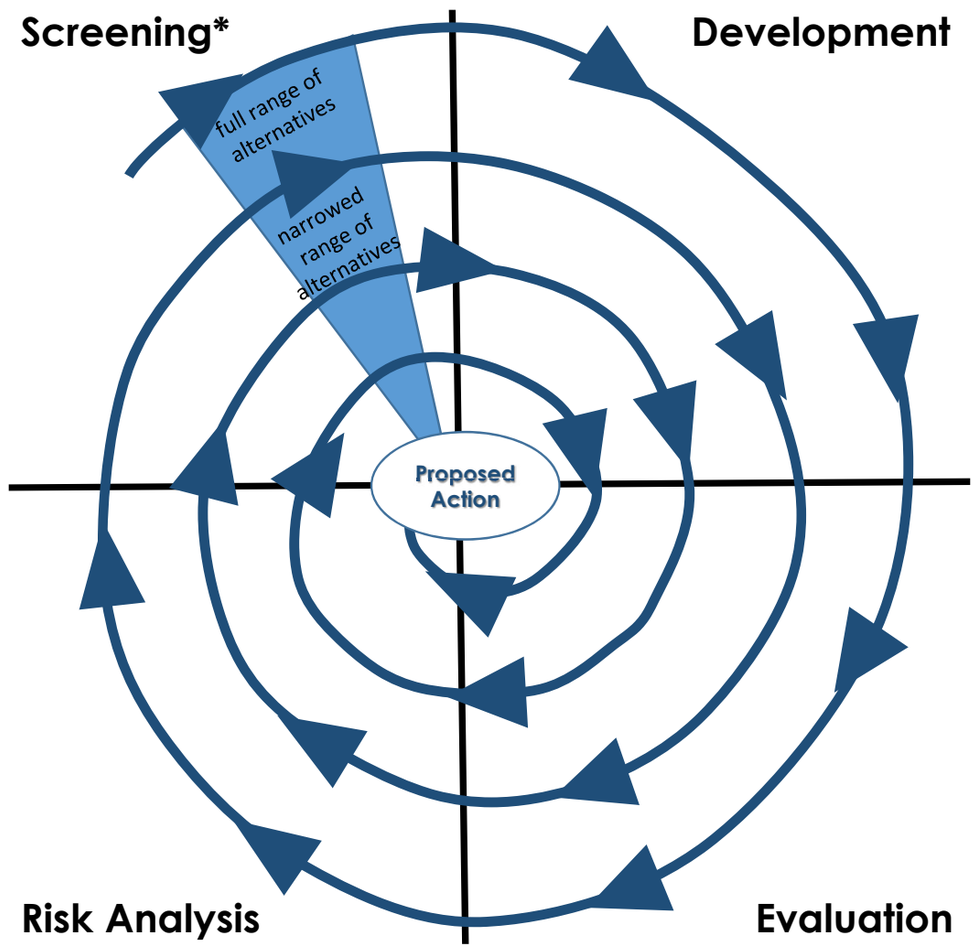
2
- Update EIS with public comment responses
- Update EIS with BiOp RPAs
- Prepare Final EIS documenting final impacts and mitigation

3
- Final EIS released for public review (no comment)
- 30 Day review Period
- Publish Record of Decision (ROD)



Iterative Risk Informed Decision Making

- To iterate is to repeat, elaborate, refine, correct, or complete a part of the decision making process.
- The entire decision making process, a single step in the process, or any portion of the process can be iterated.
  - Early iterations tend to emphasize problems; later iterations emphasize solutions.
  - The level of detail is usually the primary difference for iterations of a single step.
- Used to reduce uncertainty with each iteration.
  - Uncertainty could increase or decrease with new information; you learn as you alternative.
  - As more information becomes available, your understanding improves, and it is often necessary to go back over something to make it better.



* Decision to further consider, reformulate, or drop from further consideration.

Extra

Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

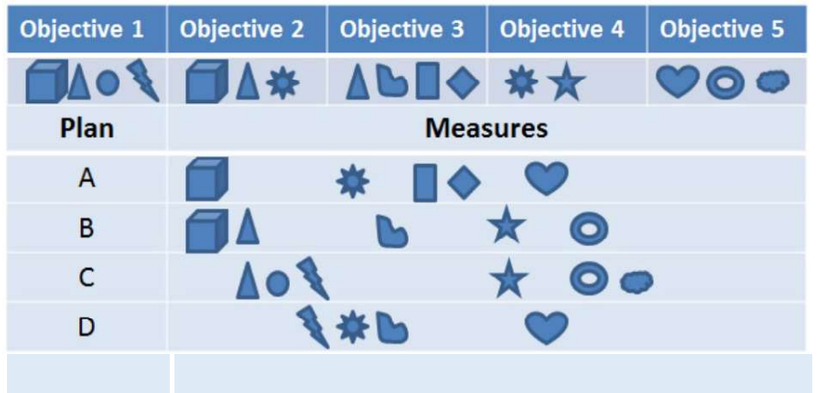
Alternatives Evaluation

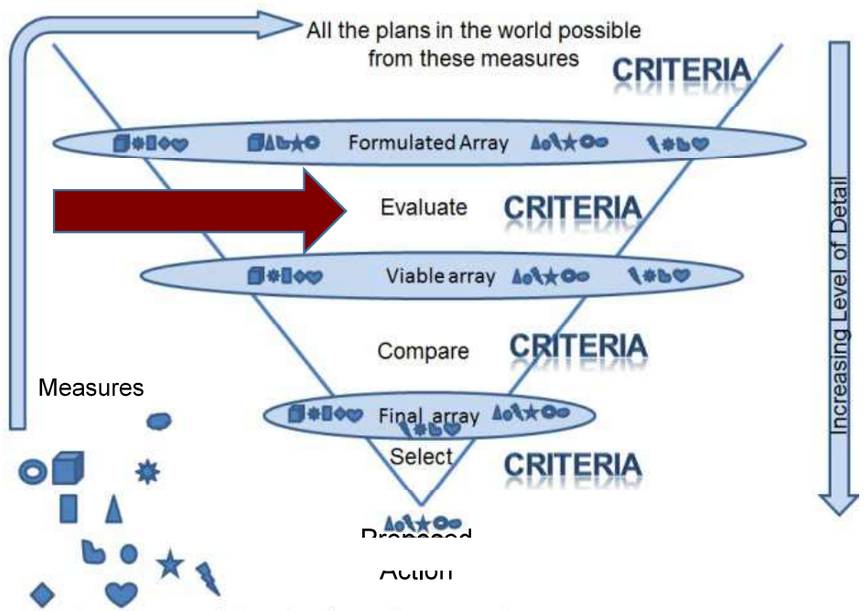
Yields a set of viable alternatives *from which to select the best.*

The **evaluation** task includes these steps:

1. Identify the alternatives that are feasible and meet the purpose and need
2. Identify the evaluation criteria.
3. Conduct the necessary analysis of each evaluation criteria for each alternative, including the No Action (if this has not already been done).
4. Compare the evaluation criteria values of each alternative to those of the No Action values.
5. Assess (i.e. describe quantitatively, where possible) all important differences between the two conditions.
6. Appraise (i.e. judge) each alternative's effects.
7. Qualify each alternative for further consideration, reformulation, or dropping it from further consideration.

The next step is to get from a bunch of individually viable alternatives to the best alternative without comparing them to one another. →



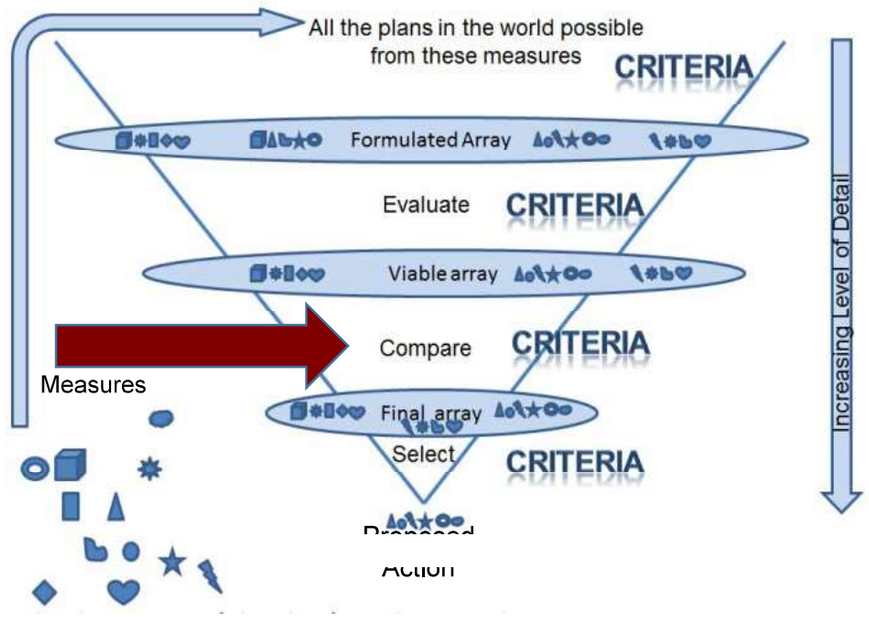


Alternatives Comparison

*Requires the PDT to **systematically look at what is alike and what is different** between alternatives.*

The comparison task includes these steps:

1. Identify a viable array of alternatives from the evaluation process.
2. Identify the comparison criteria.
3. Find the differences among the comparison criteria effects for each alternative.
4. Compare/Contrast the differences.
5. Identify trade-offs.
6. Explain the differences to people.
7. Display the differences with uncertainty.



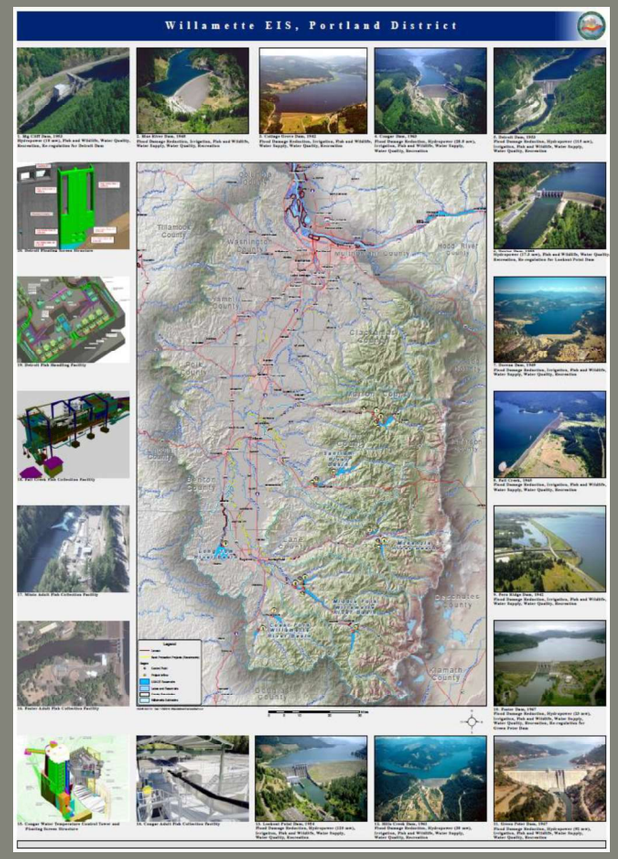
The best comparison **finds differences among the alternatives that matter to people**. It then displays these differences and the trade-offs among alternatives in a way that enables decision makers and others to see and understand them.

WILLAMETTE VALLEY SYSTEM OPERATIONS EIS

OBJECTIVES AND CONSTRAINTS

CENWP-PME-E
Suzy Hill

December 5, 2018



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PURPOSE AND NEED

The purpose and need is continued operations and maintenance of the Willamette Valley System (WVS) in accordance with authorized project purposes; while meeting Endangered Species Act (ESA) obligations. The most recent NEPA evaluation for the overall WVS operations and maintenance was an environmental impact statement completed in 1980. Since that time, operations have been modified and structural improvements for fish passage and temperature control have been implemented to address effects of the WVS on ESA-listed fish. There is also new information relevant to the environmental impacts of operating the WVS. Collectively these changes result in a need for implementation of actions to meet authorized project purposes and ESA obligations.

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HOW IS NO ACTION ALTERNATIVE DEFINED UNDER NEPA?

CEQ guidance describes No Action as:

- Continuation of ongoing programs initiated under existing legislation and regulations
- "no action" is "no change" from current management direction or level of management intensity

For the Willamette Valley System Operations the No Action Alternative includes:

- Willamette Basin Review Feasibility Study
- Cougar Dam Downstream Fish Passage
- Detroit Dam Downstream Fish Passage and Temperature Control Tower

No Action is current management under existing authorized purposes:

- Flood Risk Management
- Hydropower
- Fish and Wildlife
- Recreation
- Water Quality
- Water Supply
- Navigation

Policy documents that will help define the No Action Alternative:

Water Control Manuals
2015 COP
2008 Biological Opinion
and others

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WHAT ARE OBJECTIVES?

- Statements that describe the desired results of the process and how to meet the Purpose and Need.
- Objectives must be clearly defined and provide information on the desired outcome

WHAT DO YOU DO WITH OBJECTIVES?

- Use them.
- Use them to let people know what your study is all about.
- Use them as guides to the information you gather.
- Use them as reasons for identifying management measures
- Use them to compare the relative effectiveness of your alternatives/measures
- Use your objectives and constraints to identify effects to be evaluated. They can help you identify the alternatives/measures that qualify for further consideration.
- Use them to compare the relative effectiveness of alternatives/measures
- Use the objectives and constraints as reasons for selecting an alternative

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OBJECTIVES DEVELOPMENT

- Initial effort conducted by PDT (October/November)
- PDT reviewed and revised during PDT meeting early Nov.
- Presented to Management on 11/28/2018
- Will be revised and presented to management again following charrette

- Objectives are defined by mission area

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FLOOD RISK MANAGEMENT

Management Objectives (Specific milestones or direction of change that is preferred; ideally stated quantitatively so that can be measured)	**Metric(s) (How an objective will be measured; including uncertainty)**	**Documentation (Where is the legal or policy requirement documented?)**	**Constraints Related to Authority**	**Other Constraints and Considerations**
Maintain current flood risk level	Frequency and duration that river flows are over bank full (defined) conditions (days/reach) Manage to the rule curve in a controlled manner and reflecting dam specific operational priorities and constraints for specific outlets, etc. (days/reservoir)	Water Control Manual Congressional Authorizations	Changing the rule curve requires congressional authorization. Changing flood maps likely requires a policy decision.	System only partially regulated. Ability to forecast precipitation patterns Storms can exceed WVP system abilities to achieve objectives

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HYDROPOWER

Management Objectives	Metric(s)	Documentation	Constraints Related to Authority	Other Constraints and Considerations
Maintain operational flexibility & opportunity to produce hydropower Maintain emergency power pools until they are needed (intended use was winter cold snap)	Daily and annual hydropower generated Number of days/yr reservoirs below conservation pool elevations BPA's Revenue CO2 offsets Extent and duration that ramping rates are exceeded annually	Water Control Manual BPA/Corps operating agreements Congressional authorizations	Modifying power pools requires Congressional authorizations	Ramp rates Operating parameters Outages TDG relating changes in hydro ops

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RECREATION

Management Objectives	Metric(s)	Documentation	Constraints Related to Authority	Other Constraints and Considerations
Provide recreational opportunity as part of balanced operational strategy across authorized purposes to address objectives as defined in existing Master Plans. Optimize Detroit, Foster, and Fern Ridge Reservoir elevations.	Days boat ramps are available per year in reservoirs Days boat ramps are available per year in rivers below dams Sport fishing (angler/days) Annual number of special recreation permits – boat races, athletic events, etc. Reservoir aesthetics during the summer recreation season (reservoir elevation or percent full per month during conservation season)	Congressional authorizations Water Control Manual Engineering Regulation 1130-2-550, Recreation Operations and Maintenance Policies; Willamette COP Phase II Ops support to community and watershed councils Federal Lakes “agreement” 2001 Master Plans	Operations can be modified to the extent they continue to minimize extent and duration that each reservoir elevation is over its rule curve, and that river flows are below bank full (as defined) conditions, as balanced to meeting other authorized purposes of the WVP.	Rule curves. Bank full flows. ESA obligations for minimum flows, ramping rates, TDG, and temperature Annual water storage availability. WBR allocations for AI, M&I and FW.

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WATER QUALITY

Management Objectives	Metric(s)	Documentation	Constraints Related to Authority	Other Constraints and Considerations
Provide instream water quality for attainment of State water quality standards as part of balanced operational strategy across authorized purposes Operate to provide flows for ESA-listed fish: • Minimum flow targets • Operate to meet water temperature targets • Operate to meet TDG targets	Daily or seasonal flows, temperature, TDG, turbidity, and algae [locations TBD]	Congressional Authorizations Water Control Manual Willamette COP Phase II Willamette Basin Review draft Feasibility Study and BA CWA - TMDLs	Same as for recreation.	Rule curves Bank full flows Structural configuration of outlets ESA obligations for minimum flows, ramping rates, TDG, and temperature Annual water storage availability WBR allocations for AI, M&I and FW

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WATER SUPPLY

Management Objectives	Metric(s)	Documentation	Constraints Related to Authority	Other Constraints and Considerations
Manage reservoir storage and releases during the conservation season according to allocations defined in the WBR study for AG, M&I and FW water uses	Reservoir storage allocation available annually for Ag, M&I and FW Delivery schedule from each reservoir (timing and volume)	Congressional Authorizations Willamette Basin Review draft Feasibility Study and BA	Same as for recreation WBR will establish allocation for FW and M&I. Changing these allocations will require a Post-Authorization Change.	ESA obligations for minimum flows, ramping rates, TDG, and temperature Annual water storage availability WBR allocations and demand estimates for AI, M&I and FW Current ESA consultation for WBR has a cap on Ag (95,000 AF) and M&I (43,650 AF) uses.

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FISH AND WILDLIFE

Management Objectives	Metric(s)	Documentation	Constraints Related to Authority	Other Constraints and Considerations
Provide fish passage at dams, where authorized, to meet ESA obligations Downstream minimum flows, ramping rates and temperature targets Production and release of hatchery fish to mitigate for lost access to habitat, in accordance with Draft HGMPs Production and release of hatchery fish to supplement natural populations Revetment modifications: increase habitat and restore ecosystem function to benefit fish and wildlife.	Habitat connectivity Fish passage survival Frequency minimum flows, ramping rates and temperature targets met. Fish abundance, distribution, and life history diversity Area of habitat available Number of hatchery fish released annually Number of adult hatchery salmon and steelhead collected at traps annually Number of adult hatchery salmon and steelhead caught in sport and commercial fisheries	Congressional Authorizations Willamette COP Phase II and 5-yr Plan 2008 NMFS and USFWS Biop's 2007 BA Congressional Authorizations Draft Hatchery Genetic Management Plans NMFS EIS for HGMPs	Project-specific authorities for temperature management and fish passage Draft HGMPs include fish conservation production levels as "up to" amounts (i.e production levels can be less that levels specified in the draft HGMPs). Mitigation fish production amount is discretionary	Feasibility of fish passage at high head dams. Operational constraints relating to flood risk reduction and hydropower. Limitations of the partially regulated system on the ability to manage flow and water temperature Limitations of water storage to meet downstream demands for FW, AI, and M&I, etc. Crediting approach for addressing original mitigation need not established, and agreed to among stakeholders.

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Measures

The building blocks of alternatives.

Measures

A feature or an activity that addresses one or more objectives.

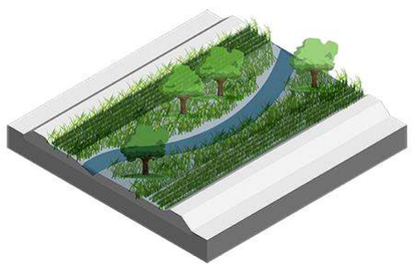
- Type
  - **Structural feature:** requires construction or assemble on-site.

Example:

Flood Risk Management/ Ecosystem Restoration Multipurpose Project

Structural Measures:

Set Back Levees



Detention Ponds



Restore Wetlands



Measures

A feature or an activity that addresses one or more objectives.

- Type
  - **Non-structure activity** such as an change in operation, a policy, practice or (a different) way of doing something or managing resources that does not require construction but has a measurable impact

Example:

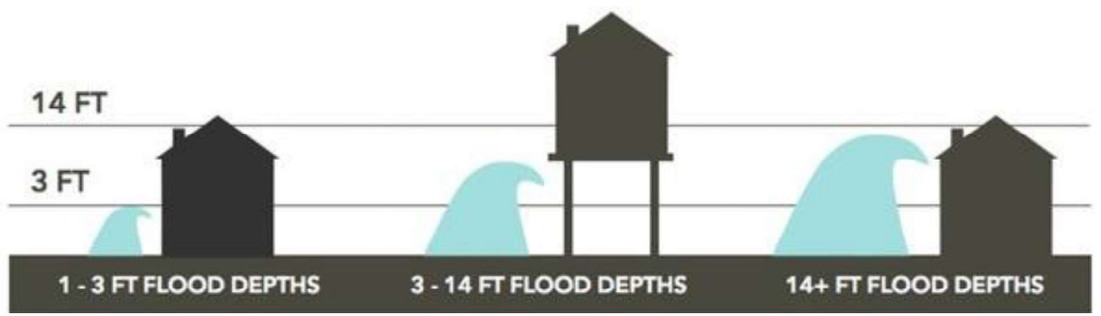
Flood Risk Management/ Ecosystem Restoration Multipurpose Project

Non-structural Measures:

Dam Operations



Flood Proofing | Elevate Structures | Voluntary Acquisition

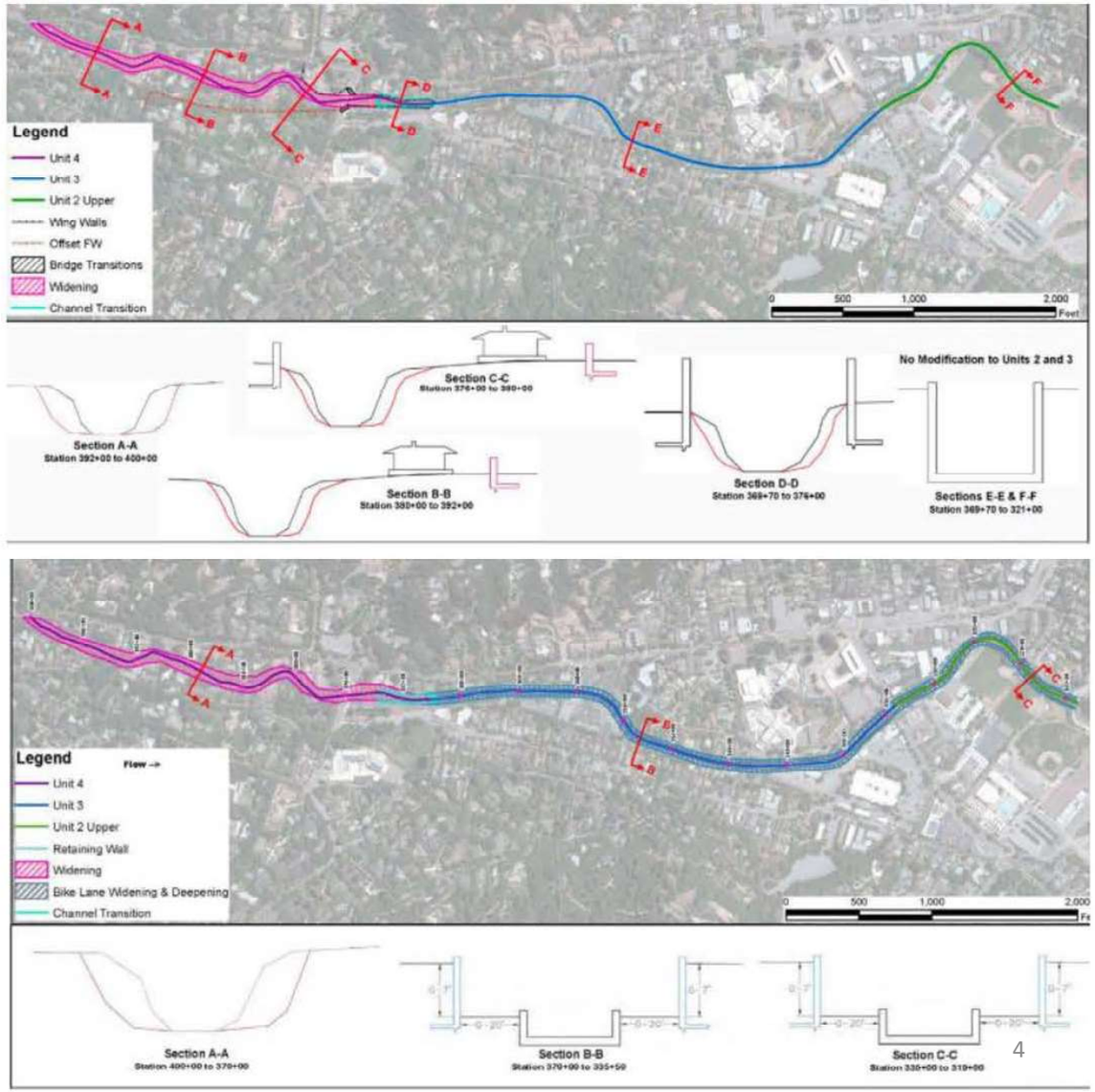


3

Measures

A feature or an activity that addresses one or more objectives.

- Location: can be implemented at one or more geographic sites.
  - i.e. widening can be proposed at a single site or at multiple



Measures

A feature or an activity that addresses one or more objectives.

- Temporal: If an activity may happen at a specific time and/or over a specific duration.
  - Different operational durations, levels, or frequency (a onetime occurrence, a periodic occurrence, or an ongoing process)
- Dimension: can come in different sizes, scales, designs or materials. Examples:
  - Different wetland restoration footprints
  - Different intensities of plantings (12 in centers vs 9 in centers)
  - Different dredging depths
  - Different revetment materials
  - Interior drainage can be handled by many different combinations of interior ponding area (storage) and pump station size.

Example Measures

Objective 1: Reduce flood damages in riverside communities

- Measure 1: Levees
- Measure 2: Floodwalls
- Measure 3: Bridge modifications
- **Measure 4: Change operations of Reservoirs**
- Measure 5: River diversion
- Measure 6: River Dredging
- Measure 7: Island removal
- Measure 8: Channel modifications
- Measure 9: Flood warning and preparedness
- **Measure 10: Buy outs of flood prone properties**
- Measure 11: Flood-proofing
- Measure 12: Flood insurance

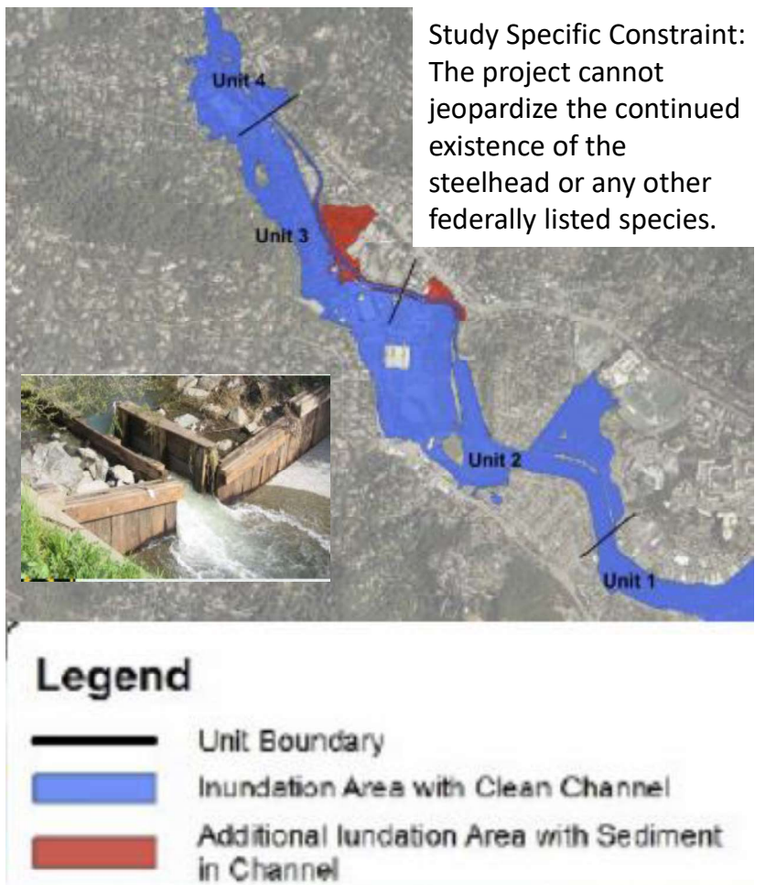
Objective 2: Maintain or increase the quantity and/or quality of fish and wildlife habitat in protected area

- **Measure 4: Change operations of Reservoirs**
- **Measure 10: Buy outs of flood prone properties**
- Measure 11: Create bird islands
- Measure 12: Mitigate acid mine drainage into Big River
- Measure 13: Construct fish channels on Big River tributaries
- Measure 14: Construct duck boxes
- Measure 15: Construct watering holes
- Measure 16: Restore Wetlands

Measures Exercise

Example FRM Project Objectives:

1. Reduce likelihood and consequence of flooding to human life and safety
2. Reduce flood damages including to critical infrastructure
3. Implement environmentally sustainable FRM features consistent with natural geomorphic processed and ecological function



Study Specific Constraint: The project cannot jeopardize the continued existence of the steelhead or any other federally listed species.

In your groups, take 7 minutes to come up with a list of measures for meeting one of the project objectives.

Write out the measures on butcher block and be prepared to report to class what measures were selected and why?

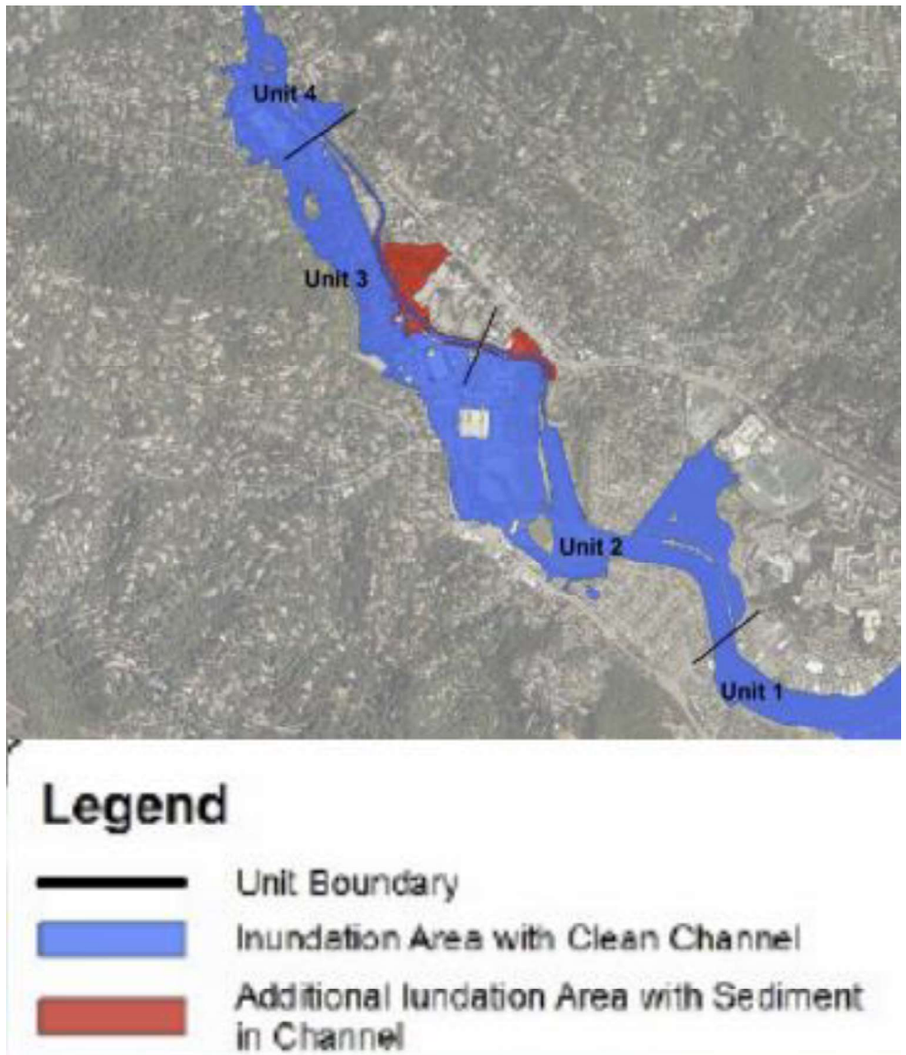
Alternatives

A set of one or more measures functioning together to address one or more objectives.

Alternatives

formulated to alleviate specific problems or take advantage of specific opportunities through a combination of

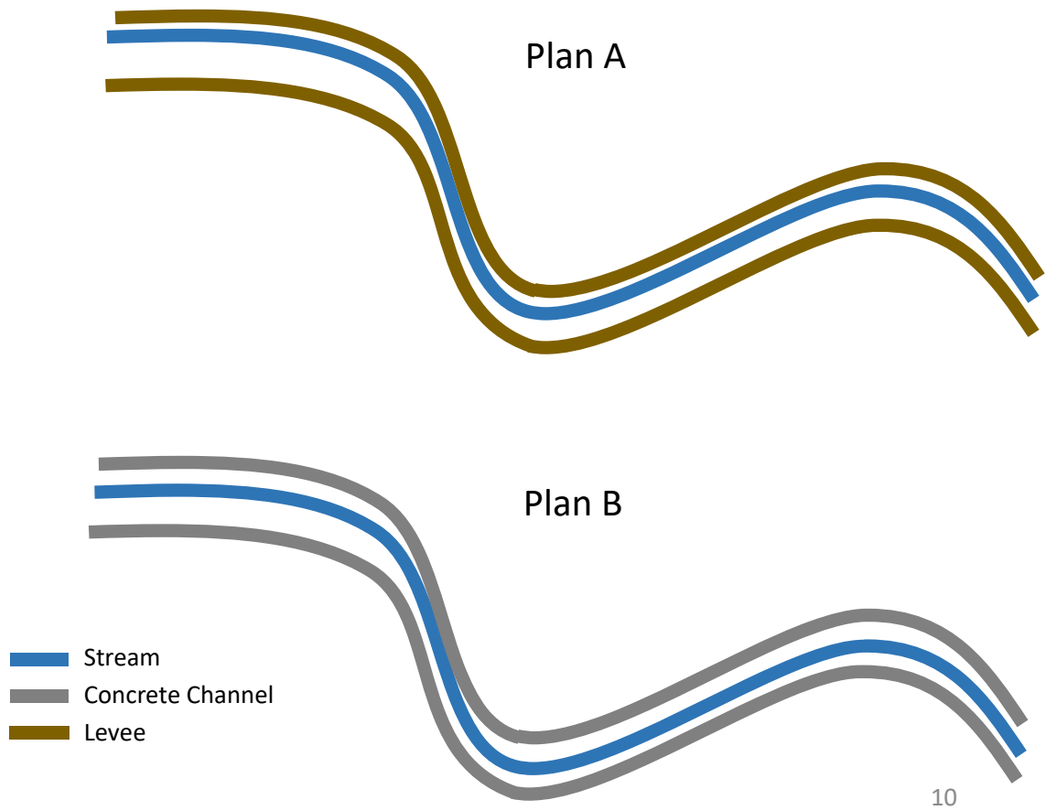
- measures,
- strategies, or
- programs



Formulating Alternatives

Alternatives should be significantly differentiated from each other.

- Different plans have different measures or

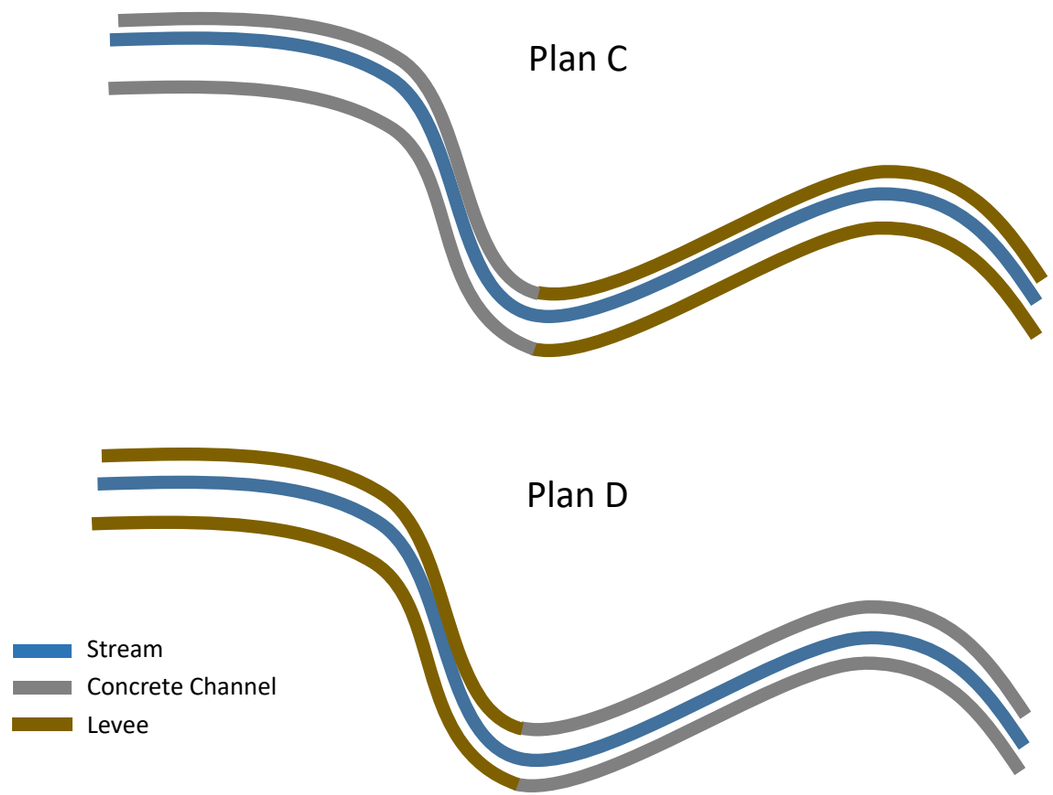


Formulating Alternatives

Alternatives should be significantly differentiated from each other.

- Different plans have different measures or
- Different plans combine the same measures in significantly different ways.

- Appropriate mitigation of adverse effects should be an integral component of each alternative.



Strategies for formulating Alternatives

more art than science

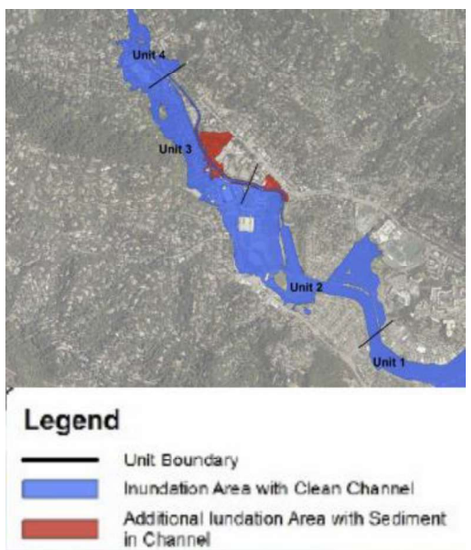
- **All Combinations**: Make every possible combination of the measures you identified a separate alternatives accounting for the dependence and mutual exclusiveness of measures

- **Single purpose**: formulating alternative to meet one objective, e.g., an ecosystem plan, a flood risk management plan, a recreation plan etc. (may leave out alternatives that contribute to multiple or all the objectives)

Strategies for formulating Alternatives

more art than science

- **Themed Strategy**: Add measures that provide something for every stakeholder or that craft specific sorts of plans like the sustainability plan or the recreation plan.



10 Alternatives developed from following Themes:

- previous work,
- increasing conveyance,
- detention,
- non-structural,
- environmentally preferred, and
- hybrids of these strategies

Strategies for formulating Alternatives

more art than science

- **Cornerstone Strategy**: Choose single most important measure as the cornerstone and add measures to meet the objectives not served by the cornerstone.
  - i.e. If flood risk management is essential and a change in dam operations does that best, then you have your cornerstone.

- **The Ideal Scenario Strategy:** What does an ideal future for the study area look like? What would complete success look like? What has to happen to make this future a reality? What are the different ways one could make this future a reality?

Strategies for formulating Alternatives

more art than science

- **Something for Everybody Strategy** (stakeholder-driven planning)**:** Formulate an alternative for each stakeholder group. This could lead to a central business district plan, a recreation plan, a fisheries plan, an urban ecosystem restoration plan, and so on, depending on the stakeholders. Now find ways to integrate these plans. Shoot for at least one plan that ensures that each stakeholder group finds some element of interest to them. Then, see if you can do it again.

Strategies for formulating Alternatives

more art than science

- **Mutation Strategy:** If you have one decent alternative, mutate it in as many ways as possible. Pick a word and change your plan in a way that satisfies that word.
  - Word examples include: subtract, add, transfer, empathize, animate, superimpose, change, scale, substitute, fragment, isolate, distort, disguise, contradict, parody, prevaricate, analogize, hybridize, metamorphosis, symbolize, mythologize, fantasize, repeat, combine, and so on.

Appropriate mitigation of adverse effects should be an integral component of each alternative.

Extras

Measures - Combinability

Allows us to mix and match measures into different alternatives

- Some measures that are not mutually exclusive are combinable.
- Some measures may preclude others based on location, function, or overlapping.
  - Location: when two different measures can't occupy the same physical space at the same time.
    - Example: building a floodwall AND a levee to reduce flooding at a single site.
  - Function: when two different measures may work against one another.
    - Example: building a retaining dike to hold water at a site AND installing drains to speed the removal of water from the site.
  - Overlapping: limits combinability if one measure is actually a smaller scale, a subset, or an intersection of another measure.
    - Example: you could not combine a 4-acre wetland with a 5-acre wetland to produce a 9-acre wetland if the two wetlands overlap each other.

Measures – Pairwise Combinability Matrix

Measure	Measure 1	Measure 2	Measure 3	Measure 4	Measure 5	Measure 6	Measure 7	Measure 8	Measure 9	Measure 10	Measure 11	Measure 12	Measure 13	Measure 14	Measure 15	Measure 16	Measure 17	Measure 18	Measure 19	Measure 20	Measure 21	Measure 22
1: Levees	NA	NO	YES	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
2: Floodwalls		NA	YES	NO	NO	NO	YES	NO	YES	NO	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
3: Bridge modifications			NA	NO	NO	YES	YES	YES	YES	NO	YES	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
4: Reservoirs				NA	NO	NO	NO	NO	YES	NO	NO	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	NO
5: River diversion					NA	NO	NO	NO	YES	NO	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	NO
6: River dredging						NA	YES	NO	YES	NO	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES
7: Island removal							NA	YES	YES	NO	YES	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	NO
8: Channel modification								NA	YES	NO	NO	YES	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES
9: Flood forecast anf warning									NA	NO	YES	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
10: Evacuation protected are										NA	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
11: Flood proofing & nonstructural protected area											NA	YES	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
12: Flood insurance												NA	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
13: Levees induced area													NA	NO	NO	NO	YES	YES	YES	YES	YES	YES
14: Floodwalls induced area														NA	NO	NO	YES	YES	YES	YES	YES	YES
15: Evacuation induced area															NA	NO	YES	YES	YES	YES	YES	YES
16: Flood proofing & nonstructural induced area																NA	YES	YES	YES	YES	YES	YES
17: Bird islands																	NA	YES	YES	YES	YES	NO
18: Acid mine drainage migration																		NA	YES	YES	YES	YES
19: Fish channels on tributaries																			NA	YES	YES	YES
20: Duck boxes																				NA	YES	YES
21: Watering holes																					NA	YES
22: Wetlands restoration																						NA

Measures - Dependencies

Recognizing dependency relationships among management measures can assist in screening out plans that are not feasible because they fail to meet dependency requirements.

- One measure may be necessary to the function of another measure.
  - Example: the survival of willow tree plantings may be dependent upon an irrigation system. Without irrigation, the plants will die. In this case, irrigation is necessary for the willows to function.
- Serve to reduce risk or uncertainty in project performance.
  - Example: Although a flood forecast and warning system may function on its own, paired with an automated telephone notification system for flood plain properties reduces the risk that a property owner will not hear a flood warning. The success of the forecast and warning system is to an extent dependent on the automated telephone notification system and vice versa.
- Improve project performance.
  - Example: Improving the growth rate of willow plantings by fertilizing them. The fertilizer is not necessary for the plants to function, nor will it reduce any risks or uncertainties of survival. However, it will improve the willows‘ performance by producing more mature trees faster.

2.2 Measures Development Charette Day 2, December 5, 2018

U.S. Army Corps of Engineers, Portland District

Willamette Valley System Operations EIS and ESA Consultation

Measures Development Charette (4 & 6 December 2018)

AGENDA

A charette is a structured, collaborative session in which a group comes together to develop a solution to a problem.

Location:

East Atrium 3rd Floor

Purpose: To gather team members from Portland District to advance the Willamette Valley System Operation and Maintenance Environmental Impact Statement.

Objectives:

- Achieve a common understanding of the Willamette EIS purpose and needs, objectives and constraints.
- Identify robust initial list of measures to address Willamette EIS objectives and opportunities.
- Draft screening criteria upon which to complete future evaluation of measures and alternatives.
- Provide training on organizing measures into alternatives.

Please bring: Paper, pen land/or pencil, coffee cup, and snacks to keep you energized.

Agenda: Please see the following pages.

Willamette Valley Charette Agenda

<u>Day 2</u>: Thursday, 6 December 2018

INTENDED OUTCOMES FOR DAY 2:

1) **Develop Conceptual Measures into Full Measures.**
2) **Identify next steps for the PDT on this study.**

TIME	DURATION	ACTION	WHO
0830 – 0845	15 minutes	Guest Speaker	Welcome
0845 – 0900	15 minutes	Housekeeping Logistics REVIEW DAY 2 Introductions (name, program area, expertise, a hobby)	Suzy Hill & Tanis Toland, Facilitator
0915 - 0930	15 minutes	PRESENTATION: Measures Review & Alternatives Development	Kelly Janes
0930 – 1000	30 minutes	ACTIVITY: Develop Measures – Introduction & Dot Voting	Tanis Toland, Facilitator
1000 – 1230	2 hrs 30 min	**BREAK (Town Hall & Lunch)**	
1230 – 1430	2 hours	ACTIVITY: Develop Measures	Tanis Toland, Facilitator
1430 – 1445	15 minutes	**BREAK**	
1445 – 1515	30 minutes	ACTIVITY: Small Groups wrap-up measures development and prepare for report out.	Tanis Toland, Facilitator
1515 – 1545	30 minutes	PRESENTATIONS: Small Group Reports	Spokesperson for each Small Group
1545 – 1615	30 minutes	ACTIVITY: Identify next steps and key information needs	Tanis Toland, Facilitator
1615 – 1630	15 minutes	Wrap-up – Charette outcomes	Suzy Hill, NEPA TL; Mike Turaski, Project Manager

2.3 Mini-charette, January 14, 2019

U.S. Army Corps of Engineers, Portland District

Willamette Valley System Operations EIS and ESA Consultation

Measures Development Mini-Charrette
14 January 2019

AGENDA

A charette is a structured, collaborative session in which a group comes together to develop a solution to a problem.

Location:

Eugene Federal Building

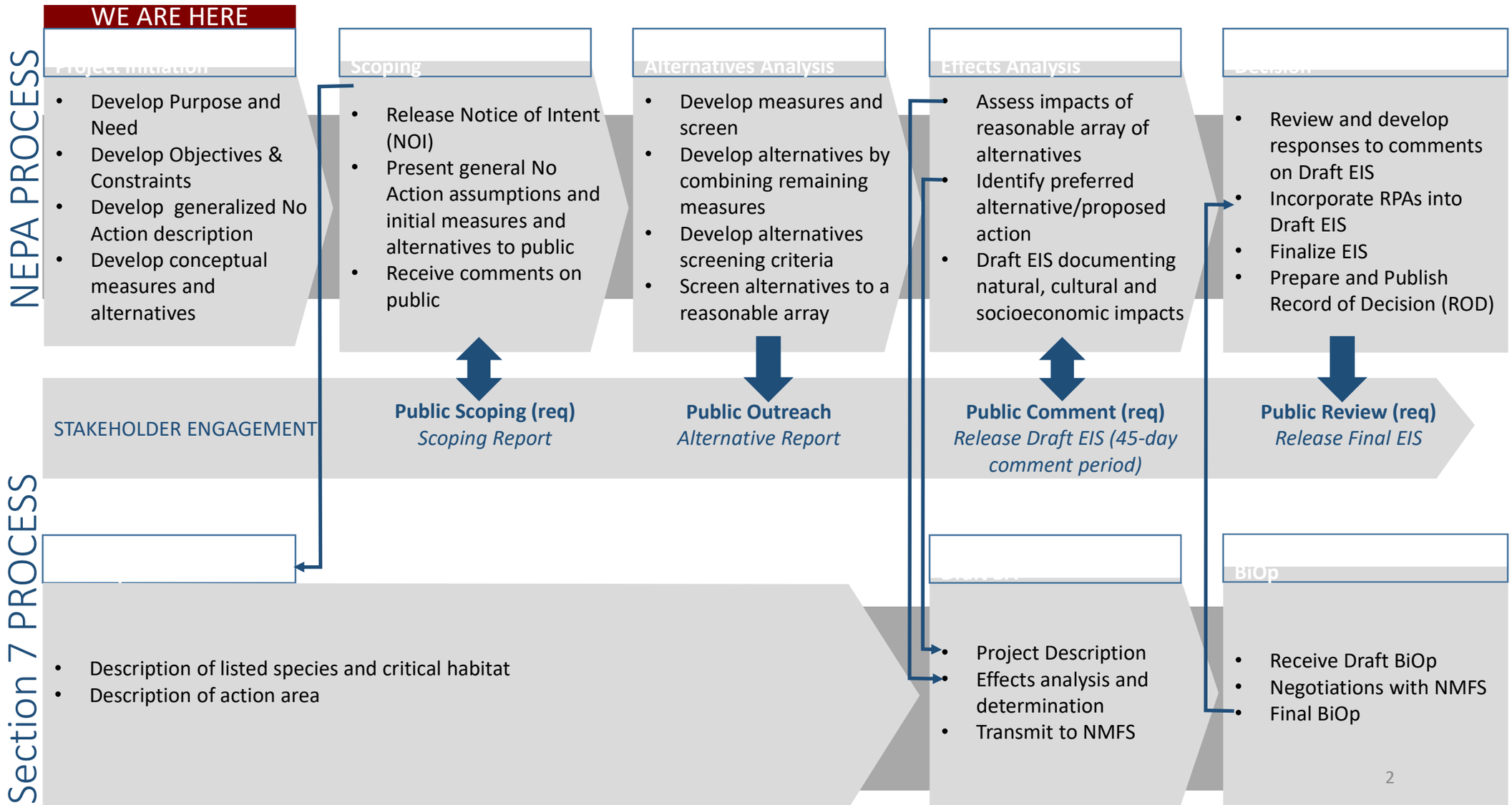
Purpose: To gather team members from the **Willamette Valley System Operations** to advance the Willamette Valley System Operation and Maintenance Environmental Impact Statement.

Objectives:

- Identify robust initial list of measures to address Willamette EIS objectives and opportunities with a focus on Maintenance Measures (regular and infrequent) and Recreation Measures.
- Identify next steps for the PDT on this study.

TIME	DURATION	ACTION	WHO
1230 – 1240	10 minutes	Welcome and Agenda Overview	Suzy Hill, NEPA TL; Mike Turaski, Project Manager
1240 – 1250	10 minutes	PRESENTATION: NEPA/ESA Process Overview, Where the PDT is in the Process, & meeting Charge	Kelly Janes
1250 - 1320	30 minutes	ACTIVITY: Small Groups wrap-up measures development and prepare for report out.	Everyone
1320 - 1335	15 minutes	PRESENTATIONS: Small Group Reports	Spokesperson for each Small Group
1335 – 1345	10 minutes	**BREAK**	
1345 – 1400	15 minutes	ACTIVITY: Further develop Maintenance Measures	Kelly Janes, Facilitator
1400 – 1415	15 minutes	ACTIVITY: Further develop Recreation Measures	Kelly Janes, Facilitator
1415 – 1500	45 minutes	ACTIVITY: Discuss/Develop Water Management Measures for any objective	Kelly Janes, Facilitator
1500 – 1530	30 minutes	ACTIVITY: Identify next steps and key information needs	Kelly Janes, Facilitator

Process Overview


WE ARE HERE
NEPA PROCESS
Project Initiation
Develop Purpose and Need
Develop Objectives & Constraints
Develop generalized No Action description
Develop conceptual measures and alternatives
Scoping
Release Notice of Intent (NOI)
Present general No Action assumptions and initial measures and alternatives to public
Receive comments on public
Alternatives Analysis
Develop measures and screen
Develop alternatives by combining remaining measures
Develop alternatives screening criteria
Screen alternatives to a reasonable array
Effects Analysis
Assess impacts of reasonable array of alternatives
Identify preferred alternative/proposed action
Draft EIS documenting natural, cultural and socioeconomic impacts
Decision
Review and develop responses to comments on Draft EIS
Incorporate RPAs into Draft EIS
Finalize EIS
Prepare and Publish Record of Decision (ROD)
STAKEHOLDER ENGAGEMENT
Public Scoping (req)
Scoping Report
Public Outreach
Alternative Report
Public Comment (req)
Release Draft EIS (45-day comment period)
Public Review (req)
Release Final EIS
Section 7 PROCESS
Description of listed species and critical habitat
Description of action area
Project Description
Effects analysis and determination
Transmit to NMFS
BiOp
Receive Draft BiOp
Negotiations with NMFS
Final BiOp
2

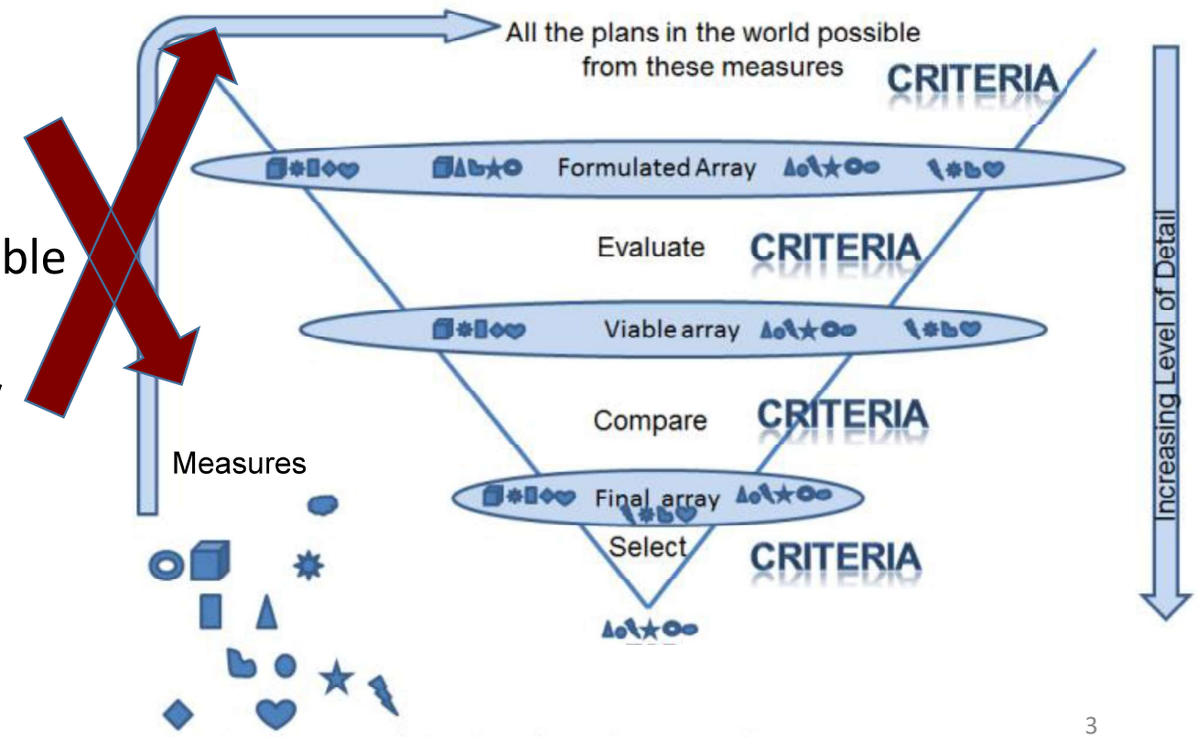
Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

Alternative Formulation Process 101

The process of building alternative alternatives from remaining measures that meet your objectives without violating your constraints. Each objective should be addressed by at least one alternative

General Steps

1. Develop as many measures as possible
2. Screen out those that are infeasible or don't meet P&N
3. Combine measures into as many alternatives as possible
4. Develop screening criteria
5. Screen alternatives
6. Iterate where needed



3

Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

Measures Screening

sneak peek for day 1 & 2 activities

Formulation (*today's activity*)

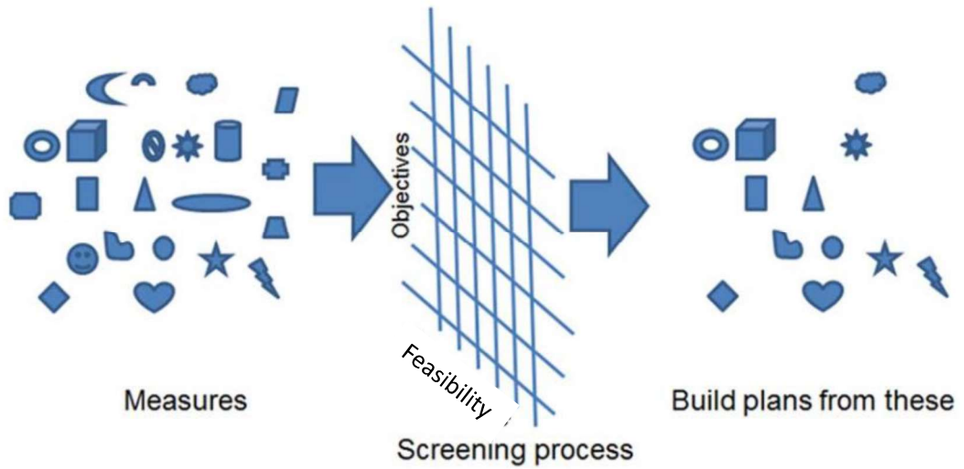
- Brainstorm as many measures as possible that meet one or more objectives.

Initial Screening

- Reality check - eliminates measures that do not have a realistic chance of being designed and built.

Comparative Screening

- Detailed look at measures to determine if some were clearly better than others.
- A qualitative (good/better/best) approach to categorize how measures meet the various objectives and identify which more effectively meet the purpose and need

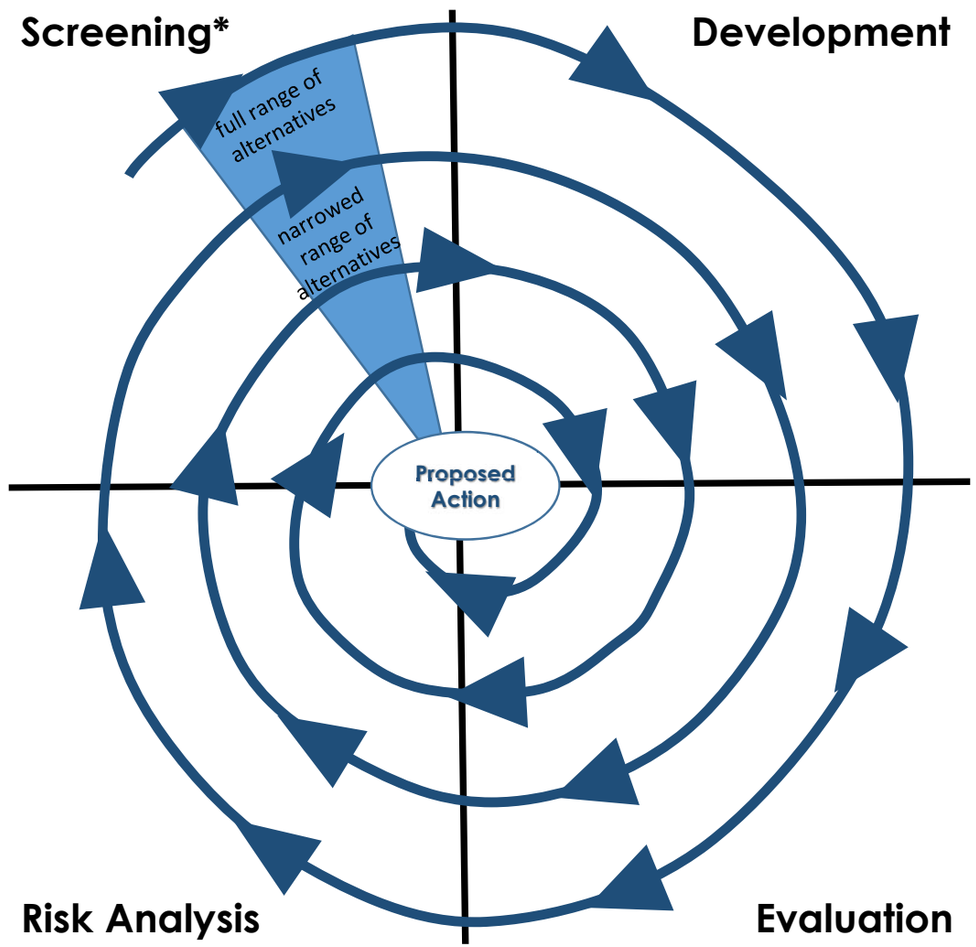


Objective 1	Objective 2	Objective 3	Objective 4	Objective 5
Plan	Measures			
A				
B				
C				
D				

4

Iterative Risk Informed Decision Making

- To iterate is to repeat, elaborate, refine, correct, or complete a part of the decision making process.
- The entire decision making process, a single step in the process, or any portion of the process can be iterated.
  - Early iterations tend to emphasize problems; later iterations emphasize solutions.
  - The level of detail is usually the primary difference for iterations of a single step.
- Used to reduce uncertainty with each iteration.
  - Uncertainty could increase or decrease with new information; you learn as you alternative.
  - As more information becomes available, your understanding improves, and it is often necessary to go back over something to make it better.



* Decision to further consider, reformulate, or drop from further consideration.

EIS Purpose and Need

To continue operations and maintenance of the Willamette Valley System in accordance with authorized project purposes; while meeting Endangered Species Act obligations.

3 Endangered Species Act (ESA)

3.1 Re-initiation of ESA Consultation with National Marine Fisheries Service (NMFS)

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND OR 97208-2946

APR 0 9 2018

CENWP-PME

Subject: Reinitiation of Consultation on the 2008 Endangered Species Act Section 7(a)(2) Consultation Biological Opinion and Magnuson-Stevens Fishery Conservation & Management Act Essential Fish Habitat Consultation for the Willamette River Basin Flood Control Project

Kim Kratz
Assistant Regional Administrator
NOAA National Marine Fisheries Service
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232

Dear Dr. Kratz,

Per the regulations set forth in 50 C.F.R. § 402.16, the U.S. Army Corps of Engineers (Corps) requests reinitiation of formal consultation under Section 7 of the Endangered Species Act (ESA) (16 U.S.C. § 1536) on the 2008 Biological Opinion and Magnuson-Stevens Fishery Conservation & Management Act Essential Fish Habitat Consultation for the Willamette River Basin Flood Control Project. Corps staff will work with our fellow Action Agencies and National Marine Fisheries Service staff to develop a schedule for submission of a revised Biological Assessment and issuance of a new Biological Opinion (BiOp) as soon as possible. During the pendency of this reinitiated consultation, the Corps will continue to implement actions contained in the 2008 BiOp's Reasonable and Prudent Alternative (RPA) that will benefit the ESA-listed fish species. We look forward to working with you during this process, and are open to considering measures designed for the protection of ESA-listed fish species, provided those actions are within the Corps' authority.

If you have any questions or need additional information, please contact me at Joyce.E.Casey@usace.army.mil or (503) 808-4760.

Sincerely,

Joyce E. Casey

Joyce E. Casey
Chief, Environmental Resources Branch

4 Fish and Wildlife Coordination Act (FWCA)

4.1 Initiation of FWCA coordination with NMFS

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

SUBJECT: Initiation of Coordination under Fish and Wildlife Coordination Act

Dr. Kim Kratz
Assistant Regional Administrator
National Marine Fisheries Service
1201 NE Lloyd Blvd., Suite 1100
Portland, OR 97232-2182

Dear Dr. Kratz:

The U.S. Army Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) to analyze the effects of the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with the authorized project purposes; while meeting Endangered Species Act (ESA) obligations to avoid jeopardizing the continued existence of listed species. The Willamette Valley Project was initially authorized by the Flood Control Act of 1938 as set for in HD 544, Seventy-fifth Congress, third session. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects (revetments), and hatchery mitigation programs in the Willamette River Basin in Oregon. The 13 multipurpose dams and reservoirs are found within the North Santiam River subbasin, South Santiam River subbasin, McKenzie River subbasin, Middle Fork Willamette River subbasin, Coast Fork Willamette River subbasin, and the Long Tom River subbasin.

The Corps has identified the need for the preparation of the WVS EIS due to; modifications to operations and structural improvements made since the previous EIS (1980), new information that is available on the environmental effects of operating and maintaining the WVS, and a large amount of new information regarding ESA listed species in the Willamette since the 2008 Willamette Valley System Biological Opinions.

The Corps has determined the proposed action resulting from the EIS, and related Section 7 consultations under the ESA, will result in a modification to a water resource development project, the WVS. As such, the purpose of this letter is to formally request coordination under the Fish and Wildlife Coordination Act with the U.S. Fish and Wildlife Service (Service) in accordance with the *Agreement Between the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers for Conducting Fish and Wildlife Coordination Act Activities* dated January 22, 2003.

Based upon our initial assessment of magnitude and scope of the proposed action, the Corps respectfully requests the Service to provide a Planning Aid Letter (PAL). The Corps may transfer funds in support of the Service's work related to the FWCA including

the preparation of fish and wildlife conservation recommendations and the PAL. You are requested to review the enclosed Scope of Work (Enclosure) for activities related to the FWCA and provide time and cost estimates for the Service's work.

If you require further information regarding this project, please contact David Griffith at the letterhead address, by telephone at (503) 808-4773 , or David.W.Griffith@usace.army.mil. Thank you for your assistance and attention to this matter.

Sincerely,



Christopher Page
Chief, Environmental Resources Branch

Enclosure

cc: Kate Wells (kathleen.wells@noaa.gov), Willamette Branch Chief

4.2 Initiation of FWCA Coordination with FWS

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND, OR 97208-2946

Environmental Resources Branch

SUBJECT: Initiation of Coordination under Fish and Wildlife Coordination Act

Paul Henson, Ph.D.
US Fish and Wildlife Service
Oregon State Office
2600 SE 98th Avenue Suite 100
Portland, Oregon 97266-1325

Dear Dr. Henson:

The U.S. Army Corps of Engineers (Corps) is preparing an Environmental Impact Statement (EIS) to analyze the effects of the continued operations and maintenance of the Willamette Valley System (WVS) in accordance with the authorized project purposes; while meeting Endangered Species Act (ESA) obligations to avoid jeopardizing the continued existence of listed species. The Willamette Valley Project was initially authorized by the Flood Control Act of 1938 as set for in HD 544, Seventy-fifth Congress, third session. The WVS consists of 13 multipurpose dams and reservoirs, riverbank protection projects (revetments), and hatchery mitigation programs in the Willamette River Basin in Oregon. The 13 multipurpose dams and reservoirs are found within the North Santiam River subbasin, South Santiam River subbasin, McKenzie River subbasin, Middle Fork Willamette River subbasin, Coast Fork Willamette River subbasin, and the Long Tom River subbasin.

The Corps has identified the need for the preparation of the WVS EIS due to; modifications to operations and structural improvements made since the previous EIS (1980), new information that is available on the environmental effects of operating and maintaining the WVS, and a large amount of new information regarding ESA listed species in the Willamette, since the 2008 Willamette Valley System Biological Opinions.

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Based upon our initial assessment of magnitude and scope of the proposed action, the Corps respectfully requests the Service to provide a Fish and Wildlife Coordination

Act Report (CAR). The Corps would transfer funds in support of the Service's work related to the FWCA including the preparation of fish and wildlife conservation recommendations and the CAR. You are requested to review the enclosed Scope of Work (Enclosure) for activities related to the FWCA and provide time and cost estimates for the Service's work.

If you require further information regarding this project, please contact Garrett Dorsey at the letterhead address, by telephone at (503) 808-4773 , or David.W.Griffith@usace.army.mil. Thank you for your assistance and attention to this matter.

Sincerely,



Christopher Page
Chief, Environmental Resources Branch

Enclosure

cc:
Chris Allen (chris_allen@fws.gov)

4.3 FWS Coordination Act Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE
911 NE 11th Avenue
Portland, Oregon 97232-4181

In Reply Refer to:
FWS/R1/ES/OFWO

Amy Gibbons
Environmental Resource Branch Chief
U. S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Subject: Completion of the Requested Fish and Wildlife Coordination Act Report for the Willamette River Basin Flood Control Project

Dear Ms. Gibbons:

In accordance with the Scope of Work from September 1, 2021, the U.S. Fish and Wildlife Service (Service) Oregon Fish and Wildlife Office and Columbia River Fish and Wildlife Conservation Office completed the enclosed Fish and Wildlife Coordination Act 2(b) Report (Report) for the Willamette Valley System (WVS) Project. The U.S. Army Corps of Engineers (Corps) initially requested this report on March 30, 2021, and a formal agreement between our agencies was signed on August 25, 2021. The Service provided the Corps a draft Report on May 24, 2022. The Service understands that the Report will be included in the appendix to a supplemental EIS, an amendment to the WVS Operations and Maintenance Environmental Impact Statement (EIS), published April 11, 2025.

This Report is the culmination of work across Service programs, and it documents the impacts of the WVS EIS alternatives (the No Action Alternative, five Alternatives, and two Sub-alternatives) on fish and wildlife species and their habitats. The Report also includes conservation recommendations that would benefit species and habitats impacted by each alternative. Both the analysis and conservation recommendations described in the Report were informed by input from local and species experts across the Willamette River Basin. The findings and recommendations of the final report are largely consistent with the draft report. This report has been updated from comments received from species and area experts during review of the draft, and for consistency with changes to alternatives, measures, and interim operations in the final EIS.

As stated in Chapter 6 of the Report, the Service envisions our recommendations to be an invitation to the Corps and its partners to further discuss and collaboratively develop solutions to reduce and minimize ongoing effects of the WVS and promote conservation in the Willamette basin. We greatly appreciate the Corps WVS project biologists that assisted in preparation of this

Report through engagement in meetings and workshops, review of early drafts, and provision of technical information.

We appreciate the opportunity to conduct this important work for the Corps and provide information for inclusion in the EIS. If you have any questions regarding the enclosed Report, please contact Brian Bangs, Fish and Wildlife Biologist with the Oregon Fish and Wildlife Office, by phone (541-908-1538) or email Brian_Bangs@fws.gov.

Sincerely,

Jared Bottcher
Acting Assistant Regional Director, Ecological Services

Enclosure: Fish and Wildlife Coordination Act Section 2(B) Report on the Willamette River Basin Flood Control Project

Cc: Mullan (NMFS)

FISH AND WILDLIFE COORDINATION ACT SECTION 2(B) REPORT

ON THE

WILLAMETTE RIVER BASIN FLOOD CONTROL PROJECT

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS – PORTLAND DISTRICT

PREPARED BY:

U.S. FISH AND WILDLIFE SERVICE – PACIFIC REGION

Oregon Fish and Wildlife Office, Portland, OR

Columbia River Fish and Wildlife Conservation Office, Vancouver, WA

APRIL 18, 2025

ACRONYMS AND ABBREVIATIONS

A1	Alternative 1
A2a	Alternative 2a
A2b	Alternative 2b
A3a	Alternative 3a
A3b	Alternative 3b
A4	Alternative 4
A5	Alternative 5
AFF	Adult Fish Facility
Basin	Willamette River Basin
BLM	Bureau of Land Management
BO	Biological Opinion
BPA	Bonneville Power Administration
CEC	Secretariat of the Commission for Environmental Cooperation
Corps or USACE	U.S. Army Corps of Engineers
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	The Clean Water Act
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
FWCA	Fish and Wildlife Coordination Act
FWCAR or Report	Fish and Wildlife Coordination Act Section 2(b) Report
GIS	Geographic Information System
IRCT	Interior Redband Conservation Team
LTW	Lamprey Technical Workgroup
LW	Large Wood
NAA	No Action Alternative
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
O&M	Operations and Maintenance
ODFW	Oregon Department of Fish and Wildlife
ORBIC	Oregon Biological Information Center
OSU	Oregon State University
RO	Regulating Outlet
ROD	Record of Decision
SOW	Scope of Work
SWIFT	Science of Willamette Instream Flows Team

TDG	Total Dissolved Gas
USDA	U.S. Department of Agriculture
USFWS or Service	U.S. Fish and Wildlife Service
UWR	Upper Willamette River
WAFWA	Western Association of Fish and Wildlife Agencies
WGA	Western Governers' Association
WVS	Willamette Valley System

MEASUREMENT ABBREVIATIONS

C	Celsius
cm	centimeter
ft	feet
km	kilometer
km2	square kilometer
m	meter
m3	cubic meter
m/s	meter per second
m3/s	cubic meter per second
RKM	river kilometers
RM	river miles

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (Corps) operates the 13 Federal projects that comprise the Willamette River Basin Flood Control Project's Willamette Valley System (WVS) to serve authorized project purposes including flood control, irrigation, water supply, navigation, flow augmentation, hydroelectric power generation, recreation, and fish and wildlife resource conservation (Corps, 2000, pp. 2.6 - 2.20).

Operation of the WVS has negatively impacted important ecological and physical processes (e.g., water flow, nutrient cycling, and natural disturbance) that maintain habitat structure and function to support ecologically, socioeconomically, and culturally valuable fish and wildlife resources throughout the Willamette River Basin (Basin). Impacts to fish, wildlife, and plant species listed as threatened and endangered under the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. § 1531 et. seq.), have been well-documented in past Biological Opinions written by the National Marine Fisheries Service (NMFS) (NMFS, 2008) and the U.S. Fish and Wildlife Service (Service) (USFWS, 2008). For many years, the Corps has implemented conservation measures to protect, mitigate, and enhance fish and wildlife resources affected by project operations. However, the WVS will continue to negatively impact fish, wildlife, and plant resources in the Basin, even with ongoing conservation measures in place.

This Fish and Wildlife Coordination Act Report (FWCAR) focuses on identifying impacts and providing conservation recommendations for fish, wildlife, and plant resources affected by current operations and the alternatives identified in the Corps public scoping process for the draft Environmental Impact Statement (DEIS) (Corps, 2022) and final Environmental Impact Statement (EIS) for the WVS (Corps, 2025). The Service considered the No Action Alternative (NAA) (i.e., current operations), five Alternatives, and two Sub-alternatives (Section 1.2.1) (Corps, 2025). In development of this FWCAR, the Service coordinated with Federal, State, Tribal, and local entities to collect relevant data to assess ecological impacts of current and future operations of the WVS. This FWCAR includes the Service's evaluation of the potential short-term and long-term, and positive and negative impacts of the alternatives on the overall health of habitats (riverine/reservoir, wetland/off-channel, riparian, upland, and prairie) in the Study Area (Section 4 and Appendix B). The Service used indicators of ecological and physical processes that support the overall ecological and physical health of these habitats and the key conservation issues for evaluating species found within them to guide the analysis of overall impacts to fish, wildlife, and plant resources (Section 5). This report includes summary tables (Tables 9, 10, 11, 12, and 13) of projected trends for the proposed measures that support water quality, flow, upstream and downstream passage, and basin-wide improvements under all alternative scenarios and a narrative that describes the impacts of dam-related structural and operational measures associated with each alternative (Appendix G).

The Service concludes that all alternatives, including the NAA, will negatively impact the overall health of habitats present within the Study Area, although the impacts vary between alternatives. Thus, each of the alternatives will also continue to negatively impact fish, wildlife, and plant resources that depend on these habitats. For instance, the Service identified primarily decreasing trends in the overall health of riverine, off-channel, wetland, riparian, and prairie habitats in the Study Area under the NAA. Most habitats are likely to experience further decreasing trends in overall health under Alternatives 1, 2a, 2b, 3a, 3b, and 5. While no alternative was projected to be wholly beneficial to fish, wildlife, and plant resources, measures associated with Alternatives 4 could slow decreasing trends in overall health compared to the NAA or even reverse decreasing trends in overall health in some habitats.

To enhance the resiliency of ecological and physical processes and fish, wildlife, and plant resources negatively impacted by the WVS, the Service recommends the Corps implement additional conservation measures that will likely result in increasing trends in the overall health of habitats. With this FWCAR, the Service shares with the Corps a list of conservation recommendations that identify measurable actions to avoid, minimize, or mitigate negative impacts of the alternatives on fish, wildlife, and plant resources (Section 6). Many of these proposed conservation recommendations address specific components or measures of the Alternatives presented by the Corps for the DEIS and EIS. We grouped these conservation recommendations into six general and seven species-specific categories in this FWCAR according to the following objectives:

- General conservation recommendations include:
    - restore or mimic critical components of natural hydrological systems;
    - increase habitat connectivity and improve fish passage;
    - maintain or enhance habitat complexity and heterogeneity;
    - maintain functionality of National Wildlife Refuges (NWRs) affected by WVS operations;
    - reduce the spread of invasive species, and prevent future non-native invasions,
    - support long-term monitoring and adaptive management approaches to future management;
    - annual reporting
- Species-specific conservation recommendations are directed toward:
    - coastal cutthroat trout and western ridged mussels in riverine/reservoir habitats;
    - northern red-legged frog and Pacific lamprey in off-channel/wetland habitats;
    - foothill yellow-legged frog and northwestern pond turtles in riparian habitats;
    - monarch butterfly and wayside aster in upland habitats;
    - dusky Canada goose and shaggy horkelia in prairie habitats;
    - delisted species such as Bradshaw's lomatium and Oregon chub; and,
    - keystone species such as American beaver and black cottonwood

Based on our analysis, reducing negative impacts to species that characterize various habitats will effectively reduce associated negative impacts on fish, wildlife, and plant resources Basin-wide.

1. PURPOSE, SCOPE, AND AUTHORITIES

1.1. PURPOSE

The Corps is preparing a new 30-year continued operation and maintenance (O&M) plan for the Willamette River Basin Flood Control Project's Willamette Valley System (WVS). As part of the Fish and Wildlife Coordination Act (FWCA), the Service is engaging with partners to develop specific, measurable, time-oriented conservation recommendations for the Corps to consider for the protection of fish, wildlife, and plant resources in the Basin. The Willamette Project was initially authorized by the Flood Control Act of 1938 as set forth in HD 544, Seventy-fifth Congress, third session. Subsequent supporting authorities for construction and operation of the WVS and its 13 Federal dams are provided in (Corps, 1992, p. 2).

The Corps is preparing an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et. seq.). This EIS will analyze the potential environmental consequences from the proposed alternatives and establish guidelines for review and/or consultation for individual actions covered under the WVS during the 30-year timeframe.

This document is the Service's formal 2(b) Fish and Wildlife Coordination Act Report (FWCAR) for the WVS, and it fulfills the Service's shared responsibilities under the FWCA of March 10, 1931, as amended (16 U.S.C. §§ 661-667e). With this report, the Service communicates the potential impacts of the proposed alternatives on trust fish, wildlife, and plant resources, highlighting the value of these resources and their significance to collaborators (e.g., Federal and State agencies, local entities, Tribes, and the general public) in the Basin. Also with this report, the Service provides conservation recommendations for the Corps to consider in developing the final EIS for the WVS. The purpose of providing these conservation recommendations is to minimize further loss of, or damage to, fish, wildlife, and plant resources in the Basin, and to support future management and restoration of those resources (Smalley and Mueller, 2004, pp. 1-28).

1.2. SCOPE

In 2021, we developed a Scope of Work (SOW), outlining key responsibilities and coordination strategies, and a budget request in support of completing this report (USFWS and Corps, 2021b, pp. 1-6). The SOW clarified the geographic area of our analysis, which included the mainstem Willamette River and major tributaries affected by dam modifications and operations as of July 2021, an approximate 0.25-mile (0.4 kilometer [km]) terrestrial habitat buffer along the river and tributary banks (Section B, Figure 1), and a summary of how evaluation species were selected. The information presented in Section 2 and Appendix B of this report further define areas included in, and excluded by, our analysis. On September 1, 2021, the Service and Corps approved the final SOW (USFWS and Corps, 2021a, p. 17). Appendix A includes a timeline that

illustrates key milestones in our engagement among our programs, the Corps, and interested parties for FWCAR development.

1.2.1. Alternatives

1.2.1.1. No Action Alternative (NAA)

The NAA is required by NEPA to provide the existing condition of the WVS for comparison of environmental effects of the proposed alternatives. The NAA consists of the current actions within the WVS and the conditions that would result from no change of the continued O&M and configuration of the WVS. Included within the NAA are all ongoing, scheduled, and routine maintenance actions for federal infrastructure, including construction that has recently been completed or is in the foreseeable future. Current actions and operations occurring in the WVS include those agreed to in previous ESA consultations between the action agencies (Corps, Bonneville Power Administration [BPA], and Bureau of Reclamation), NMFS, and the Service (Corps, 2000; NMFS, 2008; USFWS, 2008). The current operating conditions of the WVS do not adequately protect ESA-listed anadromous fish species, specifically Upper Willamette River (UWR) Chinook salmon and UWR steelhead or designated critical habitat for these species (Corps, 2025).

1.2.1.2. Alternative 1: Improve Fish Passage through Storage-Focused Measures

The purpose of Alternative 1 is to maximize the refill volumes of conservation pools at WVS reservoirs to meet authorized purposes that depend on full reservoirs, including municipal and industrial water supply, irrigation, recreation, and water quality (Corps, 2025).

Alternative 1 focuses on allowing more water storage for multiple purposes, including to improve fish passage through the WVS dams to increase the survival of ESA-listed fish species. It includes operational measures that would reduce flows to Congressionally authorized minimum flows and increase the likelihood of refilling the WVS reservoirs to their maximum conservation pool levels in the spring. This would provide increased conservation season storage that would meet multiple project objectives. Implementation of Alternative 1 would not affect the flood risk management mission of the WVS. The use of juvenile fish collection facilities to provide downstream passage was selected as a preferred measure under this alternative, as was the use of water temperature control structures needed for the juvenile fish collection facilities. The structures would allow for fish collection over various water levels throughout the year, with the intent of minimizing effects to project storage from operations for fish passage and water quality.

The measures for this alternative and the locations at which they would be implemented are shown in Appendix G.1 Summary Table of Alternatives and Measures.

1.2.1.3. Alternatives 2a and 2b: Integrated Water Management Flexibility and ESA-Listed Fish Alternative

Alternatives 2a and 2b were developed to improve fish passage through the WVS dams using a combination of modified operations and structural improvements, along with other measures to balance water management flexibility and meet ESA-listed fish obligations. Downstream fish passage is provided through a combination of structural and operational measures. Upstream passage is provided at Green Peter with the construction of a new adult fish facility (AFF). Pacific lamprey passage and infrastructure is provided at Green Peter (Corps, 2025).

Alternatives 2a and 2b are similar, however they propose different measures at Cougar Dam. Alternative 2a proposes constructing structural downstream fish passage at Cougar Dam (i.e., floating fish collection screen). Alternative 2b changes operations at Cougar Dam by drafting deep spring and fall drawdowns at the reservoir so fish can pass through the Diversion Tunnel.

The measures for this alternative and the locations where they would be implemented are shown in Appendix G.1 Summary Table of Alternatives and Measures.

1.2.1.4. Alternatives 3a and 3b: Improve Fish Passage through Operations-Focused Measures Using Regulating Outlet at Cougar Dam (3a) or Diversion Tunnel at Cougar Dam (3b)

Alternatives 3a and 3b were developed to improve fish passage through the WVS dams by modifying operations rather than focusing on storage (Alternative 1) or adding or substantially changing structures (Alternative 4). This alternative includes operational measures that allow for increased survival of ESA-listed fish while maintaining the Corps flood risk management mission. Fish passage measures include deeper fall season reservoir drawdowns, spring drawdowns, and the use of spillways to facilitate downstream fish passage (Corps, 2025).

No structural downstream fish passage measures were considered within Alternative 3a or 3b. Upstream fish passage is provided by means of existing trap and haul facilities. Operational measures in Alternative 3a and 3b are intended to improve downstream fish passage, increase water management flexibility, optimize conservation season draft rates, and reduce impaired water quality below the WVS dams to benefit ESA-listed fish species. Some operational measures may require the modification of existing infrastructure, or the construction of AFFs for benefits to be realized from the proposed operational measures.

Alternatives 3a and 3b propose slightly different combinations of operations in their spring downstream passage measures. Alternative 3a proposes downstream fish passage elements at a different combination of projects and includes drawdown drafting to 10 feet over the top of the Cougar Dam Regulating Outlet for deep fall and spring drawdown measures. Alternative 3b

includes drafting to the Cougar Diversion Tunnel for deep fall and spring drawdown, a much deeper drawdown than proposed under Alternative 3a.

The measures for this alternative and the locations at which they would be implemented are shown in Appendix G.1 Summary Table of Alternatives and Measures.

1.2.1.5. Alternative 4: Improve Fish Passage with Structures-Based Approach

Alternative 4 takes a structures-based approach to improve fish passage through the WVS dams to increase the survival of ESA-listed fish. It also contains operational measures, such as adjusting conservation season draft rates, water temperature control towers, and structures to reduce Total Dissolved Gas (TDG), and use of regulating outlets at Green Peter Dam to discharge cold water and use the spillway to release warm surface water. Fish passage measures include constructing upstream and downstream passage facilities at drop structures at Fern Ridge Dam and providing Pacific lamprey passage and infrastructure (Corps, 2025).

The measures for this alternative and the locations where they would be implemented are shown in Appendix G.1 Summary Table of Alternatives and Measures.

1.2.1.6. Alternative 5: Refined Integrated Water Management and Flexibility and ESA-listed Fish Alternative

Alternative 5 was developed from feedback received the Corps received following the publication of the DEIS on the integrated temperature and habitat flow regime measure proposed under Alternative 2B. Alternative 5 is the same as Alternative 2B except the Corps modified the integrated temperature and habitat flow regime measure to improve outcomes for ESA-listed species.

The measures for this alternative and the locations where they would be implemented are shown in Appendix G.1 Summary Table of Alternatives and Measures.

1.2.1.7. Interim Operations

The EIS includes a description of interim operations to be conducted while structural modifications and implementation of a chosen alternative is in progress. The interim operations were not developed as a separate alternative, as these operations alone will not achieve sufficient survival and passage for ESA-listed salmonids. Timing and duration of the interim operations vary by alternative, but some interim operations would extend for nearly the 30-year implementation timeframe under alternatives 1, 2a, 2b, 4, and 5. The interim operations were not developed parallel to EIS measures, and the analysis of ecological effects of each operation individually or cumulatively was not included in the EIS. However, the interim measures are similar to operational fish passage measures evaluated under alternatives 2b, 3a, 3b, and 5, including measures 40, 166, 714, 720, 721, and 726.

1.3. AUTHORITIES

1.3.1. Fish and Wildlife Coordination Act

The FWCA authorizes the Secretaries of the Departments of Interior and Commerce to provide assistance to Federal and State agencies to protect trust fish, wildlife, and plant resources, assess possible damage to wildlife resources associated with the implementation of Federal water resource development projects like those that comprise the WVS, and define protective and enhancement means and measures for these resources.

The FWCA recognizes the importance of fish, wildlife, and plant resources and their value and significance to interest groups. Further, the FWCA requires that fish and wildlife conservation be given equal consideration with other water resource development project and program elements through early coordination, joint planning efforts, data exchange, interagency cooperation, and the development of specific measures and project alternatives for fish and wildlife conservation and rehabilitation (Smalley and Mueller, 2004, pp. 14-17).

Additionally, the FWCA authorizes the Secretary of the Interior to provide assistance to, and cooperate with, Federal agencies and other groups in developing, preserving, rearing, and stocking of fish and wildlife and to protect their habitat in the course of Federal activities, such as the modification of a body of water, natural river, or such activities proposed in the WVS DEIS.

During any given project period, the FWCA authorizes the Service to make other investigations of fish, wildlife, and plant resources, including lands and waters, and to accept contributions of funds and donations of land to meet FWCA purposes.

To ensure fish, wildlife, and plant resources receive equal consideration, the FWCA requires the Corps to coordinate with the Service, NMFS, and other groups or cooperating agencies regarding the potential impacts of the proposed project and associated actions on fish, wildlife, and plant resources (NMFS and USFWS, 2018, pp. 1-6). In 2021, the Western Governors' Association (WGA) updated its policy position on the ESA which expresses their support of proactive management efforts to conserve species and their ecosystems thus precluding the need to list a species under the ESA (WGA, 2021, pp. 3-4). They also advocate for Federal consultation with states to produce implementable solutions that result in better conservation outcomes (WGA, 2021, p. 2).

For this report, early coordination and interagency cooperation resulted in data-sharing and -collection, collaborative analysis, report production and review, and our development of conservation recommendations, which are non-binding (i.e., are discretionary). Despite the fact our conservation recommendations are discretionary, we suggest the Corps fully evaluate the

ability to incorporate as many conservation recommendations into the preferred alternative as possible (Smalley and Mueller, 2004, p. 160).

We anticipate the Corps will initiate and complete various consultations, restoration projects, and mitigation projects to address the WVS and its impacts over time. Mitigation projects will depend on local opportunities and other factors, and those designed for one suite of habitats or species may lead to negative impacts on others. Potential conflicts and tradeoffs are not specifically predictable and were not considered in this analysis, however we will count on future opportunities through NEPA, the FWCA, Section 7 ESA consultation and other authorities to review and provide comments on specific project proposals and their various components (e.g., alternatives, impacts) as they arise.

1.3.2. Congressional Authority

The U.S. Congress provides the authority for the Corps to construct, operate, and maintain the 13 Federal WVS projects to meet multiple purposes (Table 1). Purposes include flood control and power generation, water supply, irrigation, navigation, recreation, and fish and wildlife conservation. Not every project is authorized for all purposes.

Table 1. Willamette Basin Storage Projects in the Willamette Basin

Project	Subbasin (HUC8)	River	Flood Control	Power Generation
Detroit	North Santiam	North Santiam River	Y	Y
Big Cliff	North Santiam	North Santiam River	N	Y
Green Peter	South Santiam	Middle Santiam River	Y	Y
Foster	South Santiam	South Santiam River	Y	Y
Blue River	McKenzie	Blue R., trib. to McKenzie R.	Y	N
Cougar	McKenzie	South Fork McKenzie River	Y	Y
Fall Creek	Middle Fork Willamette	Fall Creek	Y	N
Hills Creek	Middle Fork Willamette	Middle Fork Willamette River	Y	Y
Lookout Point	Middle Fork Willamette	Middle Fork Willamette River	Y	Y
Dexter	Middle Fork Willamette	Middle Fork Willamette River	Y	Y
Dorena	Coast Fork Willamette	Row River	Y	N
Cottage Grove	Coast Fork Willamette	Coast Fork Willamette River	Y	N
Fern Ridge	Upper Willamette	Long Tom River	Y	N

Since the previous EIS in 1980, modifications to operations and structural improvements have been made to the WVS. The Corps has identified the need for the preparation of an updated EIS with new information that is available on the environmental effects of O&M and a large amount of new information regarding ESA listed species since the 2008 Willamette Valley System biological opinions from the Service (USFWS, 2008) and NMFS (NMFS, 2008). On August

9, 2021, the Corps formally requested an Initiation of Coordination under the FWCA (Corps, 2021a, p. 1).

1.4. COOPERATING AGENCIES AND TRIBES

Early in the NEPA process, the Corps requested cooperation from Federal and State agencies, local entities, and Tribes that have either jurisdiction by law in the Study Area, or special expertise on relevant environmental issues, to participate in DEIS and final EIS development (40 CFR § 1501.6).

We invited the Corps and several of the designated cooperating agencies to collaborate during the analysis and for this reporting effort (Table 2).

Table 2. Cooperating agencies and Tribes invited to contribute to the FWCAR

General Affiliation	Specific Agencies and Tribes
Government Agencies	U.S. Army Corps of Engineers U.S. Geological Survey National Oceanic and Atmospheric Administration Oregon Dept. of Fish and Wildlife
Tribes	Conf. Tribes of Siletz Indians Conf. Tribes of Grand Ronde Conf. Tribes of the Warm Springs Reservation of Oregon
Other	Institute for Applied Ecology The Xerces Society of Invertebrate Conservation

2. STUDY AREA AND BASIN EXTENT

The Study Area includes all river reaches, riparian zones, and floodplain areas located downstream of the 13 Willamette Project dams, including the mainstem Willamette River and the tributaries on which these facilities are located (i.e., mainstem reaches of the North Santiam and South Santiam rivers, Santiam River, McKenzie River, South Fork McKenzie River, Blue River, Fall Creek, Hills Creek, Middle Fork Willamette River, Row River, Coast Fork Willamette River, and the Long Tom River). This Study Area also encompasses the 42 miles of streambank revetments maintained by the USACE and the adjacent stream reaches affected by those revetments. Upstream of the 13 Willamette Project dams, the Study Area includes stream reaches and land areas permanently or seasonally inundated by Willamette Project reservoirs in dry, average, and wet years, and all reaches of tributaries located upstream of Willamette Project dams that are presently or were historically accessible to listed fish before construction of the 13 dams in the Willamette Project (USFWS, 2008, pp. 22-23).

Channel confinement, isolation of the Willamette River from most of its floodplain, obliteration of side channels and/or severing of side channel connections, and elimination or degradation of both seasonal and permanent wetland habitats within the floodplain began as early as 1872 and has significantly changed the system. For example, along the 15.5-mile reach of the Willamette between Harrisburg and the McKenzie River confluence, the length of shoreline has declined from over 155 miles of shoreline in 1854 to less than 40 miles currently (Sedell and Froggatt, 1984, p. 1828; Sedell et al., 1990, p. 719; USFWS, 2008, p. 135).

The construction and operation of the WVS, in combination with the construction and maintenance of revetments, has facilitated floodplain development, encroachment, urbanization and rural development due to the annual protections against flooding. We cannot assume, however, that all floodplain development, encroachment, urbanization and rural development was due to the construction and operation of the Willamette Project since a great

deal of development occurred before the Project was completed despite the known risk of flooding (Corps, 2000, p. 2-1; USFWS, 2008, p. 135).

The impacts of urbanization on aquatic ecosystems are severe and long-lasting. Urbanization virtually eliminates natural vegetation in affected areas, which in turn disrupts hydrologic and erosional processes, as well as the physical characteristics of aquatic habitats. Urban developments (including roads, buildings, sidewalks, and other impervious surfaces) greatly reduce water infiltration, which alters the routing and storage of water in the affected basin. Many of the resulting changes are intended to make the land more amenable to specific human uses (e.g., transportation, human habitation), but other important resource values (e.g., water supplies, fisheries, and wildlife) may be damaged by unintended effects on aquatic ecosystems, including increased peak flows; channel erosion; loss of riparian habitats which results in increased stream temperatures; increased nutrient inputs; landslides; pollution; and channelization (Spence and Hughes, 1996, p. 13198; USFWS, 2008, p. 135).

Many species of non-native fish have been introduced to, and are common throughout the Willamette Valley, including largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), crappie (*Pomoxis sp*.), bluegill (*Lepomis macrochirus*), and western mosquitofish (*Gambusia affinis*). Many of these introduced species are known to prey on and compete for habitat with native species. Some non-native plant and animal species are invasive; without natural predators or controls, they can establish on many sites, grow quickly, and spread to the point of disrupting fish communities or ecosystems. The American bullfrog (*Lithobates catesbeianus*) for example, an omnivorous non-native invasive amphibian, also occurs in the valley and breeds in habitats preferred by species in off-channel habitats (Hjort et al., 1984, p. 70, Scheerer et al. 1992, p. 1075-1077; USFWS, 2008, p. 135). They are prolific and voracious predators that cause decline of native species through competition and predation. In this report, we reference both non-native species that have been introduced to the area, and invasive species that cause damage to an ecosystem.

2.1. WILLAMETTE SUBBASINS

Based on the Study Area, seven fourth-level subbasins were identified (8-Digit HUC): Coast Fork Willamette, Middle Fork Willamette, Upper Willamette, Middle Willamette, McKenzie, North Santiam, and South Santiam. Ten major tributaries with a stream Level < 5 and Order > 6 were identified in addition to the Mainstem Willamette River, refer to Appendices B and E.2 for details.

3. METHODS

3.1. ECOLOGICAL AND PHYSICAL PROCESSES

We identified ecological and physical processes critical to support functional Willamette Basin habitats and fish, wildlife, and plant resources under current conditions (Table 3). We considered the indicators in Table 3 to evaluate the impacts of the WVS on these processes and how they may affect fish, wildlife, and plant resources.

Table 3. Ecological and physical processes and general indicators identified for analysis

Indicators	Ecological and Physical Processes
Connectivity	Channelization Channel avulsion Natural disturbance Channel migration Sediment transport Water flow
Ecosystem function	Disturbance Instream temperature regimes Sediment transport Nutrient cycling Plant and animal interactions (e.g., growth)
Habitat complexity and diversity Species diversity	Channel avulsion Disturbance Forest succession Sediment transport Sediment bar formation Nutrient cycling Plant and animal reproduction Recruitment and transport of large wood Sediment dynamics (e.g., sediment transport) Soil formation
Native vegetation (e.g., riparian)	Natural disturbance Nutrient cycling Pollination Seasonal flooding
Natural disturbance	Bioturbation (e.g., spawning or burrowing) Erosion (e.g., bank sloughing) Fire occurrence (i.e., frequency, intensity) Flooding Sediment dynamics (e.g., deposition) Channel migration

Indicators	Ecological and Physical Processes
Natural flood regime	Precipitation Soil formation Storing water (e.g., floodwater) Water flow and timing
Pre-dam hydrograph	Natural disturbance (e.g., storms) Sediment transport Precipitation Storing water (e.g., floodwater) Water flow (e.g., base flow, subsurface flow)
Water quality (in this report, total dissolved gas, and temperature)	Climate variability patterns Cooling/warming of water Sediment dynamics (e.g., deposition) Storing/biodegrading pollutants Stratification
Water quantity	Evaporation Flooding Groundwater discharge Precipitation Water flow (e.g., subsurface flow) Water storage Water uptake (e.g., adsorption by plants)

3.2. HABITAT TYPES

To address the diverse range of ecological communities in the Study Area and their value to fish, wildlife, and plant resources, we identified five habitat types that could be impacted by the project actions: Riverine/Reservoir, Off-Channel/Wetland, Riparian, Upland, and Prairie.

3.3. EVALUATION SPECIES

A focused list of evaluation species was selected because it is impractical to identify conservation actions for all species present in the Study Area. By implementing management strategies that support the ecological conditions favored by the selected species, we assumed that the needs of the larger set of species characteristic of the habitat they represent will also be met (USFWS, 2012b, p. 12). The goal of the species selection approach was to choose species that best represent the priority habitat types and conservation issues.

The species selection process began by developing a list of species identified as species of concern by federal or state agencies, including Oregon Department of Fish and Wildlife's Oregon Conservation Strategy, Oregon Department of Agriculture's Threatened, Endangered, and Candidate Plant List, Bureau of Land Management and U.S. Forest Service's Sensitive

Species List, and the USFWS' Species of Concern List. We did not include Federal threatened or endangered species as they will be addressed in the companion ESA Section 7 consultation process on the Corps' preferred NEPA alternative and the action agencies (Corps, BPA, Bureau of Reclamation) proposed action Opinions. The Service identified a preliminary list of 68 evaluation species. This list was initially filtered based on the following criteria:

- **Species Status.** Species is *not* threatened or endangered (True/False). Threatened and endangered Species will be addressed in the Section 7 ESA consultation process. Our analysis for this FWCAR focused on species of concern.
- **Location.** This species is within the Study Area (True/False). Species are found below 751 m elevation and upstream of Willamette Falls in the Willamette River Basin. With ArcGIS Pro, we created a 0.4 km (0.25 mile) buffer around each Corps property boundary for each project. The maximum river elevation upstream of the property boundary within the buffer for each project was identified. The maximum elevation for the WVS is the Cougar Reservoir on the SF McKenzie River at 751 meters.
- **Impact.** Species may be affected by operation and maintenance of the WVS (True/False).

Each species was assessed for each criterion as True or False. For species with abundant information and high confidence in our assessment, we used black text. We indicated "True" in green text if there was not enough information to verify the species location or if there were unknown impacts from project operations. Species that were assessed as "True" for all three initial filters were selected and used in a Species Decision Matrix. We identified 34 species from the preliminary list and sorted each by their habitat types.

The Species Decision Matrix was used to develop a list of criteria against which each species would be rated within the habitat type as well as assigning importance weights to the criteria themselves (Appendix 2). We defined four criteria and applied a weight to each (1 = Not important, 2 = Somewhat Important, 3 = Important, 4 = Highly Important). The weighted criteria are as follows:

- **The species represents this habitat type**. When conservation actions are directed toward this species, the actions will also benefit the larger group of species in this habitat type (Weight = 4)
- **Range.** This species is endemic to the Willamette Valley and relatively rare subbasin frequency (Weight = 3)
- **Frequency.** This species has a high subbasin frequency (Weight = 2)
- **There is high certainty this species will be affected by project operations**. (Weight = 4)

We rated each species on a scale of 1 – 3 for each criterion. For the first criteria, the species represents this habitat type, we rated the species' ability to represent the larger group of

species within the habitat type (Low = 1, Medium = 2, High = 3). For the range criteria, 1 = if the species was found throughout the west, 2 = if it was found in low numbers in Oregon and Washington, and 3 = if it was endemic to the Willamette Valley. We rated subbasin frequency 1 if the species was found in 1 – 2 Subbasins, 2 if they were found in 3 – 5 Subbasins, and 3 if they were found in 6 – 8 Subbasins. Finally, the level of certainty that the operations will affect the species was based on the number of "True" in black text since green text indicated lack of confidence in the initial filter. The rankings were scored by multiplying the rating by criteria weight and summed for each species. Species that scored above average relative to the other species in their habitat type (26 species) were selected for further evaluation.

3.3.1. Key Conservation Issues

We refined this group of 26 species into a focused list of evaluation species by categorizing the key conservation issues for each species (i.e., invasive species, habitat loss, decline of food source, etc.) based on the Oregon Conservation strategy (ODFW, 2016, pp. 4-5). These conservation issues indicate the ecological and physical processes and habitat needs in the Study Area. Species that represented the broadest range of conservation issues in each habitat type were selected for our focused list of evaluation species. These species can serve as indicators of ecological change given the suite of potential Project impacts. We combined wetland and off-channel habitats because their conservation concerns were closely associated with one another and their similar physical and ecological processes. In the Prairie habitat we initially selected thin-leaved peavine (*Lathyrus holochlorus*), however after consulting with a specialist, we concluded shaggy horkelia (*Horkelia congesta*) would be a more appropriate representative for the habitat. Shaggy horkelia has similar conservation needs to other wet prairie species, is found at more locations within the Study Area, and is included in various prairie restoration studies. Ultimately, we generated a list of five habitat types (Riverine/Reservoir, Wetland/Off-Channel, Riparian, Upland, and Prairie) and 10 species from the preliminary list of 68 (Appendix F).

3.3.2. Delisted and Keystone Species

We refined the species list with the addition of delisted species which have post delisting monitoring plans in place, which initially included bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), Bradshaw's lomatium (*Lomatium bradshawii*) and Oregon chub (*Oregonichthys crameri*; [USFWS, 2021a, March 1]). Bald Eagles and peregrine falcons were omitted due to the unlikelihood of being affected by the Project impacts. In addition to delisted species, we included two keystone species, black cottonwood (*Populus balsamifera*) and American beaver (*Castor canadensis*), as they are likely to be affected by the Project and play key ecological roles in the Study Area (Table 4).

Table 4. Focused list of evaluation species by habitat type

Habitat Types	Evaluation Species
Riverine/Reservoir	Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) Western Ridged Mussel (*Gonidea angulata*) American Beaver (*Castor canadensis*) [a] Oregon Chub (*Oregonichthys crameri*) [b]
Wetland/ Off-Channel	Northern Red-Legged Frog (*Rana aurora*) Pacific Lamprey (*Entosphenus tridentatus*) American Beaver (*Castor canadensis*) [a] Black Cottonwood (*Populus balsamifera*) [a] Oregon Chub (*Oregonichthys crameri*) [b]
Riparian	Foothill Yellow-Legged Frog (*Rana boylii*) Northwestern Pond Turtle (*Actinemys marmorata*) American Beaver (*Castor canadensis*) [a] Black Cottonwood (*Populus balsamifera*) [a]
Upland	Monarch Butterfly (*Danaus plexippus*) Wayside Aster (*Eucephalus vialis*) Black Cottonwood (*Populus balsamifera*) [a] Bradshaw's Lomatium (*Lomatium bradshawii*) [b]
Prairie	Dusky Canada Goose (*Branta canadensis occidentalis*) Shaggy Horkelia (*Horkelia congesta*) Bradshaw's Lomatium (*Lomatium bradshawii*) [b]

[a] Keystone Species

[b] Delisted Species

3.4. COORDINATION AND INFORMATION-SHARING

3.4.1. Virtual Technical Workshops

The FWCA requires the Service to consult and coordinate with other groups, including the Corps, cooperating agencies, Federal and State agencies, Tribes, private entities, and academic institutions to augment its understanding of the potential impacts of the proposed alternatives on fish, wildlife, and plant resources. Due to the size and scope across proposed alternatives, the diversity of values held among interest groups in the Basin, and the many fish, wildlife, and plant resources at risk, it was imperative that we effectively coordinate with groups. We planned and hosted two multi-agency technical workshops in winter 2022 to coordinate and gather input. The goal of our coordination through these workshops was to enhance the information available for analysis and yield a more complete understanding of the ecological, socioeconomic, and cultural values of these resources, and their potential risk as a result of proposed changes to the WVS. These workshops allowed us to maximize effort in capturing various perspectives and insights into the research and analysis presented in this FWCAR.

We designed and facilitated two technical workshops on February 25, 2022. The morning workshop focused discussions on species in upland and prairie/wet prairie habitats, the afternoon workshop focused discussions on species in riparian, off-channel/wetland, and riverine/reservoir habitats (Table 5). Each workshop was held virtually, and a link to an online form was provided to allow for participation among all participants.

Table 5. The focus and dates of the Service's technical workshops.

Workshop Habitat Focus	Focal Species	Date
Upland, Prairie Wet Prairie	Monarch Butterfly Wayside Aster Dusky Canada Goose Shaggy Horkelia Black Cottonwood American Beaver Bradshaw's Lomatium	February 25, 2022 9:00 AM to 12:00 PM
Riverine/Reservoir Riparian Off-Channel/Wetland	Northern Red-Legged Frog Pacific Lamprey Foothill Yellow-Legged Frog Northwestern Pond Turtle Coastal Cutthroat Trout Western Ridged Mussel Black Cottonwood American Beaver Bradshaw's Lomatium Oregon Chub	February 25, 2022 1:00 PM to 4:00 PM

Appendix C includes our outreach and communications associated with these technical workshops. More than 20 participants from 6 organizations contributed to these workshops (Table 6).

Table 6. Organizations represented at the Service's technical workshops.

General Organization Group	Affiliation within General Organization Group
Federal Agencies and Programs	U.S. Amy Corps of Engineers U.S. Geological Survey U.S. Fish and Wildlife Service
State Agencies	Oregon Department of Fish and Wildlife
Private Entities	The Xerces Society

During each workshop, we provided an overview of the FWCA, detailed the analysis approach for the FWCAR, and defined the purpose and goals for the workshop. Discussions centered on four questions designed to encourage participants to share specific information on the following:

- Identify high priority areas for the evaluation species in the Study Area and explain why they are of interest or value to your agency.
- In these high priority areas, what are the unique processes, landscape features, or time periods (e.g., growing season) necessary to maintain existing conditions that support this species?
- Considering how current dam operations occur, how will changes involving higher or lower water flows affect this species and these high priority areas?
- Identify measurable and achievable actions to conserve, protect, and enhance the species, habitats, and key areas you identified, and any significant resources discussed.

Each technical workshop provided an opportunity for participants to contribute or add technical information to the conservation recommendations related to the previously identified habitats and evaluation species. We requested participants identify and describe fish, wildlife, and plant resources and habitats, or specific locations or sites with special value to them and the agencies they represent; discuss how changes to existing conditions could potentially impact these resources; and suggest measures to conserve, protect, and enhance ecological and physical processes, habitats, and species. We also asked for information (e.g., data, reports from past surveys or studies, white papers, gray literature, species population assessments, expert knowledge) to fill information gaps. Appendix D includes our workshop agendas and discussion questions.

3.5. DATA AND MODELING

We used data from different sources including modeling efforts led by the Corps, existing databases, primary literature, technical experts who participated in the virtual workshops, and draft Service and Corps reports (e.g., consultations, Biological Assessments) and gray papers, maps and aerial photographs. We performed a series of qualitative assessments using available data to examine and measure the potential impacts of the WVS on fish, wildlife, and plant resources in the Basin. Appendix E includes the primary data sources we used in the analysis for this FWCAR.

3.6. ASSESSMENT OF MEASURES AND CUMULATIVE IMPACTS

We assessed the potential impacts of each proposed measure on the indicators of ecological and physical processes, and on the key conservation issues of evaluation species for each habitat. We also assessed the potential impacts of the NAA on ecological and physical processes, and for evaluation species in each habitat. Most assessments were qualitative, however we utilized EIS model outputs in our assessment of some measures, where those model results were applicable.

For each alternative, we assessed and scored the impacts of each measure, grouped by EIS conservation objective and habitat type. For scoring, we assessed the positive and negative

impacts of each measure to give each measure an overall score. We weighted broad or permanent impacts, such as changes to ecosystem or landscape function, higher than narrow, limited, or short-term impacts, such as impacts to a single species or a portion of a species' life-history. Measures were often similar among alternatives, but often differed in the number of WVS projects to which they were applied. To assess the relative impact of each measure under each alternative, we multiplied the score of each measure by the number of WVS projects the measure applied to in that alternative. Scores were then totaled, and we scaled scores based off the total number of WVS projects where each measure was applied. This allowed us to assess the cumulative impact of each alternative and make comparisons between alternatives.

4. RESOURCES

For the analysis, we selected aquatic and terrestrial habitats that were likely to be affected by proposed changes to the WVS (Table 7). In this FWCAR, we identify and describe these habitats, the evaluation species (according to their close association with ecological and physical processes), and key sites within each habitat. We describe these resources in more detail in Appendix G.

Table 7. Habitats identified by the Service in the Study Area.

Habitat	Description
Riverine/Reservoir	Fluvial and lacustrine systems with deep water habitats in the open mainstem channel
Wetland/Off-Channel	Palustrine, perennial, and intermittent, floodplains, side channels
Riparian	Woody riparian areas associated with lotic systems
Upland	Coniferous and deciduous forest
Prairie	Upland Prairie and wet prairie

4.1. RIVERINE/RESERVOIR

A detailed definition and description of the riverine and reservoir habitat is provided, see Section F.1.1.

4.1.1. Trends in Riverine/Reservoir Habitat Quality and Quantity

Historical and recent trends in populations of biologically and culturally important aquatic species in the riverine environment throughout the Willamette River Basin (e.g., Pacific lamprey, freshwater mussels) have mirrored the declining trends of Pacific salmon fisheries (Almeida et al. 2021, p. S174; Blevins et al. 2017, p. 15). In general, the factors that pose the greatest threats to many of these species come from a loss of access to, or quality of, habitat and important ecological and physical processes. These habitats and processes continue to be

negatively impacted by water diversion projects for irrigation, power generation, and water supply, particularly throughout the Willamette Valley (Jaeger et al. 2017, p. 5).

Historically, the Willamette River and its tributaries consisted of an intact and productive mainstem and was dominated by ecological features such as gravel bars, islands, runs, pools with backwaters, side channels and sloughs. These combined features increased overall habitat complexity and ecosystem function (Gregory et al. 2002, p. 118). Prior to the construction of the 13 hydropower projects and 42 miles of revetments (USFWS 2008 BO, p. 23) the Willamette River and its tributaries flowed without constraint. Dam construction and related infrastructure, and continuing WVS project operations and maintenance, have degraded river habitats and diminished aquatic (e.g., migratory fishes) and terrestrial species populations. Reservoirs were created when the dams were built between 1941 and 1969 (USFWS 2008 BO, p. 23). One of the most prominent changes observed in riverine habitat has been the inundation of river habitat and conversion to reservoirs. In addition, overallocation of water resources in the Willamette basin have substantially reduced available riverine habitat (OSU, 2022). Climate change will increasingly impact aquatic resources, warmer temperatures will reduce winter snowpack and will further impact overall water availability, water quality for aquatic species (OSU, 2022).

4.1.2. NAA Trend

Under NAA conditions, the riverine and reservoir habitat will continue to disrupt ecological processes and further impact aquatic species populations. More specifically, the channelization and obliteration of riverine habitats, network of revetments and infrastructure, reduced sediment transport, reduced magnitude of floods, and lack of large wood input will inhibit the fluvial geomorphic processes that foster a healthy functional river system. As natural riverine processes continue to be altered, there will be a continual loss of habitat diversity overtime, that will impact native aquatic species populations.

The life histories of native species are closely correlated with the pre-dam hydrograph (Poff, et al., 1997, p. 775). Peak flow events that occur outside of the pre-dam hydrograph will continue to alter native species reproduction timing and benefit non-native species (Haley et al., 2007, p. 85). Alterations to instream water temperature regimes, combined with sediment and large wood starvation, will continue to negatively impact instream conditions (e.g., habitat suitability and availability), providing more opportunities for non-native species to become dominant. Undisturbed riverine communities are diverse, and the continued loss of this complex habitat impacts the diversity and abundance of species that depend on it for part, or all aspects, of their life history requirements (Theobold et al., 2010, pp. 3-585).

4.1.3. Evaluation Species

Evaluation species associated with the riverine/reservoir habitat include coastal cutthroat trout, Oregon chub and western ridged mussel. For detailed descriptions of these species, see Section F.1.

4.2. WETLAND/OFF-CHANNEL

A detailed definition and description of wetland/off-channel habitat is provided, see Section F.2.1.

4.2.1. Trends in Wetland/Off-Channel Habitat Quality and Quantity

Off-channel habitats are those bodies of water adjacent to the main river channel with direct surface water connections or hyporheic flow. These sloughs, alcoves, and isolated oxbows create complex aquatic habitats with functioning ecological and fluvio-geomorphic processes (Gregory et al., 2002, pp. 26-27). Side channels can evolve over time as part of the active channel to a backwater or an isolated oxbow intermittently connected to the main flow during floods, and finally to a wet depression or wetland on the floodplain (Saldi-Caromile et al., 2004, p. 219), through the process of vegetative succession.

Wetland habitats are shaped by water in the form of rainfall, runoff, or snowmelt that flows across the floodplain where it enters the groundwater system or remains in stream channels. In the Willamette River Valley, there is little elevation change from the valley margins to the valley bottom resulting in the water table at or near the land surface over large areas (Kjelstrom and Williams, 1996, p. 324). Both wetland and off-channel habitats are fed by surface and/or groundwater at a frequency and duration to support a prevalence of vegetation typically adapted for life in saturated soil conditions (Tiner, 1996, p. 29).

Wetlands generally include swamps, marshes, and bogs, and play a critical role in meeting the life history requirements of many native migratory and resident wildlife species (USFWS, 2017, p. C-7; Tiner, 1996, p. 27). The Willamette Valley's wetlands are sustained by groundwater discharge, stream flooding, or both. When the river floods, side channels are inundated and isolated oxbow lakes are filled with a water-sediment mixture allowing wetlands to form (Carter, 1996, p. 41).

Historically, the alluvial lowlands of the Willamette Valley were a highly complex, dynamic mosaic of braided riverine channels, with extensive off-channel and wetland habitats surrounded by riparian forests, up to 3 km wide (Sedell and Froggatt, 1984, p. 1830). Geomorphic processes, such as such erosion, avulsion, and deposition during flood events created new off-channel habitats as the river network meandered through the floodplain, contributing substantial inputs of large wood and coarse sediment. Wetland habitat was created through vegetative succession of alluvial remnants and maintained by frequent disturbance processes. Willamette Valley off-channel and wetland habitats support diverse

communities of plant and animal species that are obligate to these habitats or depend on them for a portion of their life history.

Extensive human activities in the Willamette River Basin have substantially reduced off-channel and wetland habitats. Starting in the 1830s, wetlands were ditched, tiled, filled, and drained for agriculture. Miles of revetments were constructed to further increase the agricultural and urban use of former floodplain habitats, along with logging of the floodplain forests. The Willamette Project dams have substantially reduced the timing, duration, and magnitude of floods in the basin, which has also resulted in decreased sediment transport and especially coarse sediment transport. The lack of natural disturbance processes has limited the maintenance and creation of new off-channel habitats. Non-native animal species prey on and compete with native species in off-channel and floodplain habitats, and non-native vegetation accelerates vegetative succession (USFWS, 2015, p. 9127).

4.2.2. NAA Trend

Under NAA conditions, the channelization of riverine habitats, network of revetments and levees, reduced sediment transport, reduced magnitude of floods, and lack of large wood input will inhibit the fluvial geomorphic processes that create new off-channel habitat. As remnant off-channel habitats continue to go through vegetative succession, there will be a loss of habitat over time, that may be exacerbated by non-native vegetation. This will likely lead to the short-term creation of wetland habitat, but without the landscape processes to create additional habitats, these will convert into upland habitat over time.

Non-native predatory fish and amphibians will continue to prey on and compete with animals using off-channel and wetland habitats. In addition, the altered timing and magnitude of the hydrograph may limit the connectivity of off-channel and wetland habitats during seasonally appropriate periods, and further limit the success of plant and animal species utilizing these habitats.

4.2.3. Evaluation Species

Evaluation species associated with the wetland/off-channel habitat include northern red-legged frog and Pacific lamprey. For detailed descriptions of these species, see Section F.2.2.

4.3. RIPARIAN

A detailed definition and description of riparian habitat is provided, see Section F.3.1.

4.3.1. Trends in Riparian Habitat Quality and Quantity

Functioning riparian habitat serves as a buffer for flora and fauna between aquatic and terrestrial ecosystems. Riparian forests in the floodplain depend on periodic disturbances to

maintain themselves on the landscape. Floods scour and deposit soil, replenish nutrients, recharge groundwater, and reset successional processes (ODFW, 2016). Healthy riparian vegetation increases habitat complexity, protects banks from erosion, provides nutrients, and filters runoff (ODFW, 2016). Large wood enables the establishment of riparian forests by stabilizing bars and islands and redirects flow toward the floodplain to create variable hydraulic and substrate environments (Wallick, et al., 2013, p. 20). Woody debris creates important habitat for beaver, amphibians, fish, and aquatic invertebrates (Pollock et al., 2017, p. 10). Shading and cover from riparian vegetation maintains favorable water temperature for fish, and beaver dams can buffer base flows by creating groundwater storage (Beechie, et al., 2013, p. 952). During summer low-flow months when rainfall and snowmelt flows have diminished, storage of water within the hyporheic zone and soil is particularly important for species that prefer moist shrubby or forested habitats. Under natural conditions on unregulated rivers, upland species are prevented from encroaching on the riparian corridor due to periodic flooding and the high-water table, and riparian species are prevented from moving into the uplands due to the lack of available soil moisture.

Cottonwood galleries along the Willamette River and tributaries are represented by a narrow band of forest along the river in the Willamette River floodplain. Historical accounts from an 1871 Corps document reported cottonwood galleries of 0.5 miles (804 m) wide along the mainstem (Gregory, et al., 2002, p. 40). Since 1850, almost half of the riparian areas in coniferous uplands along the major tributaries have been converted to mixed forests (Gregory, et al., 2002, p. 43). Today, approximately half of the riparian habitat along the mainstem is made up of agricultural or urban land use and even more (62%) is within 120 m of the mainstem Willamette (Gregory, et al., 2002, pp. 40-42). Overall, riparian areas along small streams account for 96% of the riparian areas of the entire Willamette River Basin (Gregory, et al., 2002, p. 43). The consequences of land use along small streams are reflected in the changes of plant communities. Groundwater drawdown often can negatively affect riparian and floodplain plant communities, especially when direct hydrologic inputs are limited. Thus, habitat complexity and ecosystem function decrease when riparian habitat is lost or converted to more common agricultural or urban land uses (Fierke and Kauffman, 2006, p. 85).

4.3.2. NAA Trend

Under NAA conditions, riparian forests will continue to succeed to upland forests due to the altered hydrograph that prevents the ecological processes that form and maintain riparian communities (Dykaar and Wigington, 2000, p. 101; Fierke and Kauffman, 2005, p. 161). The loss of riparian habitat will decrease habitat complexity and species diversity throughout the region. Habitat connectivity may also be reduced with the degradation of riparian habitat or the installation of levees and revetments that disconnect lowland and riparian habitats, as these remnant riparian corridors function as important migratory and dispersal routes for many wildlife species (Primozich and Bastasch, 2004, pp. 3-562).

The life histories of native species are closely correlated with the pre-dam hydrograph (Poff, et al., 1997, p. 775). Peak flow events occurring at different times can alter reproduction timing, inhibit regeneration of native vegetation, and benefit invasive species (i.e., reed canary grass inhibiting cottonwood understory re-initiation (Fierke and Kauffman, 2005, p. 159). Suppressing regeneration of riparian forests can lead to a widespread loss in structural complexity of riparian forests, as well as to a loss of native species diversity due to the invasion and establishment of non-native plant species (Theobold et al., 2010, p. 18). Decreased large wood recruitment has affected channel morphology from a historically complex multi-thread channel to a simple single-thread channel (Wallick, et al., 2013, p. 20). Riparian communities are very diverse, and the continued loss of this complex habitat impacts the diversity and abundance of species that depend on it for part, or all aspects, of their life history requirements (Theobold et al., 2010, pp. 3-585).

4.3.3. Evaluation Species

Evaluation species associated with the riparian habitat include foothill yellow-legged frog and northwestern pond turtle. For detailed descriptions of these species, see Section F.3.2.

4.4. UPLAND

A detailed definition and description of upland habitat is provided, see Section F.4.1.

4.4.1. Trends in Upland Habitat Quality and Quantity

Upland habitats have a critical role in watershed function and affect riparian and aquatic habitats (ODFW, 2016). Upland forest trees and shrubs provide habitat and food, absorb water, regulate surface and groundwater flow, and reduce soil erosion. When downed logs enter the stream channel, they influence channel morphology and sediment transport (Keller and Swanson, 1979, p. 361). Ecological processes that include disturbance driven successional conditions of forests, maintaining a patchwork of conditions and creating resilience across the landscape (Hessburg, et al., 2019, p. 9). A patchwork of both early and late successional species both store carbon and maximize species diversity which may enhance forest productivity (Caspersen and Pacala, 2001, p. 902).

Conifer forests historically accounted for two-thirds of the Basin, half of which have been converted to other forest types or land uses over the past 150 years (Gregory, et al., 2002, p. 97). Timber harvest has modified the forested uplands of the Coast and Cascade ranges (i.e., road building, and other activities), but the impact on aquatic habitat has not been as dramatic as in the lowland systems which have been converted to agricultural and developed lands (Primozich and Bastasch, 2004, pp. 3-131).

Development and road construction reduces habitat complexity and results in an overall decrease in the diversity and abundance of wildlife the region (McKinney, 2006, p. 252). In the next 25 years, human population growth in the Willamette Basin will expand urban growth boundaries, affecting natural vegetation by increasing demand for surface water and converting agricultural land to urban and rural residential uses (Hulse et al., 2002, p. 88). Additional stress caused by climate change (warmer temperatures will reduce winter snowpack - a source for water supply), will further stress forests and increase wildfires by as much as ninefold (OSU, 2022). To protect human life and property, wildfire suppression results in a high number of non-native species of plants, including highly successional species that crowd out native plants (Nasi et al., 2002, p. 39). Methods to control these non-native species for property maintenance, such as mowing and pesticide use, eliminates native plant species and the animal species they support.

4.4.2. NAA Trend

While upland habitat is located away from the functional floodplain and not affected by modern fluvial processes, the NAA trend of continued dam operations and maintenance may impact native vegetation and reduce species diversity. Lack of disturbance creates a homogenized landscape that limits the number and type of ecological and physical processes that support fish, wildlife, and plant resources (Fierke and Kauffman 2005, p. 150). Without historical overbank flooding, upland habitat will continue to successionally replace riparian and wet prairie habitats (Dykaar and Wigington, 2000, p. 101; Fierke and Kauffman, 2005, p. 161; Wallick, et al., 2013, p. 47). Upland forest habitats have lower habitat complexity and decreased ecosystem functions than the riparian areas they convert from (Fierke and Kauffman 2005, p. 160).

4.4.3. Evaluation Species

Evaluation species associated with the upland habitat include monarch butterfly and wayside aster. For detailed descriptions of these species, see Section F.4.2.

4.5. PRAIRIE

A detailed definition and description of prairie habitat is provided, see Section F.5.1.

4.5.1. Trends in Prairie Habitat Quality and Quantity

Historically, prairies were one of the dominant habitat types in the Willamette Valley, accounting for 30 percent of the valley floor (Altman et al. 2001, p. 262). Moist winters, dry summers and gentle topography are necessary to produce a prairie, but prairies will generally only persist when regular fire, flooding or other disturbance prevents succession to woody vegetation (USFWS 2010, p. I-6). prairies were kept free of encroaching trees and shrubs by the

native Kalapuya people who set frequent, low-intensity fires. Annual springtime flooding along the Willamette River rejuvenated and maintained complex habitats (Hulse, Gregory, and Baker, 2002, p. 92). Adjacent to these habitats, wet prairie occurs primarily on heavy clay soils of the valley floor that are perennially saturated or flooded during the winter and early spring (Christy & Alverson, 2011, p. 100).

After Euro-American settlement of the region began in the 1830s, regular burning of prairies ceased, seasonal flooding reduced, and most of the prairie habitats were gradually developed for agricultural or urban uses (Altman et al. 2001, p. 262, Christy and Alverson, 2011, p. 100). Woody species and non-native weeds encroached on the remaining prairie habitats. The remnant Willamette Valley native prairie are less than 1% of their former extent (Altman et al. 2001, p. 262), making the Willamette Valley Upland Prairie and Savanna one of the most critically endangered ecosystems of the United States (Risser, et al., 2000, p. 47). The decline in prairies and their increased fragmentation has led to the decline of many native prairie plants and animals (Altman et al. 2001, p. 261). Even so, remnants of these highly diverse, complex, and poorly understood ecosystems provide necessary habitat for many rare species.

Prairie habitat and prairie obligate species remained threatened by habitat destruction, isolation and fragmentation, small patch size, invasion by non-native plant species, and succession. Although climate change is almost certain to affect prairie habitats, there is great uncertainty about the direction and specific effects of climate change on these habitats and obligate species (USFWS, 2010, pp. IV-6).

4.5.2. NAA Trend

Under NAA conditions, historic and remnant prairie habitat are no longer maintained through regular flooding, a disturbance process necessary for ecosystem function and to maintain early seral stage plant communities. Current reservoir and flow management have altered the timing and extent of soil saturation in wet prairie habitats, which can alter reproduction timing, inhibit growth, benefit non-native species or successional vegetation, or impact species through rapid changes in habitat.

4.5.3. Evaluation Species

Evaluation species associated with the prairie habitat include dusky Canada goose and shaggy horkelia. For detailed descriptions of these species, see Section F.5.2.

4.6. DELISTED SPECIES

4.6.1. Evaluation Species

Delisted species include Bradshaw's lomatium and Oregon chub. For detailed descriptions of these species, see Section F.6.1.

4.7. KEYSTONE SPECIES

Keystone species include American beaver and black cottonwood. For detailed descriptions of these species, see Section F.7.1.

5. IMPACTS ON FISH, WILDLIFE, AND PLANT RESOURCES - EFFECTS OF ALTERNATIVES

We analyzed the impacts of the proposed WVS Alternatives on the overall ecological and physical health of the five habitats and the key conservation issues for the fourteen evaluation species found within them. The cumulative effects under the NAA as well as the projected change in the long-term trend (i.e., more than 5 years) resulting from each Alternative are summarized below. Projected trends of proposed measures that support water quality, flow, upstream and downstream passage, and basin-wide improvements are qualitatively summarized by habitat in Tables 9, 10, 11, 12 and 13. A key for the values in these tables is provided in Table 8. For a detailed description of each proposed measure and analysis of its effects on each habitat type and their associated evaluation species, see Appendix G. Tables with the effects of each measure and cumulative effect of each alternative by habitat type is provided in Appendix H.

5.1. NAA

Cumulative Impacts: Operations and maintenance of the projects will continue to negatively affect overall water quality, flow, and fish passage. Current operations and maintenance will likely decrease and, at best, maintain the abundance of accessible bank and run-of-river reservoir shoreline, floodplain, side channel, transition area, tributary mouth, and unimpounded reach subhabitats throughout the Study Area. Water will remain colder in the spring and warmer in the fall and with greater TDGs. (Table 9). Tributary flows are currently defined by the 2008 BO. With the NAA, there are higher minimum flows during early spring and lower flows during late spring and summer (Table 10). Lack of disturbance processes will limit the creation of new off-channel habitat, leading to a loss of habitat through vegetative succession and siltation. The current operating conditions of the WVS under the NAA do not adequately protect migrating fish species (Corps, 2025) (Table 11 and 12).

5.2. ALTERNATIVE 1

Cumulative Impacts: Retaining spring runoff to increase summer flows will alter the natural spring flood hydrograph. Downstream water quality would see improvements with normative water temperatures and fewer TDGs. (Table 9). Summer and fall flow could provide connectivity to secondary channels, off-channel habitats, and hydrologically connected wetlands, therefore increasing habitat availability and complexity. However, with increased regulated flows, natural disturbance processes will be lost. Regulated flows prevent natural

erosion, deposition, and flooding. Peak flow events may occur weeks earlier or later than normal, which also inhibit regeneration of native vegetation and benefit non-native species during seasonally low flow periods (Table 10). While this Alternative has improvements to upstream fish passage (Table 12), downstream passage will continue to be deficient (Table 11). Basin-wide measures will create an overall benefit to all in-channel habitats. However, potential negative impacts to upland habitat from gravel augmentation may occur if roads between gravel sources and points of gravel distribution introduce non-native plants or cause damage to forest cover (Table 13).

5.3. ALTERNATIVE 2A

Cumulative Impacts: Regulated water temperatures could diversify water temperature in the spring and have more normative water temperatures downstream in fall and winter, thus improving water quality. However, increased water temperature in hydrologically connected habitats may increase the dominance of non-native predatory and competitive fish and impact breeding timing for the western ridged mussel or its host fish (Table 9). Water releases via the spillway may directly impact downstream habitat depending on timing, magnitude of fluctuations and frequency of discharge. While flow management will be more stable and result in the desiccation of fewer habitats over time (i.e., wet prairie), natural disturbance processes will be lost. Stable flows may slow lateral channel movement, hindering the formation of additional off-channel habitats downstream thus favoring non-native fish and non-native amphibians, as well as successional vegetation downstream (Table 10). While this Alternative has improvements to upstream fish passage (Table 12), downstream passage will continue to be deficient (Table 11). Basin-wide measures will create an overall benefit to all in-channel habitats. However, potential negative impacts to upland habitat from gravel augmentation may occur if roads between gravel sources and points of gravel distribution introduce non-native plants or cause damage to forest cover (Table 13).

5.4. ALTERNATIVE 2B

Cumulative Impacts: Regulated water temperatures could diversify water temperature in the spring and have more normative water temperatures downstream in fall and winter, thus improving water quality. However, increased water temperature in hydrologically connected habitats may increase the dominance of non-native predatory and competitive fish and impact breeding timing for the western ridged mussel or its host fish (Table 9). Water releases via the spillway may directly impact downstream habitat depending on timing, magnitude of fluctuations and frequency of discharge. While flow management will be more stable and result in the desiccation of fewer habitats over time (i.e., wet prairie), natural disturbance processes will be lost. Stable flows may slow lateral channel movement, hindering the formation of additional off-channel habitats downstream thus favoring non-native fish and non-native amphibians, as well as successional vegetation downstream. Furthermore, a deep spring drawdown could create higher than historic flows that dislodge/sweep away amphibian egg

masses and larvae, while water levels that drop quickly could result in desiccated eggs/stranding. Increased velocities higher than historic flows and/or rising water levels could flood Northwestern Pond turtle nests resulting in mortality of eggs or hatchlings still in the nest chamber (Table 10). While this Alternative has improvements to fish upstream passage (Table 12), downstream passage will continue to be deficient (Table 11). Basin-wide measures will create an overall benefit to all in-channel habitats. However, potential negative impacts to upland habitat from gravel augmentation may occur if roads between gravel sources and points of gravel distribution introduce non-native plants or cause damage to forest cover (Table 13).

5.5. ALTERNATIVE 3A

Cumulative Impacts: Modifying operations may provide more normative fall and winter water temperatures and hence may improve water quality. However, increased water temperature in hydrologically connected habitats may increase the dominance of non-native predatory and competitive fish and impact breeding timing for the western ridged mussel or its host fish (Table 9). In high flow, low temperature years, hydrologic connectivity would be provided to habitats comparable to spring high flow events. In low flow, high temperature years, the riverine habitat would be hydrologically disconnected from other habitats unusually early. This would be followed by large increases in flow in late-spring and early-summer to meet downstream temperature targets, reconnecting off-channel habitat. The rapid shift from dry to wet conditions might impact spawning and rearing activities, habitat availability and suitability, and create conditions where large algal blooms would occur during periods with relatively high temperatures, limiting DO and impacting water quality. Altering the natural spring hydrograph by regulating flows prevents natural disturbance processes such as erosion, deposition, and flooding, and further could favor non-native species (Table 10). Altering the natural fall hydrograph by a deep drawdown in summer/early fall could benefit riverine and reservoir habitat. Increasing flushing flows (i.e., sediment flushing) could facilitate downstream movement of both native and non-native fish past the dams. Non-native fish may enter off-channel habitats in large numbers, and prey upon or compete with native fish. In addition, the drawdowns could reduce the accessibility, availability and quality of off-channel habitat for native fish downstream, as fine sediment entrained by deep reservoir drawdown collects in off-channel locations. Reduced high flows in managed reaches may limit the ability to flush deposited material out of off-channel habitats, compared to the pre-dam flows that created these habitats. A high sediment load could bury established western ridged mussel beds or increase the sediment concentration in the water column to levels that could be difficult for filtration. There is a high potential for decreased water quality downstream as low dissolved oxygen events have been observed in past drawdowns at Fall Creek. Additionally, if precipitation does not arrive by early fall, there is potential to reduce water quantity downstream (Table 10). This Alternative has improvements to fish upstream passage similar to the other Alternatives (Table 12). Basin-wide measures will create an overall benefit to all in-channel habitats. However, potential negative impacts to upland habitat from gravel

augmentation may occur if roads between gravel sources and points of gravel distribution introduce non-native plants or cause damage to forest cover (Table 13).

5.6. ALTERNATIVE 3B

Cumulative Impacts: Modifying operations may provide more normative fall and winter water temperatures and hence may improve water quality. However, increased water temperature in hydrologically connected habitats may increase the dominance of non-native predatory and competitive fish and impact breeding timing for the western ridged mussel or its host fish (Table 9). In high flow, low temperature years, hydrologic connectivity would be provided to habitats comparable to spring high flow events. In low flow, high temperature years, the riverine habitat would be hydrologically disconnected from other habitats unusually early. This would be followed by large increases in flow in late-spring and early-summer to meet downstream temperature targets, reconnecting off-channel habitat. The rapid shift from dry to wet conditions might impact spawning and rearing activities, habitat availability and suitability, and create conditions where large algal blooms would occur during periods with relatively high temperatures, limiting DO and impacting water quality. Altering the natural spring hydrograph by regulating flows prevents natural disturbance processes such as erosion, deposition, and flooding and could favor non-native species (Table 10). Altering the natural fall hydrograph by a deep drawdown in summer/early fall could benefit riverine and reservoir habitat. Increasing flushing flows (i.e., sediment flushing) could facilitate downstream movement of both native and non-native fish past the dams. Non-native fish may enter off-channel habitats in large numbers, competing with and preying upon native fish. In addition, the Fall Creek drawdown could reduce the accessibility, availability and quality of off-channel habitat for native fish downstream of the dam, as fine sediment entrained by deep reservoir draw down is deposited in off-channel locations. Reduced high flows in managed reaches may limit the ability to flush deposited material out of off-channel habitats, compared to the pre-dam flows that created these habitats. A high sediment load could bury established western ridged mussel beds or increase the sediment concentration in the water column to levels difficult for filtration. There is a high potential for decreased water quality downstream as low dissolved oxygen events have been observed in past drawdowns at Fall Creek. Additionally, if precipitation does not arrive by early fall, there is potential to reduce water quantity downstream (Table 10). This Alternative has improvements to upstream fish passage like the other Alternatives (Table 12). Basin-wide measures will create an overall benefit to all in-channel habitats. However, potential negative impacts to upland habitat from gravel augmentation may occur if roads between gravel sources and points of gravel distribution introduce non-native plants or cause damage to forest cover (Table 13).

5.7. ALTERNATIVE 4

Cumulative Impacts: Structural modifications may provide cooler temperatures in the fall and winter and improve water quality in riverine/reservoir habitats (Table 9). While flow

management will be more stable and result in the desiccation of fewer habitats over time (i.e., wet prairie), natural disturbance processes will be lost. Stable flows may slow lateral channel movement, hindering the formation of additional off-channel habitats downstream thus favoring non-native fish, non-native amphibians, and successional vegetation (Table 10). While this Alternative has improvements to upstream fish passage (Table 12), downstream passage will continue to be deficient (Table 11). Basin-wide measures will create an overall benefit to all in-channel habitats. However, potential negative impacts to upland habitat from gravel augmentation may occur if roads between gravel sources and points of gravel distribution introduce non-native plants or cause damage to forest cover (Table 13).

5.8. ALTERNATIVE 5

Cumulative Impacts: Regulated water temperatures could diversify water temperature in the spring and have more normative water temperatures downstream in fall and winter, thus improving water quality. However, increased water temperature in hydrologically connected habitats may increase the dominance of non-native predatory and competitive fish and impact breeding timing for the western ridged mussel or its host fish (Table 9). Water releases via the spillway may directly impact downstream habitat depending on timing, magnitude of fluctuations and frequency of discharge. While flow management will be more stable and result in the desiccation of fewer habitats over time (i.e., wet prairie), natural disturbance processes will be lost. Stable flows may slow lateral channel movement, hindering the formation of additional off-channel habitats downstream thus favoring non-native fish and non-native amphibians, as well as successional vegetation downstream. Furthermore, a deep spring drawdown could create higher than historic flows that dislodge/sweep away amphibian egg masses and larvae, while water levels that drop quickly could result in desiccated eggs/stranding. Increased velocities higher than historic flows and/or rising water levels could flood Northwestern Pond turtle nests resulting in mortality of eggs or hatchlings still in the nest chamber (Table 10). While this Alternative has improvements to fish upstream passage (Table 12), downstream passage will continue to be deficient (Table 11). Basin-wide measures will create an overall benefit to all in-channel habitats. However, potential negative impacts to upland habitat from gravel augmentation may occur if roads between gravel sources and points of gravel distribution introduce non-native plants or cause damage to forest cover (Table 13).

Table 8. Key to cumulative impact summary tables.

Value	Description
++	Cumulative impacts overwhelmingly positive to habitats or focal species, and often support ecosystem and landscape function. Negative impacts are relatively minor in scope.
+	Measures often include positive and negative impacts to habitats or focal species, and minor effects to ecosystem and landscape function, but generally support positive outcomes. This includes some measures with minor positive outcomes.
o	Cumulative impacts of measures in this alternative generally have little impact to habitats or focal species. This category also includes measures with generally comparable positive and negative outcomes.
-	Measures often include positive and negative impacts to habitats or focal species, and minor effects to ecosystem and landscape function, but generally result in negative outcomes. This includes some measures with minor negatives outcomes.
--	Cumulative impacts overwhelmingly negative to habitats or focal species, and often lead to a decline in ecosystem or landscape function. Positive impacts are relatively minor in scope.
	There were no likely impacts to habitat or focal species for measures in this alternative.

Table 9. Summary of projected trends of water quality under the NAA and all Alternatives, organized by habitat type

Habitat Type	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/Reservoir	-	+	o	o	-	-	+	o
Off-channel/Wetland	-	o	-	-	-	-	-	-
Riparian	-	+	-	-	-	-	+	-
Prairie								
Upland								

Table 10. Summary of projected trends of flow under the NAA and all Alternatives, organized by habitat type

Habitat Type	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/Reservoir	-	--	--	--	--	--	--	--
Off-channel/Wetland	-	--	--	--	--	--	--	--
Riparian	-	--	--	--	--	--	--	--
Prairie	-	-	+	+	+	+	+	+
Upland	-	--						

Table 11. Summary of projected trends of downstream passage under the NAA and all Alternatives, organized by habitat type

Habitat Type	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/Reservoir	-	-	-	-	--	--	-	-
Off-channel/Wetland	-	-	-	-	--	--	-	-
Riparian	-	-	-	--	--	--	-	--
Prairie	-	-	-	-	o	-	-	-
Upland	-	-	-	o			-	o

Table 12. Summary of projected trends of upstream passage under the NAA and all Alternatives, organized by habitat type

Habitat Type	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/Reservoir	-	++	++	++	++	++	++	++
Off-channel/Wetland	-	++	++	++	++	++	++	++
Riparian	-	+	+	+	+	+	+	+
Prairie	-	-	-	-	-	-	-	-
Upland	-	-	-	-	-	-	-	-

Table 13. Summary of projected trends of basin-wide measures under the NAA and all Alternatives, organized by habitat type

Habitat Type	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/Reservoir	-	++	++	++	++	++	++	++
Off-channel/Wetland	-	++	++	++	++	++	++	++
Riparian	-	++	++	++	++	++	++	++
Prairie	-	+	+	+	+	+	+	+
Upland	-	-	-	-	-	-	-	-

5.9. INTERIM OPERATIONS

The timing and duration of the interim operations vary by alternative, but some interim operations would extend for nearly the 30-year implementation timeframe under alternatives 1, 2a, 2b, 4, and 5. Although not identical, the interim measures are similar to the operational fish passage measures evaluated under alternatives 2b, 3a, 3b, and 5, including portions of measures 40, 166, 714, 720, 721, and 726.

Modifying operations may provide more normative fall and winter water temperatures and hence may improve water quality. However, increased water temperature in hydrologically connected habitats may increase the dominance of non-native predatory and competitive fish and impact breeding timing for the western ridged mussel or its host fish. Interim operations may facilitate the movement of non-native fish through the reservoirs, where they may enter riverine, off-channel, and hydrologically connected wetland habitats in large numbers, just prior to their spawning season. Altering the natural fall hydrograph by a deep drawdown in early fall could benefit riverine and reservoir habitat. Increasing flushing flows (i.e., sediment flushing) could facilitate downstream movement of both native and non-native fish past the dams. Non-native fish may enter off-channel habitats in large numbers, competing with and preying upon native fish. In addition, the drawdowns likely reduce the accessibility, availability and quality of off-channel habitat for native fish downstream of the dam, as fine sediment entrained by deep reservoir draw down is deposited in off-channel locations. Reduced high flows in managed reaches may limit the ability to flush deposited material out of off-channel habitats, compared to the pre-dam flows that created these habitats. A high sediment load could bury established western ridged mussel beds or increase the sediment concentration in the water column to levels difficult for filtration. There is a high potential for decreased water quality downstream as low dissolved oxygen events have been observed in past drawdowns at Fall Creek. Additionally, if precipitation does not arrive by early fall, there is potential to reduce water quantity downstream. Surface spill may impact aquatic organisms depending on the timing, magnitude, and frequency of fluctuations. Surface spill may allow passage of non-native aquatic species using warmer surface water.

6. CONSERVATION RECOMMENDATIONS

The conservation recommendations below address the impacts of the No Action Alternative, as well as the measures associated with the other proposed alternatives. The following conservation recommendations will benefit species likely to be affected by the WVS and support more coordinated, systemic, and adaptive management and conservation of Basin-dependent fish, wildlife, and plant resources. These recommendations address the WVS as a whole and specific species needs that are temporal or spatial in their application. Recommendations are not prioritized and, in rare circumstances, may conflict. These

conservation recommendations are not expected to occur concurrently but are expected to support species and their habitats during ongoing and adaptive management of the system. Conservation recommendations have been grouped into two categories, General Conservation Recommendations and Species-Specific Recommendations.

General Conservation Recommendations

6.1. RESTORE OR MIMIC CRITICAL COMPONENTS OF NATURAL HYDROLOGICAL REGIMES

The integrity of free-flowing water systems depends largely on natural dynamics, among which the hydrological regime is centrally important (Poff, et al., 1997, pp. 768-769). Natural hydrological regimes include varying environmental components (e.g., flows) characterized by seasonal timing, frequency, magnitude, duration, and other factors which drive ecosystem productivity. We recognize that restoring critical components of natural hydrological regimes may not be possible every year, given the variable water supply, timing of annual runoff, and the constraints by which the WVS is operated to meet flood control objectives. Thus, we offer conservation recommendations that could be implemented when environmental conditions are favorable. To identify favorable conditions, we encourage the Corps to continue to work with the Service, Federal and State agencies, Tribes, and other partners collectively to understand when, where, and how more normative conditions can be used to restore natural floodplain function while still meeting other authorized purposes. This is particularly critical when conservation measures are seemingly incompatible or during extreme flow years.

- In coordination with the Service and other experts, modify operations to provide a more normative (pre-dam) hydrograph, particularly freshets and peak flows that (1) connect floodplain and off-channel habitat, and (2) initiate sediment transport and hence restore existing and creating new riverine and off-channel habitats. Utilize the analysis and recommendations in Jones et al. 2016, including the recommendations for additional analysis and studies, to assist in identifying flow targets that will sustain fluvial geomorphic processes that create and maintain habitat diversity.
- When restoring pre-dam hydrologic regimes is not feasible, mimic natural hydrology to provide environmental flows and sediment transport at least annually or biannually. In coordination with the Service and other experts, develop and implement flow and temperature recommendations to meet this objective in addition to other objectives (e.g., juvenile fish emigration), including minimizing hourly and daily flow fluctuations; considering the timing and frequency of peaks; and providing recommendations across all water year types (e.g., deficit, normal, and abundant). Utilize the analysis in Jones et al. 2016, or similar studies, to assist in identifying flow targets that will achieve ecosystem targets.
- At Fern Ridge Reservoir, in coordination with the Service and other experts:

- Delay reservoir draining – The Corps managed Fern Ridge Project is operated so the reservoir level is low in the winter and high in the summer. This hydrology is the opposite of the natural hydrograph, as most of the precipitation falls in the winter months and the area receives very little precipitation in the summer. Service refuge managers try to mitigate for this by providing more water on the landscape during the winter, within artificial wetland cells. Ideally, reservoir water would be pumped into the wetland cells in November, simulating winter hydrology, but Corps operations currently begin reservoir drawdown around October 1st to comply with the rule curve. This would require water to be pumped as early as mid-September, resulting in an inadequate amount of water on the wildlife area, in the wrong places at the wrong time. Maintaining reservoir levels through October or November would provide an opportunity to pump water later in the year to benefit wildlife.
- Reduce the rate of reservoir drawdown – The reservoir is quickly drained resulting in several inches of reservoir drop per day. Because the Fern Ridge Project area is flat, rapid reservoir drawdown can result in a substantial amount of habitat change and species response. Some wildlife species are more mobile than others; some are unable to respond quickly to these habitat changes. Amphibians, for example, can be caught in isolated pools and become susceptible to high rates of predation. As part of a rule curve evaluation, consider reducing the rate of reservoir drawdown in the fall to account for wildlife needs.
- Establish a higher-elevation low pool level – This would hold a greater amount of water than the minimum pool and would be particularly beneficial in dry years as less water would be needed to reach full pool.

6.2. INCREASE HABITAT CONNECTIVITY AND IMPROVE FISH PASSAGE

Fish and wildlife species need to move in order to eat, reproduce, avoid predators, respond to changing habitat conditions, and maintain healthy local and regional populations. Most species that inhabit wetlands and aquatic ecosystems rely on an interconnected network of streams and rivers as pathways for movement. Fully aquatic species (e.g., fish, mussels, crayfish) travel through the water, while semi-aquatic wildlife (e.g., turtles, salamanders, beaver, mink, otter) move along streams, utilizing both water and adjacent wetland or upland habitats (UMass Climate Action Tool, 2022).

Without the ability to freely move within a watershed, many species are limited in their ability to successfully complete portions of their life cycle or to respond to changing environmental conditions. These conditions can result in an overall reduced diversity of native aquatic species, a decreased resiliency (i.e., populations ability to recover after unexpected (stochastic) events), reduced representation (i.e., genetic and ecological diversity to maintain adaptive potential)

and reduced redundancy (i.e., number of populations). Future effects of climate change are expected to exacerbate these conditions as water temperatures increase, and the magnitude, duration, and frequency of precipitation changes over time.

While the WVS dams are operated to provide a range of benefits that include fish and wildlife conservation, one of the most impactful aspects of the WVS to fish and other aquatic organisms is the fragmentation of habitats and loss of connectivity within many of the Basin's major tributaries. Of the 13 dams that comprise the WVS, there are collection facilities that allow for the transport of salmonids upstream on the North Santiam (Minto), South Santiam (Foster), McKenzie (Cougar), and Middle Fork Willamette (Fall Creek and Dexter). While project management has regularly implemented operations to facilitate downstream passage of juvenile anadromous salmonids, the efficacy of these operations and survival past the projects has been variable (Hansen et al., 2017, p. 20-83). Currently the only operational downstream passage facility is located at Cougar dam, however the preferred alternative includes a plan to improve downstream passage through deep reservoir drawdowns. Since 2011, Fall Creek reservoir has been completely drawn down to facilitate downstream passage. At other projects, the lack of facilities and current operational conditions often result in injury or mortality of passing fish and other aquatic organisms. These projects would require improvement for helping reestablish migratory sub-populations and help protect resident fish species.

As noted elsewhere in this Report, the Corps developed the EIS to meet requirements under NEPA. Along with other actions, the preferred alternative identified in the EIS includes future operational and/or structural fish passage (up and downstream) at multiple WVS dams, geared largely towards ESA protected Chinook salmon (*Oncorhynchus tshawytscha*), winter steelhead (*Oncorhynchus mykiss*) and bull trout (*Salvelinus confluentus*). Given that passage is focused on Chinook, steelhead and bull trout, the dams investigated for passage are those likely to provide the greatest benefit to those three species, without much consideration to the migratory requirements of other native aquatic species at the remaining WVS dams and the continued impacts to these species from operation and maintenance of these dams into the future.

The Corps have indicated the preferred alternative for the EIS is 5. While some measures in the preferred alternative have not yet been finalized, information to date suggests structural fish passage will likely not be included in the preferred alternative at the following dams: Blue River Dam (McKenzie River subbasin); Dorena Dam (Row River subbasin); Cottage Grove Dam (Coast Fork subbasin); and Fern Ridge Dam (Long Tom River subbasin); Hills Creek Dam (Middle Fork Willamette subbasin). Dams where fish passage is being planned under draft Alternative 5 include Green Peter, Foster, Lookout (includes Dexter, the re-regulation dam), Cougar (upstream passage already exist), and Detroit (including Big Cliff, the re-regulation dam). Passage at Fall Creek Dam is already in place (trap and haul for upstream passage and deep drawdown for downstream passage).

A full accounting of the aquatic species impacted by lack of passage at the Corps' WVS dams is unknown but impacts to native fishes, in addition to Chinook, steelhead trout and bull trout, likely includes the following: coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), rainbow trout (*Oncorhynchus mykiss*), several species of suckers (*Catostomidae* ssp.); several species of lampreys (*Entosphenus* ssp. and *Lampetra* ssp.), mountain whitefish (*Prosopium williamsoni*), peamouth chub (*Mylocheilus caurinus*), northern pikeminnow (*Ptychocheilus oregonensis*), and chiselmouth (*Acrocheilus alutaceus*). Even the formerly threatened Oregon chub (*Oregonichthys crameri*), endemic to the Willamette Basin, has been documented as a migratory fish potentially impacted by lack of passage at WVS dams.

We acknowledge the importance of minimizing WVS impacts to threatened and endangered species through multiple means, including providing upstream and downstream fish passage, along with other key measures. But in this FWCAR we also acknowledge the value and importance of habitat connectivity across the Basin for other native fishes and other aquatic organisms.

Therefore, we recommend the Corps, in coordination with the Service and other experts, conduct or fund an evaluation of fish passage alternatives at all WVS dams not included in the preferred alternative identified in the EIS. As the continued Corps operation of the WVS will likely continue to impact many species, we recommend the Corps develop a mitigation program to help fund restoration and conservation actions to off-set continued operations. We recommend this study be conducted within 5 years of completion of the NEPA process and finalization of the Record of Decision (ROD).

The Fish Passage Evaluation should include, but is not limited to, the following:

- Assessment of aquatic species likely to be impacted in each subbasin by continued operation and maintenance of each dam.
- Evaluation of alternatives for operational and/or structural solutions to provide for upstream and downstream passage for native fish and other aquatic organisms.
- Upstream and downstream passage cost estimates at each project for each identified alternative.
- Monitoring for fish passage efficiency, survival, and effectiveness for implemented operational and structural measures.
- Integration of fish passage solutions at upstream dams with passage solutions at downstream dams as applicable (ODFW, 2021).
- Long-term plans for fish passage at Hills Creek Dam to support recovery of the Middle Fork Willamette spring Chinook salmon population (ODFW, 2021).

6.3. MAINTAIN OR ENHANCE HABITAT COMPLEXITY AND HETEROGENEITY

Habitat complexity and heterogeneity greatly influence the function of ecological communities. Ecological communities with high habitat complexity and heterogeneity often contain greater

species richness and abundance, and thus, increase the chance of species survival through all life-history stages. In the Basin, the presence of dams and associated infrastructure in and along mainstems, tributaries, riparian zones, and wetlands have reduced habitat complexity and led to homogenization of habitats, thereby decreasing overall ecological function (Moyle and Mount, 2007, pp. 5711-5712; Poff, et al., 1997, p. 770). The following recommendations are intended to maintain or enhance habitat complexity and heterogeneity throughout the Basin. We recommend that off-site recommendations be implemented after actions intended to avoid and minimize have been fully explored and considered.

- We recognize that it is currently outside of the Corps authority to use Section 14 of the Rivers and Harbors Appropriation Act of 1899, as amended, and codified in 33 USC 408 (Section 408) authorities to improve connectivity, reconnect side channels. However, levees and revetments that are Corps authorized, and hence fall under the "408 Program", continue to disconnect floodplain, off-channel, riparian, and wetland habitats to the detriment of a wide spectrum of fish and wildlife species and their habitats. While not currently implementable, we encourage the Corps to review the 408 Program to determine if there is any Program flexibility that would allow currently non-functional structures to be discontinued from Program coverage. If structures are non-functional, then the current level of protection would not change. This would provide a greater opportunity by project sponsors for levee set-backs and/or revetment modification or removal, which could reduce downstream flooding by allowing instream flow to laterally expand across a greater extent of the historic floodplain.
- For Corps owned revetments and levees, remove or modify riprap by adding large wood and riparian vegetation for stabilization. Where revetment removal is not possible, leave the riprap toe in place, but remove all rock above Ordinary High Water. Assess the feasibility of setting back levees and/or removing revetments to increase channel width and floodplain connectivity.
- Utilize the Corps' Engineering with Nature (EWN) Initiative to design levee setbacks and/or revetment modification that include natural processes and increase habitat value (Corps, 2021b). Engage with partners to collaborate and implement flood-resilient and environmentally sustainable projects with long-term benefits to the system.
- Implement habitat mitigation and restoration measures throughout the Basin (at both off-site and on-site locations). Conduct botanical surveys and stand exams pre-construction of structural measures to document presence or absence of both listed species and Heritage Ranked species.
- Collect and make large wood available at existing Corps revetments.
- In managed reaches of the WVS without flood flow events but with some inundation, floodplain sloughs and secondary channels will gradually fill with fine sediment and undergo vegetative succession, resulting in a long-term decrease in these important off-channel and wetland habitats. Restoration and management techniques should be

assessed to determine where enhancement should occur to sustain these habitats within the flow limitations of the WVS.

6.4. MAINTAIN FUNCTIONALITY OF NATIONAL WILDLIFE REFUGES AFFECTED BY WVS OPERATIONS

The Service's National Wildlife Refuge (NWR) System is a network of lands and waters directed by the National Wildlife Refuge System Administration Act (16 U.S.C. § 668dd) to maintain ecological processes and habitat features to support fish, wildlife, and plants. The Study Area includes two NWRs established during the 1960s: Ankeny NWR and William L. Finley NWR; Baskett Slough NWR is located within the Basin, but it is unlikely to be directly influenced by WVS operations. Some of the tracts of native habitats found on these Refuges are considered regionally significant partly due to their size and/or populations of rare species known to exist within these areas. The habitats found in these NWRs are highly water dependent and include wetlands, wet prairies, riparian, and agricultural areas that provide resources for waterfowl, amphibians, fish and plants. Management of these habitats require retaining winter flows with a combination of dikes, spillways and water control structures. Given the loss that has already occurred in native habitats throughout the Willamette Valley due to altered water regimes, pollution, and invasive plants and animals, any maintenance or restoration of native habitats has the potential to contribute greatly to the biological integrity and diversity of the region (USFWS, 2017, pp. 1-22).

- Ensure operations maintain winter flows needed to retain water in Ankeny NWR's infrastructures for management of critical refuge system habitats (i.e., wet prairies). Most of Ankeny NWR's seasonal wetlands, are managed using a combination of dikes, spillways and water control structures.
- The 341-acre Snag Boat Bend Unit of Finley NWR is in the floodplain of the Willamette River and contains over a mile of shoreline of an inside bend of the river. The Porter Dam Revetment is congested with non-native aquatic vegetation that degrades the habitat for fish and wildlife and blocks off a backwater slough at the confluence of Lake Creek. A multi-million-dollar effort is being undertaken by Oregon Watershed Enhancement Board, Bonneville Power Administration, and the Service to remove or modify the structure and provide a more natural flow regime through the slough. It will be important for the Corps to maintain the flow regime the project was designed under for the revetment modification to function. This modification will allow the river itself to maintain off-channel habitat for the benefit of waterfowl, fish, and northwestern pond turtles.
- In coordination with the Service, support the monitoring and management of invasive species on NWRs as needed to maintain the structure and function of various habitats. For example, provide sufficient water in the spring to inundate marsh habitat when the

soil is cold to reduce reed canary grass (*Phalaris arundinacea*) germination and support native emergent plants.

- Work with NWRs and their partners to support reforestation efforts in lower tributaries affected by flow management. Spring flooding is needed to create seasonal ponds that hold water in the winter and spring and typically dry out in the summer. These ponds support an insect prey base for Refuge species and provide habitat for amphibian reproduction.
- Ensure sustainability of current management operations on NWRs as needed to meet system mission, goals, and Refuge purposes. Provide sufficient flows to preserve intact wet prairie habitat for migratory waterfowl and plants. Maintaining wet prairie, off-channel, and riparian habitats will allow conservation and protection of migratory birds and the "big six" fish and wildlife-dependent public uses (e.g., hunting, fishing, wildlife observation, photography, interpretation, and environmental education).

6.5. REDUCE THE SPREAD OF INVASIVE SPECIES, AND PREVENT FUTURE INVASIONS

Invasive species are non-native animal and plant species that pose harm to native fish, wildlife, and plant resources. Invaders often thrive in new environments as they have few, if any, natural predators but plenty of resources, allowing them to outcompete native species. Invaders can also introduce new pathogens (which are also invasive species) to ecosystems.

We recognize WVS operations are not solely responsible for introducing invasive species to the Basin, and those operations are not likely to lead to future introductions. However, because of the Federal dam operations and project reservoirs, there is the potential to spread invasive species throughout the Basin. If left unaddressed, then invasive species can lead to additional negative environmental and economic impacts (e.g., higher costs for prevention of their establishment and control). In the interest of managing invasive species, reducing their spread, and preventing future invasions, the Service offers the following recommendations:

- Continue to conduct regular vegetation monitoring of land exposed during new reservoir drawdowns. Establish a management plan to address invasive plant species in new, early seral habitat no longer flooded in summer and restore native vegetation where reservoirs are kept below full pool levels.
- Continue to conduct regular vegetation monitoring of new reservoir fills; allowing reservoirs to overfill can spread invasive plant species into adjacent prairie habitats.
- Continue to support native species and reduce risk from invasive species by reducing the abundance and impacts of non-native fish and non-native vegetation in lands and waters under the Corp's ownership/authority.
- Continue funding the Oregon Department of Fish and Wildlife and Oregon State Marine Board program for vessel inspection facilities and operations. Provide support and resources for additional boat cleaning stations to prevent invasion and establishment of

non-native species. Include and update information in signage at WVS boat ramps and other appropriate locations frequented by the public.

- Continue to participate in regional agreements and forums for invasive species management. Coordinate with, and implement prioritized actions identified by, interagency invasive species teams. The Aquatic Invasive Species Network and the Western Regional Panel can provide direction regarding aquatic invasive species. Work with the Oregon Invasive Species Council for direction on focused actions to eradicate and reduce the spread of invasive species.

6.6. SUPPORT LONG-TERM MONITORING AND ADAPTIVE APPROACHES TO FUTURE MANAGEMENT

In the Basin, maintaining ecological processes, restoring habitat, and preserving fish, wildlife, and plants are essential to the future sustainability of our biologically, socioeconomically, and culturally valuable natural resources. Predicting how water resource and infrastructure development or changing conditions such as climate change will impact the environment is exceedingly difficult. In the face of such uncertainty, Federal, State, Tribal, academic, and private partners should inform and support science-based policy decisions that advocate for more research, long-term monitoring and evaluation, and adaptive approaches to managing fish, wildlife, and plant resources. To maintain ecosystem resiliency in the face of uncertainty and future threats, we offer the following recommendations:

- Continue to monitor water quality (temperature, TDG, pH) to ensure that operations do not result in significant, long-term changes to standards or benchmarks that serve as important environmental cues for successful growth and reproduction of migratory and resident fishes and other aquatic and semi-aquatic species. Adjust operations to correct if needed.
- Climate change is expected to increase drought and reduce snowpack in areas that currently depend on glacial and snow-melt runoff (Doppelt, et al., 2019, p. ii) as well as areas that depend on inflows provided by seasonal rains. Several studies have concluded that the region has a high likelihood of experiencing multi-decade droughts. Such an event will likely require substantially different management strategies as the impacts will cross multiple consecutive generations of fish, reducing their ability to rebound (ODFW, 2021).
    - Evaluate the potential for, and flexibility to implement, additional rule curves or water control diagrams based on the water forecast. As the frequency of extreme events increase due to climate change, current rule curves may need to be re-evaluated. Consider increasing the number of days the project is allowed to deviate from the rule curve to account for forecasted dry periods following a large flow event.
    - Identify areas to promote beaver activity as storage behind beaver dams high in watersheds may provide a buffer for base flows (Pollock et al., 2017, p. 4).

- The USGS Water Resources Mission Area is planning to intensively study the Willamette Basin over the next decade. Support activities that integrate enhanced monitoring, research, modeling, and assessment to improve understanding of water availability. This improved understanding will support goals for restoration of both habitat and normative flows when water management needs for human uses and habitat conservation are in conflict.

6.7. ANNUAL REPORTING

- Annually provide a progress report to the Service with information on the FWCA actions and associated tasks attempted, implemented, or completed.

6.8. ANNUAL FUNDING FOR COORDINATION

As noted previously, and in parallel with the current NEPA process, ESA Section 7 consultation is underway between the Corps and Service with a BO anticipated to be signed in 2026. While this CAR provides general conservation recommendations, implementation of our BO, as well as the BO from NMFS expected to be completed on the same schedule, will include multiple actions, consistent with the final EIS, that we expect will warrant additional engagement and coordination with the Service under the FWCA (e.g., construction of fish passage facilities, water temperature control towers, floodplain restoration, etc.). In order to maximize and streamline future coordination under FWCA as the EIS' preferred alternative and BOs are implemented, we recommend the Corps provide annual funding to the FWS for the duration of the Service's BO.

Species-Specific Conservation Recommendations

6.9. RIVERINE/RESERVOIR SPECIES

6.9.1. Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*)

- Provide opportunities to improve the natural distribution of coastal cutthroat trout by improving passage and connectivity for all life stages to high quality habitat (IRCT 2016, p. 55; ODFW, 2016a).
    - Inventory fish passage conditions for fish bearing streams entering the WVS reservoirs at low reservoir elevations and provide corrective measures that will allow for migratory fish passage during the October through April migration period.
        - Maintain passable culverts at WVS reservoirs especially during the months of October through April.
        - Replace unpassable culverts in reservoirs with culverts that are always passable and not dependent on the reservoir water elevation. Initial replacement should be with first culvert upstream from the dams which are impassable to migratory fish. Coastal cutthroat trout populations

require access to tributaries for reproduction. Reduced access to spawning habitat has contributed to declines in cutthroat populations associated with WVS reservoirs over time.
        - Develop and implement mitigation efforts to move migratory coastal cutthroat trout upstream of impassable culverts (October to April).
    - Inventory culverts on the Long Tom River to identify passage and lateral connectivity barriers.
    - Develop and implement restoration projects that restore lateral connectivity (e.g., disconnected side channels and wetlands created by reductions in water surface elevation due to channel incision and downcutting) to the floodplain. Side channel habitat is especially important for rearing juvenile coastal cutthroat trout.
    - Soften revetments by interplanting the rock with vegetation and restoring streamside and riparian habitat using native vegetation and/or large wood.
- In coordination with the Service and other experts, maintain or restore riverine and riparian habitat and promote complex in-stream habitat (ODFW, 2016a).
    - Do not remove native vegetation from streambanks.
    - Support large wood inputs that create complex habitat such as pools, runs, riffles and side channels. Do not remove instream large wood without a thorough risk evaluation and determination that it is an imminent threat to life and/or critical infrastructure.
    - Implement flow regimes that promote the success of black cottonwood galleries for large wood recruitment.
    - Support ongoing restoration efforts involving landowners, tribes, and agency partners.
    - Identify areas to promote beaver activity to improve coastal cutthroat trout habitat.

6.9.2. Western Ridged Mussel (*Gonidea angulata*)

- In coordination with the Service and other experts, survey areas to determine western ridged mussel presence. Monitor western ridged mussel populations affected by hydropower operations. Initial survey locations should include tributary mouths, below dam impoundments, and reaches above and below dams. Share data with the Pacific Northwest Native Freshwater Mussel workgroup, which maintains a database for mussel distribution.
- In coordination with the Service and other experts, identify the life history needs and implement best management practices for freshwater mussels as outlined in Xerces Society's: Conserving the Gems of our Waters (Blevins, et al., 2017) when developing flow releases, reservoir management, dam maintenance actions or conducting any in-water work.
    - Consider implementing flow prescriptions and flow releases that imitate, to the degree possible, a natural flow regime which would benefit the western ridged mussel and their respective host fish populations (Gates et al., 2015, p.620).

        - Specific flow characteristics that should be considered include magnitude, frequency, duration, timing, and rate of change (Blevins et al. 2017, p. 49).
        - Dam flow prescriptions should:
            - Avoid drying and dewatering mussels and their habitat (riverine and reservoir), especially when air or water temperatures may be more stressful to mussels (i.e., extreme heat or cold). Additionally, freshwater mussels exposed during these periods are more susceptible to predators.
            - Limit high, low, or pulse flows during sensitive life stages, particularly when mussels may interact with host fish (spring and summer). Limit high flows when mussels may be more susceptible to dislodgement, such as months when actively feeding and reproducing (spring and summer).
            - Limit quick reservoir drawdowns and extended sediment flushes if mussel beds are located within 100 feet downstream of a dam.
            - Abstain from discharging return flows in the immediate area of freshwater mussel beds and discharge only high-quality water of normative temperature.
            - Consider measures/operations that do not desiccate mussel beds for extended periods of time (i.e., several hours).
- Coordinate and partner with the Pacific Northwest Native Freshwater Mussel workgroup and its members to 1) develop and implement studies, 2) develop and implement flow release strategies that minimize effects to the western ridged mussel and other freshwater mussels, and 3) identify and implement restoration and conservation actions for mitigation purposes.
    - Create and implement studies that collect fundamental freshwater mussel species distribution, abundance data, and information about breeding timing, host fish, and habitat use. Survey locations should include tributary mouths, below dam impoundments, and reaches above and below dams.
    - Design, fund, and implement studies that investigate environmental flow modelling with a focus on the western ridged mussel including all life histories, traits like reproductive phenology, brooding length, host species' life history, method of host infection, and physiological tolerances (Blevins et al., 2017, p. 49; Gates et al., 2015, p. 622; Hansen et al., 2016, p. 203; Parasiewicz et al., 2016, p. 278).
    - Design, fund, and implement studies to assess the impact of non-native fish, and Asian clams (*Corbicula fluminea*) on the western ridged mussel and their native fish host species.
    - Continue efforts to monitor the Study Area for non-native and highly invasive Dreissenid mussels (e.g., Quagga and Zebra).

  - Design, fund, and implement sampling of fish at collection sites for glochidia inoculation (i.e., attachment of young mussels to host fish fins and gills). These data could better describe host fish species, distribution, and breeding timing.
  - Develop and implement technical recommendations for sediment flushing practices to minimize impacts to the western ridged mussel and other freshwater mussels.
  - Consider studies to better inform future analyses of the impacts of dam operation changes on western ridged mussel populations.
  - Create and implement effective reintroduction plans above Federal projects with little to no access or connectivity. Since the western ridged mussel is limited in its own ability to recolonize areas which they have been extirpated, consider reintroducing in appropriate river and reservoir landscapes throughout the Basin to correct or mitigate.
- Avoid gravel augmentation in locations with established mussel beds.
- Western ridged mussels are sedentary animals and unable to move out of harm's way, therefore, all in-water work should highlight the potential impact to freshwater mussels and implement mitigation measures when in-water activities such as dredging and extended dewatering activities are planned. If conducting reservoir drawdowns for maintenance or salmonid passage efforts, survey for mussel presence in areas in the drawdown zone of the reservoir and consider best management practices to mitigate. Salvage and relocation efforts are often not the best course of action, as this can result in low survival of relocated mussels. Work with partners and the Pacific Northwest Native Freshwater Mussel workgroup to determine if salvage efforts are needed.
- Western ridged mussels are dependent on host fish such as sculpin to reproduce and complete their lifecycle, therefore, implement dam operations that benefit native fishes. Provide upstream passage for native fishes at all dams to minimize fragmentation and isolation of populations by maintaining connectivity across hydrologic corridors and basins to support mussel host fish gene flow and increase distribution (Liu et al., 2020, p. 266; Newton et al., 2008, p. 424).
- Develop and install interpretive signs at appropriate project locations to educate public on ecology and importance of freshwater mussels or incorporate information on mussels into existing signage.

6.10. OFF-CHANNEL/WETLAND SPECIES

6.10.1. Northern Red-Legged Frog (*Rana aurora*)

- Consider management strategies outlined in Habitat Management Guidelines for Amphibians and Reptiles of the Northwestern United States and Western Canada and in the Oregon Conservation Strategy. Collaborate with land and resource managers and other local partners in efforts to implement these strategies and promote conservation of northern red-legged frogs throughout the Willamette Basin.

- Prioritize conservation and restoration of intact riparian forest adjacent to northern red-legged frog habitats (Pearl et al., 2005, pp. 82-85). Identify barriers between aquatic and upland habitats and address to restore connectivity.
- Northern red-legged frogs have the largest dispersion of all northwest amphibians (Hayes, 2001, p. 35). Identify areas where road crossings occur between off-channel/wetland and upland habitats. Assess impacts of vehicle mortality on northern red-legged frog populations and determine if wildlife crossings and other mitigation techniques could benefit important populations. Mitigate when appropriate. Such mitigation techniques could include, but not be limited to, ensuring that culverts under roads adjacent to breeding and upland habitats remain open. In upland habitats, consider placing large wood on the landscape to increase habitat complexity and provide cover.
- Northern red-legged frogs require native emergent vegetation in wetlands and off-channel habitats for reproduction. Control non-native vegetation in wetlands and off-channel habitats and assess limiting factors to normative seasonal growth of emergent vegetation in important off-channel and wetland habitats impacted by managed flows.
- Work with the Service and other experts to conduct research on impacts of flow and temperature management on northern red-legged frog egg laying habitat. Determine the benefits of natural flow regimes, impacts of flow timing, flow ramping (both in reservoirs, in habitats adjacent to the reservoirs, and downstream of dams) on populations. Assess areas where populations sinks may occur (e.g., habitats that desiccate prior to tadpole metamorphosis). Note population sinks (desiccating too early) and implement corrective actions to maintain wetlands and other off-channel habitats.
- Northern red-legged frog populations may be impacted by non-native fish and invasive American bullfrog populations (see Rowe et al., 2019 pp. 16-17, which observes that areas where non-native fish and American bullfrog co-occur appear to have the greatest impacts). Assess the impacts of managed flow on the dispersion and dominance of non-native species in off-channel habitats. Reduce the dominance of non-native species at important populations.
- Manage for and maintain some wetland habitats that desiccate late-season, to reduce dominance of American bullfrog and non-native fish species in northern red-legged frog habitats. These would include habitats adjacent to WVS reservoirs and downstream floodplain habitats.
- In reaches with relatively low presence of off-channel habitat, or where the lack of disturbance limits the creation of new off-channel habitats, prioritize the restoration of existing off-channel habitats (e.g., dredging and excavation, re-introducing disturbance by increasing up- and downstream connectivity of habitats, removal of successional plant species). Habitat modeling may be necessary to determine where wetland and off-channel habitats may be limited, both compared to historical landscapes and to maintain biological diversity. Assess the effectiveness of operational techniques, such as implementing pulse- or bank-full flows, in achieving the disturbance required to

maintain and create these habitats. Plan and support conservation partners seeking funding to implement habitat improvement and reconnection projects.

- In collaboration with ODFW and other local partners, draft and distribute educational and outreach materials to inform the public about the ecological impacts of non-native species, such as American bullfrog.

6.10.2. Pacific Lamprey (*Entosphenus tridentatus*)

- As signatory to the Pacific Lamprey Conservation Initiative Agreement, the Corps should direct staff to participate actively in this existing group and use this existing framework along with its authorities and management of the WVS to coordinate, partner and promote lamprey conservation throughout the Willamette Basin. Active participation in Pacific Lamprey Conservation Initiative, along with associated committees and teams, would foster coordination and allow Corps to partner with others on ongoing and new research projects that could assist evaluation of Pacific lamprey at WVS dams and reservoirs, as discussed below.
- Collaborate with land and resource managers and other local partners in efforts to implement specific actions outlined in Lamprey Technical Workgroup (LTW) documents: 1) Best management guidelines for native lampreys during in-water work (LTW 2020b), 2) barriers to adult Pacific lamprey at road crossings: guidelines for evaluating and providing passage (LTW 2020a), 3) the annual Pacific Lamprey Regional Implementation Plan for the Lower Columbia/Willamette Regional Management Unit Willamette Sub-Unit, and 4) the ODFW Coastal, Columbia, and Snake Conservation Plan for Lampreys in Oregon (ODFW, 2020b).
- Work with the Service and other experts to create a prioritization framework for Pacific lamprey conservation and reintroduction of lamprey into historical habitats above the Corps dams. Historically, Pacific lamprey distribution in the Willamette largely reflects anadromous salmonid distribution. Such a framework would include assessment of habitat availability and suitability for all life stages of Pacific lamprey and evaluate the potential for completing upstream passage for lamprey at its new AFF and evaluating downstream passage routes for outmigrating Pacific lamprey at the WVS dams (including an evaluation of predation risks from large populations of non-native fish residing in some reservoirs). Assess availability and suitability of off-channel habitats in reaches downstream of WVS dams. In reaches with relatively low presence of off-channel habitat, or where the lack of disturbance limits the creation of new off-channel habitats, prioritize the restoration of existing off-channel habitats (e.g., dredging and excavation, re-introducing disturbance by increasing up- and downstream connectivity of habitats, and removal of successional plant species). Off-channel habitats are important rearing habitats for Pacific larval lamprey (Schultz et al., 2016, p. 266).
- The Corps should complete an effective Trap and Haul facility, specific to Pacific lamprey, to pass returning adult Pacific lamprey from the base of Fall Creek Dam into the stream reaches above the reservoir. Pacific lamprey were successfully reintroduced above Fall Creek Dam over the past decade by efforts of the Confederated Tribe of the

Grand Ronde Indians. Adult Pacific lamprey were transferred from Willamette Falls for seven years to riverine reaches above Fall Creek Reservoir: spawning was documented in these reaches, and juvenile Pacific lamprey were later collected in outmigrant monitoring trap immediately below the dam. The Corps recently incorporated many significant features necessary to collect adult Pacific lamprey within the new AFF for salmonids; however, a permanent, lamprey-specific passage structure within that fishway to pass adult Pacific lamprey has not been completed. Structures such as a wetted wall or inclined ramp into a lamprey-specific holding tank, (such as those that exist at Bonneville Dam or PGE's River Mill Dam), are potential solutions to address passage via Trap and Haul at Fall Creek Dam. Passage guidelines for Pacific lamprey and specific case studies that are applicable to the Fall Creek AFF can be found in Practical Guidelines for Incorporating Adult Pacific Lamprey Passage at Fishways (LTW, 2017). Similar efforts to complete lamprey passage at the Cougar AFF and re-establish lamprey above Cougar Dam, and possibly other WVS dams, should also be initiated.

- Determine the impacts of the annual complete reservoir drawdown on Pacific lamprey because the annual full drawdown of Fall Creek reservoir for salmonid passage may impact larval and juvenile Pacific lamprey that may be stranded in the sediments. In coordination with the Service and other experts, evaluate the potential to reduce the ramping rate to slow the change in reservoir elevation during the drawdown, especially in areas of the reservoir that contain fine sediment deposits with little to no slope, or other strategies that would limit impacts to rearing Pacific larvae in the sediments. A similar study was initiated at Leaburg reservoir on the McKenzie River in 2017. Such a study would help inform the management of Pacific lamprey in Fall Creek and assist managers in planning future reintroductions.
- Highlight the potential impacts to Pacific lamprey for all in-water work conducted for the WVS, or other work permitted by the Corps in the Willamette watershed and require that all life stages of Pacific lamprey are salvaged, if dewatering actions occur.
- Include Pacific lamprey when developing education and outreach materials and public signage at WVS dams about anadromous fish.

6.11. RIPARIAN SPECIES

6.11.1. Foothill Yellow-Legged Frog (*Rana boylii*)

- Identify and protect suitable breeding, juvenile rearing, and overwintering habitat sites. Maintain natural flow regimes and streamside vegetation at these sites to provide eggs and tadpoles with appropriate flow timing and water temperature (see Appendix F.3.2.1).
- Minimize fluctuations of flow regimes and avoid manipulating flow regimes – Altered and fluctuating flows are a concern specific to water impoundments, and likely have the greatest effect on frogs during breeding and larval development, spring to summer (ODFW, 2016). Small pools created by fluctuating pools concentrate tadpoles and desiccate early.

- Minimize fragmentation and isolation of populations - Aquatic connectivity across hydrologic corridors and river basins can support gene flow and help retain the resiliency of populations to the variety of potential threats they may encounter.
- Minimize fine sediment loading into streams from water impoundments, road building, and maintenance (Borisenko and Hayes, 1999, p. 32).
- Minimize alterations of stream-edge habitats at water impoundments, during road building and maintenance activities, and at recreation sites (Borisenko and Hayes, 1999, p. 32).
- Actively remove American bullfrog and minimize exotic species distributions of smallmouth bass and other Centrarchid fishes (Borisenko and Hayes, 1999, p. 32).
- Minimize degradation of water quality from chemical applications, water impoundments, and road maintenance (Borisenko and Hayes, 1999, p. 32).
- Guide conservation actions and management decisions for reintroductions with the results of feasibility studies.

6.11.2. Northwestern Pond Turtle (*Actinemys marmorata*)

- Continue efforts to survey for and inventory northwestern pond turtles on Corps properties.
- Continue measures to protect turtle nests at Fern Ridge, Fall Creek, Hills Creek, and elsewhere. Utilize survey and inventory results to determine and prioritize where similar efforts could be used to protect critical populations (Holland, 1994, pp. 5-8).
- Follow management strategies outlined in several recent publications (ODFW, 2015; Pilliod and Wind, 2008; Rosenberg et al., 2009) for the conservation of northwestern pond turtles on Corps properties or impacted by project operations. Collaborate with land and resource managers and other local partners in efforts to promote conservation of northwestern pond turtles throughout the Willamette Basin.
- Monitor and remove red-eared sliders (*Trachemys scripta elegans*) in northwestern pond turtle habitats.
- Conduct habitat restoration: remove woody vegetation from nesting habitat, provide cover for newly emerged hatchlings, address barriers to connectivity between aquatic and upland habitats, place large wood basking logs in deep pool habitats.
- Assess habitat factors, such as access to suitable nesting habitat, over-wintering habitat, deep pool and basking habitat, to help determine where further conservation measures could take place.
- Assess connectivity between aquatic and upland habitats. Culverts provide important passage pathways for turtles moving between reservoir and upland habitats, limiting potential threats caused by crossing road surfaces. Assess and fix failed culverts adjacent to the reservoirs to ensure unhindered passage.
- Flow and temperature management to limit non-native aquatic predators (e.g., largemouth bass, American bullfrog). Both predators are considered warm adapted species and live in non-flowing waters. Adult bullfrogs require water temperatures above 25 degrees Celsius for breeding and largemouth bass require water temperatures

above 16 degrees Celsius. Maintaining flows of cold-water (< 16 degrees Celsius) during breeding seasons from May to July could hinder their reproduction.

- Assess availability and suitability of off-channel habitats in reaches downstream of WVS dams. In reaches with relatively low presence of off-channel habitat, or where the lack of disturbance limits the creation of new off-channel habitats, prioritize the restoration of existing off-channel habitats (e.g., dredging and excavation, re-introducing disturbance by increasing up- and downstream connectivity of habitats, removal of successional plant species.
- In northwestern pond turtle nesting habitats, plan mowing and other management activities to not disrupt the nesting or emergence periods.
- Assess if the Fall Creek Spillway Ponds may be a population sink for northwestern pond turtles. Consider creating new habitat adjacent to the Fall Creek spillway to mitigate impacts of future use of the spillway on northwestern pond turtles.
- Plan, fund, support, and implement research to understand the impact of WVS operations, augmentation of reservoir elevation, and flow and water temperature management on northwestern pond turtles. Assess the movement and genetic structure around the dams and between river systems. As turtles are long-lived, impacts of reservoir elevation, flow, and water temperature augmentation on populations may require assessing long-term trends to adequately assess. Research studies should consider the use of telemetry techniques to assess turtle movement around dams. In addition, studies should consider assessing effects on changes in reservoir management on populations using head-of-reservoir and adjacent alcove habitats. Note: restoration techniques for salmon often prioritize re-establishing full coverage of banks with woody vegetation, but northwestern pond turtles require open, typically south-exposed upland habitats for nesting.

6.12. UPLAND SPECIES

6.12.1. Monarch Butterfly (*Danaus plexippus*)

- Follow best management practices and conservation strategies outlined in recent publications (WAFWA, 2019; Xerces, 2018) to identify, protect, and manage existing habitat and restore habitat that has been lost on Corps properties.
- Continue supporting Corps conservation programs in areas designated for wildlife management, conservation, and vegetation management including the Research Natural Area at Fern Ridge.
- Continue providing resources to Corps nurseries that grow multiple species of milkweed (such as showy milkweed, *Asclepias speciosa* and narrow leaf milkweed, *Asclepias fascicularis*) to incorporate into plantings on Corps land.
- Identify, manage, and protect existing monarch habitat through appropriate timing and application of land management techniques (EPRI, 2019, pp. x -xi; Xerces, 2022).
- Create monarch habitat at facilities and properties when possible (i.e., along roadsides, utility easements, powerplants, substations, revetments or levees, surplus properties, etc.) and convert existing lawns. Plant a mixture of native and appropriately sourced

plant species so that bloom times range from early spring to late fall. Natural scouring along riparian banks due to changing water levels may support the milkweeds continuation in the landscape, however they are not highly flood tolerant plants.

- Use only native, insecticide-free plants for habitat restoration and enhancement actions.
- If detected, remove non-native tropical milkweed (*Asclepias curassavica*), a potentially lethal pathogen, *Ophryocystis elektroscirrha*, can infect monarchs by building up on the evergreen leaves of tropical milkweed (USFWS, 2021, December 29, pp. 1-6).
- Avoid management activities such as mowing, burning, and grazing in monarch migratory/breeding habitat when monarchs are likely present in the Willamette Basin (June 1 to October 1, some may be earlier in May or later in October in some years [Pelton, 2018]).
- Establish conservation efforts to protect monarchs and their habitats from pesticides (i.e., insecticides and herbicides).
    - Avoid the use of pesticides when monarchs may be present in the Willamette Basin (June 1 to October 1).
    - Use targeted application herbicide methods or non-chemical weed control techniques.
    - Separate habitat areas from areas receiving treatment with a pesticide-free spatial buffer and/or evergreen vegetative buffer of coniferous, non-flowering trees to capture chemical drift. The appropriate monarch and pollinator habitat spatial buffer size depends on several factors, including weather and wind conditions, but at a minimum, the habitat should be at least 40 feet from ground-based pesticide applications, 60 feet from air-blast sprayers, and 125 feet from any systemic insecticide applications or seed-treated plants.
    - Screen all classes of pesticides for monarch risk to avoid harmful applications, including biological pesticides such as *Bacillus thuringiensis*.
    - Avoid the use of neonicotinoids or other systemic insecticides, including coated seeds, any time of the year in monarch habitat due to their ecosystem persistence, systemic nature, and toxicity.
    - Avoid herbicide application on blooming flowers. Apply herbicides during young plant phases, when plants are more responsive to treatment, and when monarchs and other pollinators are less likely to be nectaring on the plants.
    - Avoid large-scale broadcast herbicide applications, take precautions to limit movement of herbicides off-site (e.g., drift from wind and discharge from surface water flows).

6.12.2. Wayside Aster (*Eucephalus vialis*)

- Continue qualitative monitoring to document species occurrence for management.
    - Surveys should be completed July through September when plants are in flower or fruit.
- Support activities conducted by utility companies that manage wayside aster:
    - Reduce duff layers in and around individuals to allow for seedling germination and establishment.

    - Control competing vegetation in the understory and noxious or exotic weeds using integrated noxious weed management techniques that do not negatively impact individual plants and will not adversely modify their habitat.
- Avoid adverse modification of habitat from road maintenance activities, exotic weed or competitive vegetation control, wildlife and recreation developments, and ungulate browsing as well as negative impacts to individual plants (Vance and Larson, 2005, p. 4).
- Create gaps and edge habitat through fine scale disturbances.
- Open forest canopy to 50 to 75 percent.
- Determine where inbreeding depression occurs and improve genetic viability by utilizing techniques such as manual pollination.

6.13. PRAIRIE SPECIES

6.13.1. Dusky Canada Goose (*Branta canadensis occidentalis*)

- Implement management strategies outlined in Fern Ridge Wildlife Area Management Plan (ODFW, 2020a). Expand restoration strategies described in this document to wet prairie habitats managed or influenced by Corps operations throughout the WVS. Collaborate with land and resource managers and other local partners in efforts to promote conservation of dusky Canada goose throughout the Willamette Basin. Build partnerships with conservation partners and private landowners to increase high-quality overwintering habitat.
- Increase annual management of areas dominated by reed canary grass on Corps properties to improve forage for geese. This management may include mowing, discing, and burning to remove residual foliage and release younger foliage more palatable as forage. Discing will have the added benefit of providing mudflats for shorebirds and seasonal pond plants such as popcorn flower, *Downingia* for pollinators, and water foxtail and mannagrass for waterfowl.
- Support conservation partners by utilizing a combination of strategies to restore ecological processes (e.g., hydrology and fire) that drive structure and function in key habitat types. These actions may range from intensive management of hydrology and plants in impounded wetlands to controlled burns on remnant wet prairie habitats, and low-level monitoring and control of invasive species (ODFW, 2020a). Ensure that management activities for dusky Canada goose are compatible with conservation needs of other species of concern sharing those habitats.

6.13.2. Shaggy Horkelia (*Horkelia congesta ssp. congesta*)

- The Corps maintains a complete inventory of Shaggy Horkelia presence for Fern Ridge and Dorena, and routinely augment and reintroduce populations at these lakes. Continue these ongoing actions and maintain relationships with conservation partners to assist with monitoring efforts, and to plan, fund, and implement conservation activities throughout the range of shaggy horkelia. Increase funding for shaggy horkelia

habitat restoration that includes a diversity of native plant species, invasive species management, and prescribed burning.

- Dedicate additional resources to control the succession of woody plants. Create disturbance processes that will disrupt the succession of wet prairie habitat into riparian forest. This can be accomplished through a wide range of management techniques, from manual removal to prescribed fire. In addition, reducing tree encroachment on the border of prairie habitats, may be required for long-term maintenance. The removal of trees between adjacent prairies may be a useful enhancement technique, where applicable.
- Dedicate additional resources to control the dominance of non-native vegetation, such as Scotch broom (*Cytisus scoparius*), false-brome (*Brachypodium sylvaticum*), Himalayan blackberry (*Rubus armeniacus*), and bristly dogstail grass (*Cynosurus echinatus*). This can be accomplished by treatment with herbicides, mechanical removal, and mowing. Replacement with native vegetation soon after removal may help in reducing may increase the success of control projects.
- Assess limitations of prescribed burns, given the concerns for wildfire. Determine if augmented management techniques, increased monitoring, or changes in the timing of prescribed fire may benefit the management and overall conservation of the species. Plan to rapidly re-seed following prescribed fire to limit the spread of invasive species.
- Assess the suitability of prairie habitats for reintroduction.

6.14. DELISTED SPECIES

6.14.1. Bradshaw's Lomatium (*Lomatium bradshawii*)

- Continue to support the efforts outlined in the Bradshaw's Lomatium Post Delisting Monitoring Plan (USFWS, 2020c).
- Protect Bradshaw's Lomatium populations on Corps property.
- Maintain wet prairies using prescribed fire on a three to five-year fire return interval. This has been shown to be crucial to maintaining populations (Caswell and Kaye, 2001, p. 44; Kaye et al., 2001, p. 1377).
- Decrease the invasion of wet prairie habitats by non-native species (e.g., reed canary grass).
- Prevent the encroachment of trees and shrubs into prairie habitats
- Decrease the elimination of natural disturbance regimes and increase the frequency of prescribed burns.
- Avoid mowing or site disturbance to known habitation sites from March to July, as flower production occurs in April and May, and seeds in June.

6.14.2. Oregon Chub (*Oregonichthys crameri*)

- Implement monitoring and management strategies described in the Post-Delisting Monitoring Plan for the Oregon Chub and the Oregon Chub Cooperative Management

Plan (in draft). Collaborate with land and resource managers and other local partners in efforts to promote conservation of Oregon chub throughout the Willamette Basin.

- Maintain regular surveys at Corps managed Oregon chub populations (Foster Pullout Pond, Fall Creek Spillway Ponds, Dexter Alcove "The Pit", Dexter RV Alcove, Hospital Pond, Hospital Impoundment Pond, and Hills Creek Pond). These surveys should, at a minimum, verify that Oregon chub are present at each location, and assess potential threats: non-native fish, successional vegetation, habitat quality and quantity.
- Periodically, assess availability and suitability of off-channel habitats in reaches downstream of WVS dams for Oregon chub. In reaches with relatively low presence of off-channel habitat, or where the lack of disturbance limits the creation of new off-channel habitats, prioritize the restoration of existing off-channel habitats (e.g., dredging and excavation, re-introducing disturbance by increasing up- and downstream connectivity of habitats, removal of successional plant species). The successful recovery of Oregon chub was achieved, in part, through the establishment of connected populations in the North Santiam, McKenzie, and Middle Fork Willamette River subbasins. These periodic surveys would assess the distribution of Oregon chub, the quality and quantity of off-channel habitats, and the dominance of non-native fish and non-native vegetation in off-channel habitats, relative to the status of the species at the end of the post-delisting monitoring period.

6.15. KEYSTONE SPECIES

6.15.1. American Beaver (*Castor canadensis*)

- Consider management and restoration strategies outlined in the Beaver Restoration Guidebook (Pollock et al., 2017). Collaborate with and support local conservation partners to plan, fund, and implement beaver related restoration and beaver coexistence devices (e.g., beaver pond levelling devices, culvert protection). Work with road departments and Animal and Plant Health Inspection Service (APHIS) to design and implement coexistence tools on Corps properties.
- Identify areas where ecological conditions would be benefitted by beaver dams (e.g., secondary channels, sloughs, alcoves). Determine the limiting factors for beaver-use in these locations, which may include predation, competition with other herbivores, lacking food resources, or other factors. Plan and implement restoration and management projects to increase the prevalence of beaver on the landscape. Projects may include installing beaver dam analogs to increase water depth, encouraging the growth of preferred forage, and providing cover from predation; the placement of large wood to encourage beaver dam building; and planting preferred forage vegetation.

6.15.2. Black Cottonwood (*Populus balsamifera*)

- Use vegetative canopy mapping to identify locations of large black cottonwood stands around reservoirs to document where they can naturally establish (Cline and McAllister, 2012, p. 1520; Wallick et al., 2013, p. 53; Jones et al., 2016, p. 82).

- The current flow regime is generally supportive of cottonwood establishment (Jones et al., 2016 p. 79; Wallick et al., 2013, p. 40), but geomorphic conditions that allow black cottonwood to establish in spring/summer *and* persist through winter are a limiting factor (Cline and McAllister, 2012, p. 1535). Set up a formal monitoring plan to document the role of geomorphology, flows, and cottonwood in the Willamette floodplain to determine the effects of different dam operations on black cottonwood.
- Support monitoring of black cottonwood and seedling recruitment and mortality.
- Create functional flows with a combination of increased minimum flow and flow ramping to improve the health of established trees and increase seedling recruitment (Foster and Rood, 2017, p. 1094).
- Prevent occurrence of severely low flows (Foster and Rood, 2017, p. 1094).

APPENDICES

A. APPENDIX A: TIMELINE OF ACTIVITIES RELATED TO WVS FWCAR DEVELOPMENT

The timeline in this appendix highlights key milestone activities in the Service's engagement in WVS FWCAR development from spring 2021 through spring 2025.

Date of Activity	Activity Description
2021	
March 30, 2021	The Service committed to develop a SOW, including budget request, for the Corps to potentially develop a FWCAR for the WVS
April 2021	The Service compiled a list of 73 species including fish, amphibians, birds, invertebrates, mammals, and plants and identified five habitat types that may be impacted by Project operations (Rivers/Lakes/Reservoirs, Secondary/Off-channel habitat, Riparian, Wetlands, and Uplands).
April - May 2021	The Service developed a weighted species ranking matrix to select 10 species in 5 habitat types that could be affected by project operations. The Service included two keystone species and two delisted species.
June 9, 2021	The Service met with the Corps for an overview on Alternatives 3a and 3b
June 2021	A draft report and experts contact list were created. Habitat types and species descriptions were drafted
July 14, 2021	The Service met with the Corps to discuss SOW and budget
July 27, 2021	The Corps presented the alternatives via WEBEX
August 9, 2021	The Corps formally requested a FWCAR for the WVS and asked the Service to finalize the SOW
August 13, 2021	The Service delivered the SOW to the Corps
August 24, 2021	The Service met with NOAA to share FWCAR progress

September - October 2021	The Service developed a matrix to analyze the effects of the alternatives
September 1, 2021	The SOW was formally approved
September 13, 2021	The Service met with NOAA to share species selection methods and analysis plans
September 14, 2021	The Service met with the Corps to discuss action items, a request for a lamprey workshop was decided not needed in the scope of the FWCA
October 12, 2021	The Service met with NOAA for monthly coordination, NOAA plans to submit planning aid memos
October 13, 2021	The Service met with the Corps for monthly coordination. The Corps presented Alternative 2
October 18, 2021	FWCA notice sent to ODFW
November 12, 2021	Invitation for participation letter sent to Tribes
November 17, 2021	The Service met with the Corps for monthly coordination.
November 19, 2021	The Service met with NOAA for monthly coordination, NOAA presented their draft species list.
2022	
January 13, 2022	The Service met with the Corps for monthly coordination. The Corps revised the schedule at a no time-cost extension for the following deliverables and deadlines: Draft Conservation Recommendations March 1, Draft Report June 1, Final Report June 2023.
January 24, 2022	The Service met with NOAA for monthly coordination and shared updated timeline.
February 2, 2022	Invitation for participation letter sent to species experts (via email) with an invitation to the Virtual Workshop to discuss conservation recommendations
February 8, 2022	The Service provided species experts with USFWS Draft Conservation Recommendations for review before Virtual Workshop

February 22, 2022	The Service met with the Corps to discuss non-listed species and habitat conservation opportunities; potential effects of the measures outlined in the draft EIS.
February 25, 2022	The Service hosted two Virtual Workshops ("Upland and Prairie" and "Riparian, Riverine/Reservoir, Off-Channel/Wetland") to coordinate with species experts for technical input on the Service's Draft Conservation Recommendations.
March 1, 2022	Service staff finalized conservation recommendations and provided the Corps with Draft Conservation Recommendations.
March 11, 2022	The Service met with the Corps to discuss preliminary feedback on Draft Conservation Recommendations and provide clarifications.
January – March 2022	Service staff analyzed the WVS alternatives
March 28, 2022	The Corps provided updated Alternatives and Measures and indicated the Preferred Alternative would be 2b
April 19, 2022	The Corps provided the Service with written feedback on the FWCA Draft Conservation Recommendations
April 25, 2022	The Service began internal review of the draft WVS FWCAR
May 6, 2022	Service staff briefed regional leadership on the status of the draft WVS FWCAR and upcoming review opportunities
June 1, 2022	The Service delivered the draft WVS FWCAR to the Corps
November 25, 2022	The Corps released the WVS DEIS and the draft WVS FWCAR, attached as an appendix, and began the review and comment period
April 11, 2025	The Corps' released the final WVS EIS and indicated the Preferred Alternative would be 5
Spring 2025	The WVS FWCAR was finalized and submitted to the Corps as an amended appendix in the Corps' final WVS EIS

B. APPENDIX B: STUDY AREA, FURTHER DEFINED

This appendix includes additional information we used to further define the Study Area for the FWCAR.

B.1. FOCAL BASINS AND MAJOR TRIBUTARIES

The North and South Santiam, Long Tom, McKenzie, Middle Fork and Coast Fork of the Willamette, and the mainstem Middle and Upper Willamette reaches represent the focal Basins in the Corps' EIS Preferred Alternative.

B.1.1. Middle Willamette Basin

This reach of the mainstem Willamette River starts near Salem at the confluence of the Santiam River (RKM 175) downstream to Willamette Falls near Oregon City (RKM 40). Total drainage area of this reach is approximately 1,841 km^2 (455,018 acres).

B.1.2. North Santiam Basin

The North Santiam Basin is located on the east side of the Willamette Basin and drains approximately 1,979 km^2 (489,022 acres) of the Cascade Range into the Santiam River Willamette River at RKM 175.

B.1.2.1. *North Santiam River*

The North Santiam River runs approximately 160 km before it joins the South Santiam River and has a bankfull discharge estimate of 510 m^3/s at RKM 24 (Risley et al., 2012, p. 15). Corps projects include Detroit and Big Cliff. The Detroit Dam is located 77 km upstream of the confluence with the Willamette River and inundates a 14 km-long reservoir that can hold 561,000,000 m^3. Big Cliff Dam is a re-regulating dam for Detroit Dam that inundates the 4.5 km downstream from Detroit Dam and holds 7,960,000 m^3. Historically, 71 percent of spring Chinook production in the North Santiam River occurred above Detroit Dam, but all access was lost because dams were built without fish passage facilities (Mattson, 1948, as cited by ODFW, 2005, p. 170).

B.1.3. South Santiam Basin

The South Santiam Basin is located on the east side of the Willamette Basin and drains approximately 2,696 km^2 (666,196 acres) of the Cascade Range into the Willamette River at RKM 175.

B.1.3.1. *South Santiam River*

The South Santiam River runs approximately 113 km before it joins the North Santiam River approximately 16 km east of the confluence of the Santiam and the Willamette River. It has a bankfull discharge estimate of 343 m^3/s at RKM 61 (Risley et al., 2012, p. 15). Foster Dam is located at RKM 62 at the confluence of the South Santiam and Middle Santiam rivers and impounds a 5.6 km reservoir with a volume of 34,907,484 m^3.

B.1.3.2. *Middle Santiam River*

The Middle Santiam flows into Green Peter Reservoir River with a bankfull discharge estimate of 200 m^3/s at RKM 1.6 (Risley et al., 2012, p. 15). Green Peter Dam is located 11 km upstream of Foster Dam at RKM 8.9 on the Middle Santiam River. The dam impounds a 16 km reservoir with a volume of 530,396,400 m^3.

B.1.4. Upper Willamette Basin

This reach of the mainstem Willamette River starts at the confluence of the Middle and Coast Forks of the Willamette River near Eugene (RKM 301) and continues downstream to the confluence of Santiam River near Salem (RKM 175). Total drainage area of this reach is approximately 4,849 km^2 (1,198,334 acres).

B.1.4.1. *Long Tom River*

The Long Tom River is a 92 km tributary of the Willamette River located on the west side of the Willamette Valley. The Long Tom River has a Willamette Valley Project, Fern Ridge Dam and Reservoir, at RKM 37.9. Fern Ridge is a storage project and impounds a 7.2 km long reservoir with a volume of 124,828,176 m^3.

B.1.5. McKenzie River Basin

The McKenzie River Basin is located on the east side of the Willamette Basin and drains approximately 3,468 km^2 (856,962 acres) into the Willamette River at RKM 282.

B.1.5.1. *South Fork McKenzie River*

The South Fork McKenzie River is a 50 km tributary to the McKenzie River. Cougar Dam is located at RKM 6.4 upstream from the South Fork McKenzie River mouth and impounds an 8 km reservoir with a volume of 270,132,120 m^3.

B.1.5.2. *Blue River*

Blue River Dam is located 2.9 km above its confluence with the McKenzie River and works in coordination with Cougar Dam to provide flood risk management and impounds a 10.3 km reservoir with a volume of 105,000,000 m^3.

B.1.6. Middle Fork Willamette River Basin

The Middle Fork Willamette River Basin is located on the east side of the Willamette Valley. Total drainage area of this basin is approximately 3,540 km^2 (874,862 acres) into the Willamette River at RKM 301.

B.1.6.1. *Fall Creek*

Falls Creek is a 55 km long tributary of the Middle Fork Willamette River located near Lowell. A Willamette Valley Project, Fall Creek, is located at RKM 12.7, approximately 32 km from the confluence of the Middle and Coast Fork Willamette basins. Fall Creek is a storage project that impounds a 10.9 km long reservoir with a volume of 154,000,000 m^3.

B.1.6.2. *Middle Fork Willamette River*

The Middle Fork Willamette River is approximately 185 km long. The river contains two Willamette Valley Projects, Lookout Point and Dexter. Lookout Point is storage project located at RKM 32 and impounds a 16 km long reservoir with a volume of 589,200,000 m^3. Dexter reservoir is a re-regulatory project located downstream of Lookout Point and is located at RKM 27. Dexter reservoir impounds a 5 km reservoir with a volume of 36,900,000 m^3.

B.1.6.3. *Hills Creek*

Hills Creek is a 26 km long tributary of the Middle Fork Willamette River located near Oakridge. A Willamette Valley Project, Hills Creek, is located at RKM 6.4, approximately 76.9 km from the confluence of the Middle and Coast Fork Willamette basins. Hills Creek is a storage project and impounds a 14.7 km long reservoir with a volume of 438,500,000 m^3.

B.1.7. Coast Fork Willamette Basin

The Coast Fork Willamette Basin is located on the southern extent of the Willamette Basin. The Basin contains two Willamette Valley Projects, Dorena and Cottage Grove. Total drainage of this basin is approximately 1,726 km^2 (426,504 acres) into the Willamette River at RKM 301.

B.1.7.1. *Row River*

The Row River is a 32 km tributary that joins the Coast Fork Willamette River near Cottage Grove. Dorena Reservoir is a storage project located at RKM 12.1 and impounds a 21 km long reservoir with a volume of 95,700 m^3.

B.1.7.2. *Coast Fork Willamette River*

The Coast Fork Willamette River is a 64 km tributary that meets the Middle Fork Willamette south of Eugene. Cottage Grove reservoir is a storage project located at RKM 47 and impounds a 4.8 km long reservoir with a volume of 41,000,000 m^3.

B.2. WILLAMETTE VALLEY SYSTEM FEDERAL PROJECTS

The Study Area considered in our analysis includes the 13 Federal dams or projects managed as part of a single, larger system of operations, the WVS (Figure 1).

B.1. EXCLUDED AREAS

The Study Area does not include reaches or basin watersheds downstream of Willamette Falls or Basin watersheds beyond the 0.4 km (0.25 mile) buffer. We excluded lands associated with the transmission of electricity and irrigation on private lands from the analysis because they are outside the approved scope of this FWCAR.

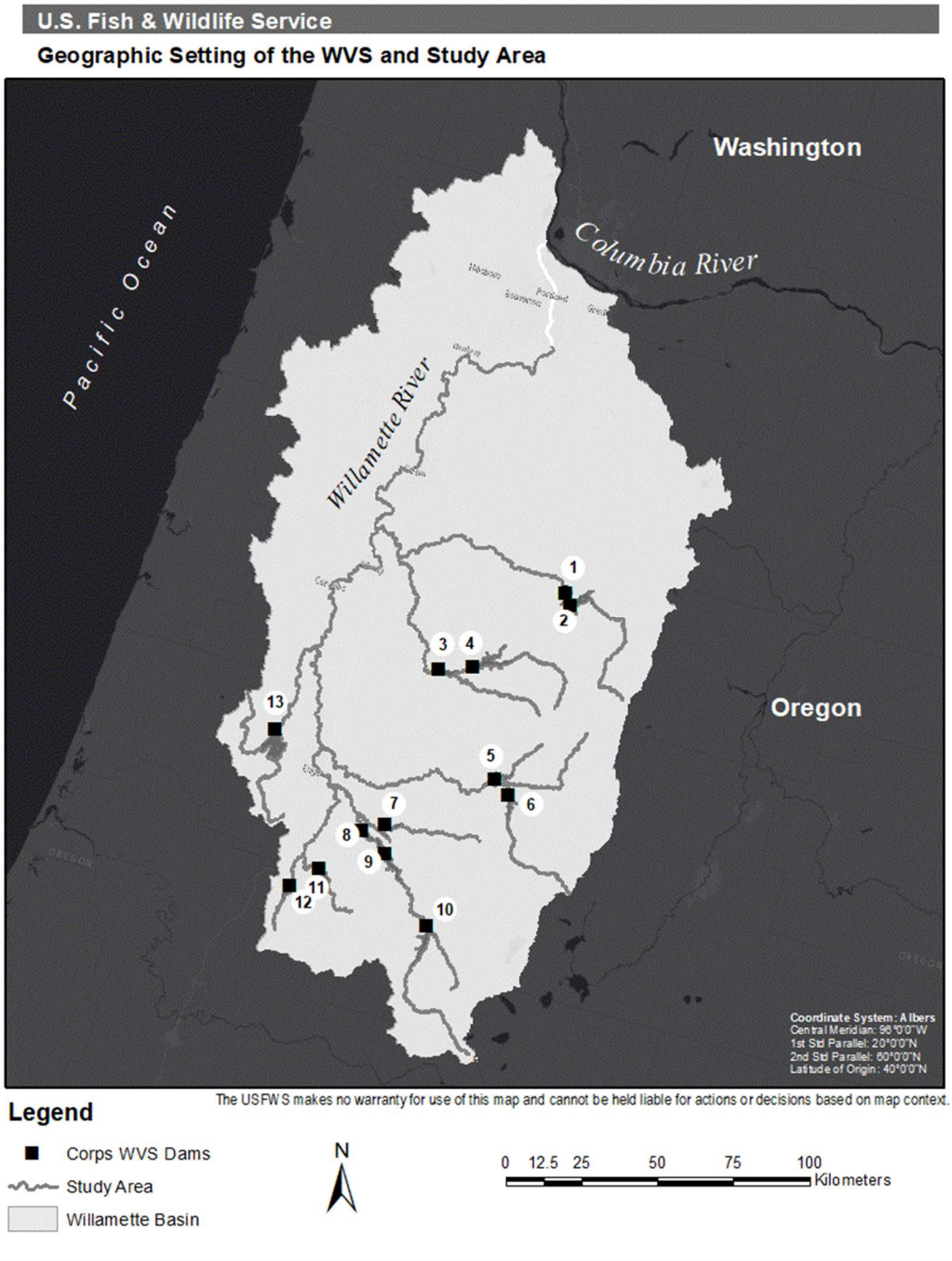


Figure 1. Geographic setting of the WVS and river reaches included in the FWCAR analysis and 0.4 km (0.25 mile) buffer. Projects include 1) Big Cliff and 2) Detroit on the North Santiam River; 3) Foster on the South Santiam River; 4) Green Peter on the Middle Santiam River; 5) Blue River; 6) Cougar on the South Fork McKenzie River; 7) Fall Creek; 8) Dexter, 9) Lookout Point, and 10) Hills Creek on the Middle Fork Willamette River; 11) Dorena on the Row River; 12) Cottage Grove on the Coast Fork Willamette River; and 13) Fern Ridge on the Long Tom River.

C. APPENDIX C: SERVICE OUTREACH AND COMMUNICATIONS

The following documents represent our outreach to interest groups during the analysis. Outreach materials included briefing memos and e-mails to Service programs' leadership, staff from other fish and wildlife resource agencies, Tribes, and private groups.

From: Bangs, Brian L <brian_bangs@fws.gov>
Sent: Monday, October 18, 2021 1:33 AM
To: [Species Expert]
Cc: Silver, Brook <brook_silver@fws.gov>; Newlon, Courtney <courtney_newlon@fws.gov>
Subject: Request: USFWS Willamette Valley System Coordination Act Report

The Fish and Wildlife Coordination Act (FWCA) provides a formal method for coordination between the U.S. Fish and Wildlife Service (Service) and tribal, state, and other federal agencies on projects that impact fish, wildlife, and plant resources. The Service is providing this notice for a future request for input on preparation of a Fish and Wildlife Coordination Act Report (FWCAR) for the Army Corps of Engineers (Corps). The Corps is preparing an Environmental Impact Statement (EIS) to update its continued operations and maintenance activities of the Willamette Valley System (WVS). The Corps has provided funding to the Service to produce a formal FWCAR that will help the Corps refine the suite of alternatives for continued operations and maintenance activities and to provide conservation measures to benefit species of concern. The FWCAR will be included as an appendix to the EIS for the WVS and we will deliver the final FWCAR to the Corps before the draft EIS is provided for public review in 2022.

The main objective of the FWCAR is to evaluate and document the potential effects of dam operations and maintenance activities on ecological processes and communities that will not be prioritized through Endangered Species Act (ESA) Section 7 consultation. Consultation under the ESA will thoroughly analyze effects to ESA-listed species and their habitats, but dam operations and maintenance activities may affect ecological processes and communities not linked to an ESA-listed species. Therefore, we will not address bull trout or other listed species under ESA authority of the FWS in the FWCAR. We will also not be addressing anadromous salmonids, as these species will be addressed by the National Marine Fisheries Service during ESA consultation or a separate FWCAR.

Given the number of ecological processes, communities, and species that could be affected by dam operations and maintenance activities of the WVS, the team is framing its analysis on habitat most likely be impacted. The team identified evaluation species with broad conservation needs representative of other species using these habitats. We have identified five priority habitat types, 10 focal species, two keystone species and two delisted species likely to be impacted within the WVS (Table 1).

Table 1. Based on a suite of criteria the team has identified the following five priority habitat types and associated species to be included in the FWCAR analysis.

Habitat Types	**Evaluation Species**
Upland	Monarch Butterfly (*Danaus plexippus*) Wayside Aster (*Eucephalus vialis*)
Prairie / Wet-Prairie	Dusky Canada Goose (*Branta canadensis occidentalis*) Shaggy Horkelia (*Horkelia congesta ssp. congesta*)
Wetland/ Off-Channel	Northern Red-Legged Frog (*Rana aurora*) Pacific Lamprey (*Entosphenus tridentatus*)
Riparian	Foothill Yellow-Legged Frog (*Rana boylii*) Northwestern Pond Turtle (*Actinemys marmorata*)
Riverine / Reservoirs	Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) Western Ridged Mussel (*Gonidea angulata*)
Keystone Species	Black Cottonwood (*Populus balsamifera*) American Beaver (*Castor canadensis*)

Delisted Species	Bradshaw's Lomatium (*Lomatium bradshawii*) Oregon Chub (*Oregonichthys crameri*)

We plan to distribute the draft report this fall/early winter and will schedule an online meeting to provide a forum to discuss the conservation measures and receive feedback and information from participants. The team will also accept comment letters as input for the FWCAR.

For more information, please contact the team coordinator: Courtney Newlon at (503) 231-6972 or by email at courtney_newlon@fws.gov, Brian Bangs at (541) 908-1538 or brian_bangs@fws.gov, or Brook Silver at (360) 604-2580 or brook_silver@fws.gov.

From: Newlon, Courtney <courtney_newlon@fws.gov>
Sent: Friday, November 12, 2021 2:01 PM
To: [Tribal Chairperson, Natural Resource Director]
Cc: Silver, Brook <brook_silver@fws.gov>; Bangs, Brian L <brian_bangs@fws.gov>; Hudson, Michael <michael_hudson@fws.gov>; Newlon, Courtney <courtney_newlon@fws.gov>
Subject: Opportunity for [Tribal] Input on the USFWS's Willamette Valley System Fish & Wildlife Coordination Act Report

Dear [Chairperson]:

In recognition of the unique government-to-government relationship between Tribes and the United States, the U.S. Fish and Wildlife Service (Service) invites you to contribute to our formal 2(b) Fish and Wildlife Coordination Act Report (FWCAR) on the Willamette Valley System (WVS).

The U.S. Army Corps of Engineers (Corps) has contracted the Service to produce a FWCAR on the long-term operation and management of the thirteen federal WVS Projects. Our FWCAR recommendations will focus on habitats and species not federally protected under the Endangered Species Act (ESA), whereas potential impacts to threatened and endangered species and associated critical habitats will be analyzed through an ESA Section 7 consultation between the Service and the Corps. The final FWCAR will be delivered to the Corps for inclusion as an appendix to their draft Environmental Impact Statement for the WVS scheduled for public review in June 2022.

The mission of the Service's WVS FWCAR is to:

> *"Promote conservation of ecological processes and diverse ecological communities affected by dam modifications and operations in the Willamette Basin by providing technical assistance and recommendations to the co-lead agencies."*

The Service can recommend measures through the FWCAR to conserve, protect, or enhance ecological processes, landscapes, communities, and species. Conservation measures advocated for, or informed by input from, Tribes will be more effective and may be more likely to be implemented by the federal action agencies.

There are multiple ways that Tribes can share their knowledge, expertise, and priorities, especially as related to species, resources, and/or areas of tribal importance, so that the Service can appropriately reflect them in the FWCAR. We plan to distribute the draft report this fall/early winter and will schedule online meetings to provide a forum to discuss the conservation measures and receive feedback and information from participants. However, your input and comments are welcomed and encouraged whether they are delivered through the meetings, comment letters, or government-to-government consultation.

Tribally shared information and Traditional Ecological Knowledge will be used by the Service to describe species and habitat statuses in the analyses of dam modification/operation alternatives. Given the number of ecological processes, communities, and species that could be affected by dam operations and maintenance activities of the WVS, the team is framing its analysis on habitat most likely be impacted. The team identified evaluation species with broad conservation needs representative of other species using these habitats. We have identified five priority habitat types, 10 focal species, two keystone

species and two recently recovered and federally delisted species likely to be impacted within the WVS (Table 1).

Table 1. Based on a suite of criteria the team has identified the following five priority habitat types and associated species to be included in the FWCAR analysis.

Habitat Types	Evaluation Species
Upland	Monarch Butterfly (*Danaus plexippus*) Wayside Aster (*Eucephalus vialis*)
Prairie	Dusky Canada Goose (*Branta canadensis occidentalis*) Shaggy Horkelia (*Horkelia congesta ssp. congesta*)
Wetland/ Off-Channel	Northern Red-Legged Frog (*Rana aurora*) Pacific Lamprey (*Entosphenus tridentatus*)
Riparian	Foothill Yellow-Legged Frog (*Rana boylii*) Northwestern Pond Turtle (*Actinemys marmorata*)
Riverine / Reservoirs	Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) Western Ridged Mussel (*Gonidea angulata*)
Keystone Species	Black Cottonwood (*Populus balsamifera*) American Beaver (*Castor canadensis*)
Delisted Species	Bradshaw's Lomatium (*Lomatium bradshawii*) Oregon Chub (*Oregonichthys crameri*)

For more information, please contact Courtney Newlon at (503) 231-6972 or by email at courtney_newlon@fws.gov, Brian Bangs at (541) 908-1538 or brian_bangs@fws.gov, or Brook Silver at (360) 604-2580 or brook_silver@fws.gov.

The Service appreciates your conservation of species and habitats in the Willamette River Basin, and we look forward to working with you on this project.

Sincerely,

Courtney

Courtney Newlon
Fish and Wildlife Biologist

U.S. Fish & Wildlife Service
Oregon Fish and Wildlife Office
2600 SE 98th Ave, Suite 100
Portland, Oregon 97266
Phone: (503) 231-6972

http://www.fws.gov/oregonfwo

From: Bangs, Brian L <brian_bangs@fws.gov>
Sent: Saturday, December 4, 2021 1:22 AM
To: NWP-LongTom-EcoRes@usace.army.mil <NWP-LongTom-EcoRes@usace.army.mil>
Cc: Gray, Ann E <ann_e_gray@fws.gov>; Skalicky, Joe <joe_skalicky@fws.gov>; dana@longtom.org <dana@longtom.org>
Subject: Comments on the potential project at the Monroe Dam, Long Tom River

Kat Herzog and Sarah Knowles,

Thank you for soliciting for comments on potential fish passage and habitat projects in the lower Long Tom River. I appreciate that the USACE has engaged with the local community as well as federal and state agencies, local tribes, NGOs, and other organizations as they begin to assess potential measures and develop alternatives related to this project. I am writing to encourage the USACE to consider measures that provide passage at a broad range of flows, addresses passage requirements for fish and other aquatic species, addresses connectivity and ecological processes of off-channel habitats, and promote natural riverine processes within the constraints of the WVS operations.

In the winter of '18 - '19, I assisted ODFW and USACE staff with fish sampling below the dam at Monroe, and at several locations downstream. We sampled in both in-channel habitats, and in off-channel locations where accessible. I was surprised that juvenile Chinook were common in our catch and found throughout the lower Long Tom right up to the dam at Monroe. We did not catch salmonids in off-channel habitats we sampled; most of these locations had limited open-water connection to the Long Tom channel. Both from this sampling event, and numerous surveys I've conducted over the past 16 years, I have been surprised at the rich native nongame fish diversity in the lower Long Tom River. In the spring of 2019, I even located a small bed of western ridged mussels downstream of Monroe. Passage at the Monroe dam should be addressed for a wide range of aquatic organisms, not just Chinook and other salmonids. Coastal cutthroat trout, Pacific lamprey, and a wide range of native nongame species use the lower Long Tom River, and would benefit to accessing the river upstream, and the high quality habitats available in the smaller tributaries; passage timing and requirements (e.g., water velocity, design limitation) are often very different for these species compared to salmonids. It's my opinion that removal of the structure and restoration of the river channel should be assessed as a measure, as this would likely have the greatest potential benefit for passage at all flows and restore natural fluvial and floodplain processes to the downstream river reach. Maintaining a structure will continue to inhibit floodplain processes and fish passage, and likely require more maintenance and costs in the long-term than construction of a newer structure for the City's water supply that does not require a dam. The diverted water for the City should be screened, at a minimum, to criteria developed by the National Marine Fisheries Service and available online: https://www.fisheries.noaa.gov/resource/document/anadromous-salmonid-passage-facility-design. If instead of dam removal, a new fishway is constructed, then design should incorporate features recommended in Practical Guidelines for Incorporating Adult Pacific Lamprey Passage at Fishways (Lamprey Technical Workgroup, 2017), available online https://www.fws.gov/pacificlamprey/Documents/2017.06.20%20LampreyPsgFINAL.pdf. This will allow the larger Pacific lamprey to pass the dam but will be unlikely to pass smaller lamprey species (Western Brook lamprey) and other smaller native fish.

Along with the Monroe Dam, there are a several other structures in the river upstream that may benefit from passage improvements. For the greatest benefits system-wide, I recommend assessing other structures to determine if improvements could be made to benefit fish passage. Even if these structures

are outside the scope of this project, identifying passage issues at these structures could assist non-federal partners with outreach and obtaining grants to complete restoration work. See my comments in the paragraph above - these structures should be assessed in terms of the limitations for a wide variety of native migratory fish at a variety of flows.

In addition to upstream passage, I urge the USACE to consider addressing lateral connectivity of off-channel habitats within the lower Long Tom River. The lower Long Tom River has been channelized and greatly simplified compared to its original form, however many of these old meanders still exist as alcoves, sloughs, and isolated pools adjacent to the current channel. Many of these connect to the river during flooding, which may trap fish seeking refuge from high flow events, and many have old, undersized culverts to allow drainage to the main channel. Improving connectivity of these habitats could have multiple ecological benefits: 1) while these off-channel habitats still exist, they will eventually progress through vegetative succession, and will be lost over time unless they receive regular disturbance; 2) in an unconstrained river, these habitats would have been created as the main channel laterally meandered across the low gradient valley floor. Many species are floodplain-obligate (see Oregon Chub, native amphibian and reptile species, even Pacific lamprey utilize off-channel habitats for portions of their life history) and would benefit from high quality off-channel habitats; and 3) these provide excellent refuge for riverine species during high flow events. Projects might include, but not limited to, culvert replacement, notching levees to allow flow-through disturbance, or embankment removal/setback.

In other managed Willamette River tributaries and the mainstem, the USACE has utilized USGS habitat and flow modelling to help determine if operational changes could improve ecological conditions downstream. If hydrological modelling will be needed to determine the suitability of potential measures and packaged alternatives, I recommend more extensive modelling to determine if operational changes in flow could have ecological benefits in the lower Long Tom. Such modelling could look at the potential habitat for juvenile Chinook, passage and habitat suitability for Pacific lamprey and other native nongame species, and lateral connectivity of off-channel habitats.

Thank you for consideration of these comments. Please let me know if you have any questions or feedback. If you have questions in regards to Pacific Lamprey, please reach out to my colleagues Ann Gray (ann_e_gray@fws.gov) or Joe Skalicky (joe_skalicky@fws.gov), USFWS lamprey experts familiar with the lower Long Tom River.

Brian Bangs
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From: Newlon, Courtney <courtney_newlon@fws.gov>
Sent: Wednesday, February 2, 2022, 3:31 PM
To: [Species Expert]
Subject: Opportunity to provide input - WVS Fish and Wildlife Coordination Act Report Virtual Workshop via TEAMS - Friday, February 25, 2022

Dear Species Expert -

As you are likely aware, the USFWS is completing a Fish and Wildlife Coordination Act Report as part of the Willamette Valley System EIS process. Our main objective is to assess potential effects of proposed and current Army Corps operations on ecological processes, habitats, and communities ***not*** covered under the federal Endangered Species Act; listed species will be addressed through separate consultations by the USFWS and NMFS. By incorporating proposed actions to benefit non-ESA species through this Coordination Act process, there may be an opportunity to provide benefits for these species that can otherwise take a backseat to ESA-listed fish and wildlife. Our assessment includes a number of Oregon Conservation Strategy Species, and species managed and conserved by ODFW (Table 1). We have identified five habitats and 10 focal (evaluation) species with the idea that they would be the surrogate for other species, that is, recommendations that benefit them, would benefit a suite of species.

You have been identified as a potential species expert and we hope to get your input on the draft list of conservation recommendations currently under development. In the interest of efficiency, we intend to hold two virtual TEAMS meetings on Friday, February 25, 2022. The Draft species conservation recommendations will be sent with a link to an online form to report any feedback. If you are unavailable to attend the virtual meeting, we hope that you can still provide feedback either by the online form or via email. If you feel that we missed someone, please feel free to forward this email.

Our tentative timeline:
February 8, 2022 – Draft species conservation recommendations will be emailed to species experts.
February 25, 2022 – FWCA virtual (via TEAMS)* workshop 9:00 AM to 12:00 PM (Upland and Prairie/Wet Prairie)
February 25, 2022 – FWCA virtual (via TEAMS)* workshop 1:00 PM to 4:00 PM (Riverine/Reservoir, Riparian, Wetland/Off-Channel)
*Invitation link will be sent

Table 1. Willamette Valley System FWCA habitat types and focal (evaluation) species.

Habitat Types	**Focal Species**
Upland	Monarch Butterfly (*Danaus plexippus*) Wayside Aster (*Eucephalus vialis*)
Prairie/Wet Prairie	Dusky Canada Goose (*Branta canadensis occidentalis*) Shaggy Horkelia *(Horkelia congesta)*

Wetland/ Off-Channel	Northern Red-Legged Frog (*Rana aurora*) Pacific Lamprey (*Entosphenus tridentatus*)
Riparian	Foothill Yellow-Legged Frog (*Rana boylii*) Northwestern Pond Turtle (*Actinemys marmorata*)
Riverine/Reservoir	Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) Western Ridged Mussel (*Gonidea angulata*)
Keystone Species	Black Cottonwood (*Populus trichocarpa*) American Beaver (*Castor canadensis*)
Delisted Species	Bradshaw's Lomatium (*Lomatium bradshawii*) Oregon Chub (*Oregonichthys crameri*)

Thank you for your consideration,

Courtney Newlon, Brian Bangs, and Brook Silver

Courtney Newlon
Fish and Wildlife Biologist

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Portland, Oregon 97266
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From: Newlon, Courtney <courtney_newlon@fws.gov>
Sent: Tuesday, February 8, 2022, 1:23 PM
To: [Species Expert]
Subject: Opportunity to provide input - WVS Fish and Wildlife Coordination Act Report - Draft Species Conservation Recommendations attached

Dear Species Expert –

Please see the attached draft conservation recommendations for the focal species that the FWS has identified for the Willamette Valley System Fish and Wildlife Coordination Act report (FWCA).
At this time, we are requesting feedback on these conservation recommendations through the survey link below, email, and/or at the February 25, 2022 workshop. You are welcome to participate using all three methods, though this is not expected. There will be an opportunity to provide feedback on a draft FWCA report at a later date, which will include a general assessment of measures within each proposed alternative relative to the species and their habitats; however, we will not be discussing these effects in depth at this time.

The Survey link can be accessed HERE. If you are unable to attend the workshop, please provide any feedback by March 2, 2022. If you send in your comments ahead of the workshop (via email or survey link) please note that we will not be reviewing these prior to the workshop. Our intention is to coalesce the feedback at one time, after the workshop.

A calendar TEAMS invite will be sent shortly.
February 25, 2022 – FWCA virtual (via TEAMS)* workshop 9:00 AM to 12:00 PM PST (GMT-8) (Upland and Prairie/Wet Prairie)
February 25, 2022 – FWCA virtual (via TEAMS)* workshop 1:00 PM to 4:00 PM PST (GMT-8) (Riverine/Reservoir, Riparian, Wetland/Off-Channel)

We strive to host an inclusive, accessible event that enable all individuals to engage and participate fully. To request an accommodation or for inquiries about accessibility, please contact Brook Silver, brook_silver@fws.gov, 503-239-7378.

Thank you for your consideration,

Courtney Newlon courtney_newlon@fws.gov, Brook Silver brook_silver@fws.gov, and Brian Bangs brian_bangs@fws.gov.

Courtney Newlon
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D. APPENDIX D: SERVICE VIRTUAL WORKSHOP AGENDAS

The following documents are the agendas for our technical workshops. For each workshop, there were four or five questions designed to encourage participants to share information about fish, wildlife, and plant resources in the Basin for our analysis.

USFWS WVS FWCA Virtual Workshop
Upland, Prairie / Wet Prairie Habitats

February 25, 2022 (9:00 AM to 12:00 PM PST)
Via Microsoft TEAMS
Click here to join the meeting

Virtual Workshop Goals

- Identify significant resources for focal species (e.g., ecological or physical processes, habitat components, and key locations) within the study area that are of special value to workshop participants.
- Discuss how modifications to existing conditions related to dam maintenance and operations could potentially impact species and habitats.
- Compile a list of potential actions to conserve, protect, and enhance significant resources for species and habitats.
- Obtain valuable data (e.g., from white papers, grey literature, technical reports, survey assessments) to fill existing information gaps.

Habitat Type	Focal Species
Upland	Monarch Butterfly (*Danaus plexippus*) Wayside Aster (*Eucephalus vialis)*
Prairie/Wet-Prairie	Dusky Canada Goose (*Branta canadensis occidentalis*) Shaggy Horkelia (*Horkelia congesta ssp. congesta*)
Keystone Species	Black Cottonwood (*Populus balsamifera*) American Beaver (*Castor canadensis*)
Delisted Species	Bradshaw's Lomatium (*Lomatium bradshawii*)

AGENDA

February 25, 2022

Introduction to the USFWS WVS FWCA		
9:00 am	**Welcome and Introductions**	Courtney Newlon
9:10 am	**An Introduction to the Fish and Wildlife Coordination Act –** *What is it? When and how is it used?*	Chris Allen
9:25 pm	**Putting the FWCA in context with ESA and NEPA processes underway for the Willamette Valley Project**	Chris Allen
9:40 am	**Geographic Scope** Study area Brief orientation to habitat types How we chose our species and habitats	Brook Silver
Discussion Topics		
9:50 am	**Key Areas (Landscapes, Reaches or Sites)** Discussion: *Given your knowledge of the focal species and their habitat needs, please identify any high priority areas (i.e., landscapes, reaches, sites) in the study area and explain why they are of interest or value to your agency for the following habitats:* *Upland* *Prairie / Wet-Prairie*	Courtney Newlon

10:15 am	**BREAK**	
10:30 am	**"What must we maintain?"** Discussion*: In these high priority areas (i.e., landscapes, reaches, sites), what are the unique processes, landscape features, or time periods (e.g., growing season, migration timing, and breeding timing) necessary to maintain existing conditions that support focal species?* *Upland* *Prairie / Wet-Prairie*	Courtney Newlon
10:50 am	**"How could it all change?"** Discussion*: Considering how current dam operations occur, how will changes involving higher or lower water flows, flow timing, or water temperature affect focal species and these areas (i.e., landscapes, reaches, sites)?* *Upland* *Prairie / Wet-Prairie*	Brian Bangs
11:15 am	**Conservation Recommendations** Discussion: *Please identify measurable and achievable actions to conserve, protect, and enhance the focal species, habitats, and key areas (i.e., landscapes, reaches, sites) you identified and any significant resources you discussed?* *Upland* *Prairie / Wet-Prairie*	Brian Bangs
11:50 am	**Next Steps…** *Further comments, due February 28 via email, survey link* *How we will incorporate your feedback?* *Draft FWCAR report for review*	Courtney Newlon
12:00 pm	**Adjourn**	

Reminder

If you have access to, or are aware of, data that is related to the geographic areas or significant resources we discussed during this workshop, then please contact Courtney Newlon at courtney_newlon@fws.gov or (503) 231-6972, Brook Silver at brook_silver@fws.gov, or Brian Bangs at Brian_bangs@fws.gov.

Virtual Workshop Feedback Questionnaire

Please note in the email that included the draft species conservation recommendations, we provided a link to a questionnaire (access HERE). We provided this so that you could have some time to think about it and document your suggestions. If you did not already submit this digital form, please plan to share your thoughts at the workshop.

USFWS WVS FWCA Virtual Workshop
Riverine/Reservoir, Riparian, and Off-Channel/Wetland Habitats

February 25, 2022 (1:00 PM to 4:00 PM PST)
Via Microsoft TEAMS
Click here to join the meeting

Virtual Workshop Goals

- Identify significant resources for focal species (e.g., ecological or physical processes, habitat components, and key locations) within the study area that are of special value to workshop participants.
- Discuss how modifications to existing conditions related to water quality and quantity could potentially impact species and habitats.
- Compile a list of potential actions to conserve, protect, and enhance significant resources for species and habitats.
- Obtain valuable data (e.g., from white papers, grey literature, technical reports, survey assessments) to fill existing information gaps.

Habitat Type	Focal Species
Wetland/ Off-Channel	Northern Red-Legged Frog (*Rana aurora*) Pacific Lamprey (*Entosphenus tridentatus*)
Riparian	Foothill Yellow-Legged Frog (*Rana boylii*) Northwestern Pond Turtle (*Actinemys marmorata*)
Riverine/Reservoir	Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) Western Ridged Mussel (*Gonidea angulata*)
Keystone Species	Black Cottonwood (*Populus balsamifera*) American Beaver (*Castor canadensis*)
Delisted Species	Bradshaw's Lomatium (*Lomatium bradshawii*) Oregon Chub (*Oregonichthys crameri*)

AGENDA

February 25, 2022

Introduction to the USFWS WVS FWCA		
1:00 pm	**Welcome and Introductions**	Courtney Newlon
1:10 pm	**An Introduction to the Fish and Wildlife Coordination Act –** *What is it? When and how is it used?*	Chris Allen
1:25 pm	**Putting the FWCA in context with ESA and NEPA processes underway for the Willamette Valley Project**	Chris Allen
1:40 pm	**Geographic Scope** *Study area* *Brief orientation to habitat types* *How we chose our species and habitats*	Brook Silver
Discussion Topics		
1:50 pm	**Key Areas (Landscapes, Reaches or Sites)** Discussion: *Given your knowledge of the focal species and their habitat needs, please identify any high priority areas (i.e., landscapes, reaches,*	Courtney Newlon

	sites) in the study area and explain why they are of interest or value to your agency for the following habitats: *Riverine/Reservoir* *Off-Channel/Wetland* *Riparian*	
2:15 pm	**BREAK**	
2:30 pm	**"What must we maintain?"** Discussion*: In these high priority areas (i.e., landscapes, reaches, sites), what are the unique processes, landscape features, or time periods (e.g., growing season, migration timing, and breeding timing) necessary to maintain existing conditions that support focal species?* *Riverine/Reservoir* *Off-Channel/Wetland* *Riparian*	Courtney Newlon
2:50 pm	**"How could it all change?"** Discussion*: Considering how current dam operations occur, how will changes involving higher or lower water flows, flow timing, or water temperature affect focal species and these areas (i.e., landscapes, reaches, sites)?* *Riverine/Reservoir* *Off-Channel/Wetland* *Riparian*	Brain Bangs
3:15 pm	**Conservation Recommendations** Discussion: *Please identify measurable and achievable actions to conserve, protect, and enhance the focal species, habitats, and key areas (i.e., landscapes, reaches, sites) you identified and any significant resources you discussed?* *Riverine/Reservoir* *Off-Channel/Wetland* *Riparian*	Brian Bangs
3:50 pm	**Next Steps…** *Further comments, due February 28 via email, survey link* *How we will incorporate your feedback?* *Draft FWCAR report for review*	Courtney Newlon
4:00 pm	**Adjourn**	

Reminder

If you have access to, or are aware of, data that is related to the geographic areas or significant resources we discussed during this workshop, then please contact Courtney Newlon at courtney_newlon@fws.gov or (503) 231-6972, Brook Silver at brook_silver@fws.gov, or Brian Bangs at Brian_bangs@fws.gov

Virtual Workshop Feedback Questionnaire

Please note in the email that included the draft species conservation recommendations, we provided a link to a questionnaire (access HERE). We provided this so that you could have some time to think about it and document your suggestions. If you did not already submit this digital form, please plan to share your thoughts at the workshop.

E. APPENDIX E: DATA SOURCES

We used the following data sources to conduct quantitative and qualitative assessments of the suite of potential WVS impacts on fish, wildlife, and plant resources for this report.

E.1. WATER HYDROLOGY AND HYDRAULICS MODELS

We used model outputs provided by the Corps to determine potential impacts of some measures. This included the HEC-ResSim model output dated 1/23/20, the WVEIS TDG model output dated 12/17/21, and the WVEIS Water Quality model output dated 8/13/21.

E.2. GIS DATA

We also used GIS data related to hydrology, ecoregions, and wetland priority sites throughout the Study Area. We collected and mapped GIS data from readily accessible natural resources databases.

E.2.1. National Hydrography Dataset Plus (NHDPlus) High Resolution (HR)

The NHDPlus HR hydrography framework provided data used for hydrologic sequencing; stream order; stream level; and cumulative drainage area. The focal area contained seven subbasins (HUC8) containing a WVS Project within the Willamette Basin (HUC 4 = 1709). We filtered Flowlines by Stream Level < 5 and Stream Order > 6 to identify major tributaries within these subbasins.

E.2.2. StreamNet Routed Streams

StreamNet maintains regional data and provides standardization and access to data throughout the Columbia River Basin. StreamNet's Hydrography Base Layer (StreamNet, 2012) was synchronized with the National Hydrography Dataset in April 2019 to create whole stream route data. We used these routed streams to select major tributaries that contain a WVS Project and applied a 0.4 km (0.25 mile) buffer to constrain the Study Area analysis (Figure 1).

E.2.3. Protected Areas Database of the United States (PAD-US)

The USGS Protected Areas Database of the United States is the nation's inventory of protected public land (USGS, 2018). We identified all reservoirs and lands owned by the Corps (Recreation Management Areas) and applied a 0.4 km (0.25 mile) buffer to constrain the Study Area analysis (Figure 1).

E.2.4. Level III and IV Ecoregion Descriptions for Oregon

We characterized and classified ecoregions throughout the Study Area using data primarily from the EPA (EPA, 2013). Level III and IV Ecoregion Descriptions for Oregon were extracted

from the seamless national shapefile and provide a spatial framework to analyze patterns of biotic and abiotic phenomena, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. We identified seven Level IV ecoregions within the 0.4 km (0.25 mile) buffer (Table 14).

Table 14. Ecoregions in the WVS Study Area

Ecoregion	Area (km^2) of Study Area
Mid-Coastal Sedimentary	2.2
Cascade Crest Montane Forest	32.1
Western Cascades Montane Highlands	54.3
Prairie Terraces	103.0
Valley Foothills	150.7
Willamette River and Tributaries Gallery Forest	350.9
Western Cascades Lowlands and Valleys	420.3

E.2.5. Willamette Valley Wetland Priority Sites

The Oregon Natural Heritage Information Center and The Wetlands Conservancy (TWC) created Wetland Priority Sites for the Willamette Valley Basin. This GIS layer identifies areas with concentrations of important wetland habitats and opportunities for wetland restoration. We identified 292 km^2 of floodplain wetlands and wet prairie habitat within the 0.4 km (0.25 mile) buffer. This data is a component of the Oregon Wetlands Explorer website, a collaborative project between the Oregon Natural Heritage Information Center and The Wetlands Conservancy and was funded by the EPA (Oregon Natural Heritage Information Center and The Wetlands Conservancy, 2022).

E.3. SPECIES OCCURRENCE DATA

Species occurrence is a foundation of our analysis and was gathered through many sources. The Corps and cooperating agencies supplied much of the data used through the coordination process, as previously described. Additionally, we documented critical information from technical experts and other participants during the technical workshop period. Sources include Oregon Department of Fish and Wildlife's Oregon Conservation Strategy, Oregon Department of Agriculture's Threatened, Endangered, and Candidate Plant List, Bureau of Land Management and U.S. Forest Service's Special Status/Sensitive Species Program List, and the USFWS Species of Concern List.

F. DETAILED DESCRIPTION OF HABITATS AND EVALUATION SPECIES AND STATUSES

This appendix includes detailed descriptions, organized by habitats and evaluation species analyzed in the FWCAR.

F.1. RIVERINE/RESERVOIR

F.1.1. Habitat

The riverine/reservoir habitat includes both the free-flowing unbraided primary channel and their reservoirs created by man-made impoundments. Historically, the upstream end of the Willamette River was extensively braided with channels carved through large sediment deposits (Hulse et al., 2002, p. 18). Between 1850 and 1995, the mainstem of the Willamette was straightened, therefore losing the sinuosity and habitat diversity associated with variation in river velocities (Hulse et al., 2002, p. 22). Islands and side channels were eliminated in efforts to open the main channel for navigation and the proportion of the primary channel increased (Hulse et al., 2002, p. 18). In the late 1930s, thirteen federal reservoirs in the middle and upper Willamette Basin were authorized for construction. Their primary purpose is to reduce flood damage in the Willamette River Basin, and the North and South Santiam, McKenzie, Coast Fork, Long Tom, and Middle Fork Willamette River tributary basins in the winter months.

Riverine ecosystems are created by smaller headwater streams that progressively drain into larger networks. They contain important hydrologic processes that allow for habitat complexity, increased ecosystem function, and improved water quantity and quality standards required to support healthy fish and aquatic species populations at various life history stages (Ward et al., 2001, pp. 318-321).

Reservoirs are formed as a result of the damming of a river and involves the conversion of lotic to lentic environments. In comparison to rivers, reservoirs store large volumes of water for retention of runoff and snowmelt, have large operating ranges (hydraulic heads) and long water retention times (hydraulic residence). In the WVS, reservoir water surface elevation levels and flow depend on riverine inflow and dam operations, and riverine water temperatures downstream are influenced by factors including the volume and depth of water that is released from dams. The size and shape of the reservoirs created by the dams can vary considerably depending on inflow and project operations. At low water levels, both rivers and reservoirs may be exposed that are normally underwater at higher water levels. Table 15 includes river and reservoir habitat considered in our analysis of impacts.

Table 15. Willamette subbasin rivers and federal storage reservoirs

Subbasin	River	Storage Reservoirs	Federal Project
North Santiam	North Santiam River	Detroit Reservoir	Detroit Dam and Powerhouse
		Big Cliff Reservoir	Big Cliff Dam and Powerhouse
South Santiam	Middle Santiam River	Green Peter Reservoir	Green Peter Dam and Powerhouse
	South Santiam and Middle Santiam River Confluence	Foster Reservoir	Foster Dam and Powerhouse
McKenzie	Blue River (trib. to McKenzie River)	Blue River Reservoir	Blue River Dam
	SF McKenzie River	Cougar Reservoir	Cougar Dam and Powerhouse
Middle Fork Willamette	Fall Creek	Fall Creek Reservoir	Fall Creek Dam
	Middle Fork Willamette River	Hills Creek Reservoir	Hills Creek Dam and Powerhouse
		Lookout Point Reservoir	Lookout Point Dam and Powerhouse
		Dexter Reservoir	Dexter Dam and Powerhouse
Coast Fork Willamette	Row River	Dorena Reservoir	Dorena Dam
	Coast Fork Willamette River	Cottage Grove Reservoir	Cottage Grove Dam
Upper Willamette	Long Tom River	Fern Ridge Reservoir	Fern Ridge Dam

F.1.2. Evaluation Species

F.1.2.1. *Coastal Cutthroat Trout*

Range: The coastal cutthroat trout ranges from Alaska south along western states Washington, Oregon, and California, and throughout British Columbia (NatureServe, 2021). In Oregon, the coastal cutthroat trout is found in suitable habitat west of the Cascades (ODFW, 2005, p. 100)

Habitat: Coastal cutthroat trout are typically associated with abundance of in-stream cover such as large woody debris, undercut banks, complex structure, and riparian vegetation. After their first year, they range widely and move downstream to the main stem in the spring and return upstream into tributaries in the winter (Trotter, 1989, p. 465). Environmental constraints include preferred water temperatures from 9-12 °C, spawning temperatures ranging between 6-17 °C. Spawning habitat for the coastal cutthroat trout usually entails pool tail-outs in smaller headwater streams (Moyle et al., 1989, p. 110).

Reproduction: Coastal cutthroat trout express resident, fluvial and adfluvial life history strategies. Resident populations in the Willamette River exhibit migratory behavior like anadromous sea-run cutthroat except they do not migrate to the sea, instead moving into spawning tributaries in late winter or spring (Trotter, 1989, p. 468). Spawning varies throughout its range, however, in Oregon spawning typically occurs from December through June, with the peak occurring in February. Eggs hatch after 6-7 weeks, hatchings emerge from gravel in 1-2 weeks (March-June) with the peak emergence in April. Sexual maturity is reached at 2-4 years, and they can live 4-7 years (Moyle et al., 1989, p. 114).

Threats: Habitat fragmentation resulting in decreased connectivity and increased population isolation is a main threat to coastal cutthroat trout. Other factors that have impacted populations include alterations in hydrology and watershed function, degradation of water quality, loss of estuarine habitat for rearing and decreased ocean productivity (ODFW, 2005, p. 9).

Status: The coastal cutthroat trout is classified as an Oregon USFWS species of concern, a sensitive species for both ODFW and Bureau of Land Management (BLM) and an ORBIC List 1 species classifying it as threatened or endangered throughout its range. It is ranked as vulnerable by NatureServe and the Oregon Natural Heritage Information Center ranks the species in Oregon as G1, or imperiled throughout its range (NatureServe, 2021; Oregon Natural Heritage Information Center, 2019, p. 10).

F.1.2.2. *Western Ridged Mussel*

Range: The western ridged mussel is currently found in portions of Northern California, Oregon, Washington, Idaho, northern Nevada, and the Canadian Province of British Columbia. In Oregon, the western ridged mussel is found throughout the state (Xerces/CTUIR, 2020). A recent assessment found its current distribution to have decreased 43 percent from the historical distribution (Blevins, et al., 2017, p. 75).

Habitat: Western ridged mussels are typically associated with low to mid-elevation lower gradient streams with substrates that vary from gravel to firm mud, and include at least some sand, silt, or clay. Preferred sites generally have constant flow, shallow water (< 3 m in depth), and well-oxygenated (COSEWIC, 2003, p. iv). Western ridged mussels prefer areas with stable habitat conditions and avoid areas with shifting substrates, periodic dewatering or extreme water level fluctuations (COSEWIC 2003, p. 12).

Reproduction: Like other freshwater mussels, the western ridged life cycle includes a short parasitic stage which requires attachment to a fish host to reproduce and disperse (COSEWIC 2003, p. 14). Documentation on host fish species is sparse, however, sculpins have been documented as host species in other locations. Generally, females release juvenile mussels (i.e., glochidia) into the water typically from April to July (Haley et al., 2007, p. 2). Glochidia attach to

the fish host for weeks to months and then land where they will live out the rest of their lives. Reproduction may be triggered by increasing water temperatures and day length (COSEWIC 2003, p. 14).

Threats: The western ridged mussel is threatened by habitat destruction and modification (Mageroy, 2015, p. 13); impacts to habitat resulting from water management, water quality and quantity, and natural flow (e.g., dams) (Haley et al., 2007, p. 85) and temperature regimes (Pandolfo, et al., 2010, p. 6). Other factors that threaten populations are disease/viruses resulting in enigmatic die-offs throughout its range (Blevins et al., 2020, p. 7). Loss and impacts to the host fish species are a huge limiting factor to the success of the species (Mageroy, 2015, p. 17).

Status: The western ridged mussel has been petitioned for listing under the ESA and is currently undergoing a Species Status Assessment (Blevins et al., 2020, p. 2). ODFW has identified the western ridged as a conservation strategy species. BLM and USFS have categorized this mussel as a sensitive species and ORBIC classified it as a List 1 species rating, which is threatened or endangered throughout its range. NatureServe has categorized the western ridged as vulnerable throughout its range, and the Oregon Natural Heritage Information Center ranks the species in Oregon as G1, or imperiled throughout its range (NatureServe, 2021; Oregon Natural Heritage Information Center, 2019, p. 24).

F.2. WETLAND/OFF-CHANNEL

F.2.1. Habitat

Wetland habitats are formed by water in the form of rainfall runoff or snowmelt that flows across the floodplain where it enters the groundwater system or remains in stream channels. In the Willamette River Valley, there is little elevation change from the valley margins to the valley floor resulting in the water table at or near the land surface over large areas (Kjelstrom and Williams, 1996, p. 324). Both wetland and off-channel habitats are fed by surface or groundwater at a frequency and duration to support a prevalence of vegetation typically adapted for life in saturated soil conditions (Tiner, 1996, p. 29).

Wetlands generally include swamps, marshes, bogs, and play a critical role in meeting the life-history requirements of many native migratory and resident wildlife species (USFWS, 2017, p. C-7; Tiner, 1996, p. 27). The Willamette Valley's wetlands are sustained by groundwater discharge, stream flooding, or both. When the river floods, side channels are inundated and isolated oxbow lakes are filled with sediment allowing wetlands to form (Carter, 1996, p. 41).

Off-channel habitats are those bodies of water adjacent to the main river channel with direct surface water connections or hyporheic flow. These side channels and alcoves create complex aquatic habitats with functioning ecological and fluvio-geomorphic processes (Gregory et al.,

2002, pp. 26-27). Side channels can evolve over time as part of the active channel to a backwater or an isolated oxbow intermittently connected to the main flow during floods, and finally to a wet depression or wetland on the floodplain (Saldi-Caromile et al., 2004, p. 219), through the process of vegetative succession. Descriptions of other habitats with water tables near the land surface (e.g., wet prairie, riparian) are included in the other habitat descriptions in this report.

F.2.2. Evaluation Species

F.2.2.1. *Northern Red-Legged Frog*

Range: The northern red-legged frog ranges from Northern California north along the west coast through Oregon and Washington west of the Cascades Mountains, and along the southwestern coast of British Columbia including Vancouver Island. Two-thirds of the global distribution of the northern red-legged frog is in the United States with about one-third being in Canada (B.C. Ministry of Environment, 2015, p. 2).

Habitat: Northern red-legged frogs are typically associated with shallow-water ponds and wetlands with emergent vegetation (ODFW, 2016). They are reliant on aquatic habitat for egg-laying and development, larval development, metamorphosis, and juvenile growth (Hayes et al., 2008, pp. 134-135). As adults, they are primarily found in riparian or cool, damp upland areas with complex understory structure during the non-breeding season. There is little data regarding their specific overwintering requirements, however, overwintering patterns from other ranid frogs in temperate regions utilize both terrestrial and aquatic habitats (Hayes et al., 2008, p. 135).

Reproduction: In the Willamette Valley, adults use lentic habitat for reproduction beginning in January through February (Storm, 1960, p. 256). Breeding habitat requires the water persist at least 5 months in forested sites with still-water exposed to sunlight (ODFW, 2016). Egg-laying only occurs at night; the masses are attached to submerged vegetation in water temperature greater than six degrees Celsius (Licht, 1971, p. 116). Eggs incubate over six weeks before they hatch and tadpoles take approximately four months to develop into juveniles (Storm, 1960, p. 256).

Threats: Loss of egg-laying habitat is a key limiting factor, though changes to active-season habitat such as hydrologic modifications, fragmentation by roads, and urban development may have more direct effects on populations. Predation and competition by invasive fish and bullfrogs pose additional threats (ODFW, 2016).

Status: The northern red-legged frog is recognized as a Federal Listing Status Species of Concern and as Sensitive by the State of Oregon.

F.2.2.2. *Pacific Lamprey*

Range: Pacific lamprey are distributed from Eastern Asia to Western North America. They were historically widespread along the West Coast of North America; however, their abundance is declining, and their distribution is contracting throughout Oregon, Washington, Idaho, and California (Clemens et al., 2017, p.269; Luzier et al., 2009, p. 4).

Habitat: Pacific lamprey utilize various habitats by life history stage (Luzier et al., 2009, pp. 6-7). In the Willamette Basin, larval lamprey predominantly use of off-channel habitat (Schultz, et al., 2016, p. 261). Larvae burrow into fine sediments to filter-feed and use slow depositional areas along stream margins during their rearing period (Torgersen and Close, 2004, pp. 620-621). Schultz et al. (2016, p. 265) found Pacific lamprey catch rates in Willamette Basin off-channel habitats was 4 times greater than in pools and 32 times greater than in riffles. As juveniles transform, they move downstream from fine substrate in low velocity areas to boulder substrates in moderate to strong currents (Beamish, 1980, p. 1914).

Reproduction: Pacific lamprey emigrate to the ocean between late fall and spring where they mature into adults. After spending one to three years in the marine environment, Pacific lampreys cease feeding and migrate to freshwater between February and June. A study in the Willamette River Basin found the median last day of upstream movement ranged from June 29 to November 9 with the median August 31 (Clemens et al., 2012, p. 252). Most upstream migration takes place at night. Pacific Lamprey are thought to overwinter and remain in freshwater habitat for approximately one year before spawning. Spawning occurs between March and July depending upon location and water temperature. The degree of homing is unknown, but adult lamprey cue in on larval areas which release pheromones that are thought to aid adult migration and spawning location.

Threats: Pacific lamprey face a variety of threats throughout their various life history stages, including artificial barriers to migration, poor water quality, predation by non-native species, stream and floodplain degradation, decline in prey, ocean conditions, dredging, and dam operations (Clemens et al., 2017, p. 272; Luzier et al., 2009, p. 9). Larval lamprey are unable to move out of areas of disturbance and a single dewatering event, physical disturbance, or contamination may have a significant effect on a local lamprey population. The highest priority threats to lamprey in the Willamette Basin are stream and floodplain degradation. Moderate threats include passage, flow management, water quality, and predation (Luzier et al., 2011, p. 174). These threats in conjunction with declining distribution and depressed abundance affect the overall status of lamprey (USFWS, 2012a, p. 4).

Status: Populations in the Willamette River sub-region are at relatively lower risk to extirpation according to their NatureServe ranking (Luzier et al., 2011, p. 2). The Pacific lamprey is currently recognized as a Federal Listing Status Species of Concern and the state of Oregon, has listed Pacific lamprey as a ‘sensitive’ species at risk of extinction (ODFW, 2006, p. 2).

F.3. RIPARIAN

F.3.1. Habitat

Riparian areas are a transition between wetland and upland where groundwater flows at shallower depths and the frequency of flooding is greater than in neighboring terrestrial environments or uplands. These habitats have distinctly different vegetation, exhibiting more vigorous or robust growth forms, than adjacent areas (USFWS, 2019, p. 6). Riparian zones may contain forests, low woody vegetation, sand and gravel bars, wet meadows, flood-scoured areas, perennial and intermittent secondary channels or side channels, and other stream-related habitats and vegetation (Fischer, et al., 2001, pp. 1-2).

Riparian habitat occurs at all elevations in the Basin and functions with stream gradient, geomorphic surfaces, and disturbance events to influence plant assemblage and structure (ODFW, 2016). In the Willamette Valley, riverine flooding and the succession that occurs after major flood events are the primary ecological processes that perpetuate riparian habitat (USFWS, 2017, p. C-3). From the Willamette Valley foothills to higher elevations, the landscape is dominated by conifers and riparian function is driven by the process of woody debris loading into channels and floodplains (Gregory et al, 1990, p. ii).

For the analysis, we interpreted riparian habitat as primarily woody vegetation associated with lotic systems. Riparian areas lack the amount or duration of water usually present in wetlands, yet their connection to surface or subsurface water distinguishes them from adjacent uplands (USFWS 2019, pp. 7-8). Descriptions of other habitats within riparian zones (e.g., wetland/off-channel, wet prairie) are included in the other habitat descriptions in this report.

F.3.2. Evaluation Species

F.3.2.1. *Foothill Yellow-Legged Frog*

Range: The foothill yellow-legged frog occurs in Pacific drainages of western Oregon and California, with an isolated population in Baja California, Mexico (Olson and Davis, 2009, p. 3). In the Willamette Basin, the frog's current distribution appears to be in the central portions of Linn (Santiam River) and Lane Counties in the Cascade Range, west of the Cascade Range crest (Olson and Davis, 2009, p. 9).

Habitat: Foothill yellow-legged frogs are dependent on lotic habitat along open, shallow (< 0.15 m), partly shaded stream sites with riffles dominated by cobble-sized substrate (Hayes and Jennings, 1988, p. 148; Yarnell, 2013, p. 202). Their life cycle is synchronized with the seasonal timing of streamflow conditions and restricted to movement along the stream network (Bourque, 2008, p. 51; Kupferberg, 1996, p. 1340). Egg masses are laid in the spring along low-velocity (0.05 m/s) margins of streams, usually in water less than 0.05 m deep with water

temperatures ranging from 15-16 °C (Olson and Davis, 2009, p. 12; Yarnell, 2013, p. 202). Tadpoles are found in water temperatures from 12-27 °C at velocities less than 0.10 m/s (Kupferberg et al., 2011, p. 149; Olson and Davis, 2009, p. 12; Yarnell, 2013, p. 202). Adults were also found at temperatures ranging from 12-27 °C at velocities less than 0.40 m/s (Kupferberg et al., 2011, p. 149; Olson and Davis, 2009, p. 12; Yarnell, 2013, p. 202).

Reproduction: Foothill yellow-legged frogs emerge from overwintering locations after high spring flows to breed (Kupferberg S. , 1996, p. 1339). Females deposit eggs in slow-moving water or backwater locations in late spring (Wheeler and Welsh, 2008, p. 136). Eggs hatch in 5-37 days and larvae metamorphose in 3-4 months (Olson and Davis, 2009, p. 8).

Threats: Surveys in the Willamette River drainage between 1997 and 1998 found foothill yellow-legged frogs at 1 of 14 (7%) historic locations (Borisenko and Hayes, 1999, p. 13). Threats in Oregon appear to be habitat loss from water impoundments or agricultural practices that alter natural flow regimes, predation and competition by introduced exotic species, chemicals, habitat degradation, and disease (Olson and Davis, 2009, pp. 14-15)

Status: The foothill yellow-legged frog is a Federal Species of Concern, listed under the California Endangered Species Act in many parts of its California range, they are classified as Sensitive on Oregon's State Sensitive Species List, and have a NatureServe Status Global Status of vulnerable and (vulnerable/imperiled in Oregon (NatureServe, 2021).

F.3.2.2. *Northwestern Pond Turtle*

Range: The northwestern pond turtle is the only turtle native to only western North America. Its range extends from northwestern Baja California, Mexico, north to Puget Sound in Washington west of the Sierra Nevada and Cascade Mountains. Northwestern pond turtles are found from San Francisco, California north to Puget Sound. In Oregon, the northwestern pond turtle is found in suitable habitat primarily west of the Cascades below 1,800 m (Barela and Olson, 2014, p. 8; Smith, 2021, p. 2.). The largest populations in Oregon are found in the Willamette, Umpqua, Rogue, and Klamath River drainages (Rosenberg, et al., 2009, p. 6).

Habitat: Northwestern pond turtles require both aquatic and terrestrial habitat throughout their life cycle. They use permanent and seasonal watercourses including rivers, sloughs, lakes, reservoirs, ponds, and irrigation canals and are most common in stagnant or slow-moving waters (Rosenberg, et al., 2009, p. 13). Basking opportunities are critical for suitable habitat, sources include open banks, logs, and tree stumps (ODFW, 2015, p. 31). The species moves onto land for half the year or more (September - April) for nesting, overwintering, dispersal, and basking (Bury, 2012, p. 10; Smith, 2021, p. 9).

Reproduction: Nesting typically occurs from May to July within 200 m of aquatic habitat in areas with compact soil, sparse vegetation, and good solar exposure (Rosenberg, et al., 2009, p. 16;

Holland, 1994, p. 2.10; Smith, 2021, p. 9). In the Willamette Valley, females emigrate from their aquatic habitat to an upland location to nest and deposit approximately 7 eggs below ground (Holland, 1994, p. 2.10). Hatchlings remain in the nest over the winter and emerge in the spring between March and April (Smith, 2021, p. 9). Northwestern pond turtles are thought to be long-lived, since the maximum age achieved by animals in the wild was at least 42 years (D. Holland and R. B. Bury, unpublished data cited by Hays et al., 1999, p. 13).

Threats: Surveys in the Willamette Basin indicated the distribution of northwestern pond turtles in 2008 was similar to their presumed historic distribution (Rosenberg, et al., 2009, pp. 31 - 32). However, their population size was estimated to be only two to four percent of the number of turtles present 150 years ago (Holland, 1993, cited by Holte, 1998, p. 2). Major factors limiting northwestern pond turtle populations include loss of aquatic habitat, nest and hatchling predation by introduced fish and bullfrogs (*Lithobates catesbeianus*), reduced availability of nest habitat, mowing and maintenance, road mortality, and displacement from basking sites by recreationalists (Smith, 2021, p. 7).

Status: The northwestern pond turtle was proposed as a threatened species under the ESA (USFWS, 2023) in October 3, 2023. The Center for Biological Diversity listed the northwestern pond turtle as one of the 10 most vulnerable reptiles in the United States in 2013 (ODFW, 2015, p. 7). They are classified as “Sensitive-Critical” on Oregon’s State Sensitive Species List, are identified as priority at-risk species in the Oregon Conservation Strategy (ODFW, 2016). They have a NatureServe Global Status of vulnerable and imperiled in Oregon (NatureServe, 2021).

F.4. UPLANDS

F.4.1. Habitat

In general, upland habitats are located outside waterbodies (lakes, reservoirs, and rivers) and include areas that are not prone to inundation long enough for their soils to have anaerobic characteristics (i.e., wetlands). Flooding or high-water tables do not greatly influence the function of upland habitats. Forested uplands generally support more than ten percent tree canopy cover. We identified two broad forested upland habitats characterized by dominant vegetation (deciduous and conifer) in the Basin.

Deciduous upland forests are found at the margins of the Willamette Valley where Oregon white oak (*Quercus garryana*) is either the sole dominant tree species or codominant with Douglas fir (*Pseudotsuga menziesii*) (NatureServe, 2011, cited by USFWS, 2017). This system is associated with dry, predominantly higher-elevation sites within the valley. These sites likely experienced low-intensity fires presettlement (Christy and Alverson, 2011, p. 94). In the absence of fire, succession tends to favor increased shrub dominance in the understory, increased tree density, and increased cover by conifers, especially Douglas fir, with the end

result being conversion to a conifer forest and loss of oak woodland habitat (NatureServe, 2011, cited by USFWS, 2017).

Conifer upland forests are dominated by Douglas fir and western red cedar (*Thuja plicata*) in the foothills and at higher elevations in the Coast Range and western slope of the Cascades. Conifer forests historically accounted for two-thirds of the basin, half of which have been converted to other forest types or land uses over the past 150 years (Gregory, et al., 2002, p. 97). Descriptions of other habitats within upland areas (e.g., prairie, agricultural land) are included in the other habitat descriptions in this report.

F.4.2. Evaluation Species

F.4.2.1. *Monarch Butterfly*

Range: The monarch is a species of that occurs in North, Central, and South America; Australia; New Zealand; islands of the Pacific and Caribbean, and elsewhere (CEC, 1993, pp. 3 - 8). The western North American Adaptive Capacity Unit comprises as much as 30% of the area occupied by monarch butterflies in North America (Dilts, et al., 2019, p. 11).

Habitat: Adult butterflies require a diversity of blooming nectar resources to feed on during breeding and migration (spring through fall). While the migratory generation of adults live six to nine months, the multiple generations of adult monarchs produced during the breeding season live approximately two to five weeks (Cockrell et al. 1993, pp. 245-246; Herman and Tatar 2001, p. 2509; Figure 2.1). During the breeding season, monarchs lay their eggs on their obligate milkweed host plant (primarily *Asclepias* spp.) for both oviposition and larval feeding (Zalucki 1982, p. 242; CEC 2008, p. 12). The correct phenology, or timing, of both monarchs and nectar plants and milkweed is important for monarch survival. In western North America, nectar and milkweed resources are often associated with riparian corridors, and milkweed may function as the principal nectar source for monarchs in more arid regions (Dingle et al. 2005, p. 494; Pelton et al. 2018, p. 18; Waterbury and Potter 2018, p. 38; Dilts et al. 2019, p. 8).

Reproduction: In the fall, western North American monarchs enter reproductive diapause (suspended reproduction) and undergo long-distance migration, flying from Canada and states west of the Rockies to overwintering groves located primarily along the California coast south into Baja California, Mexico (Jepsen and Black, 2015, pp. 147 - 156). In early spring (February-March), surviving monarchs break diapause and mate at the overwintering sites before dispersing (Leong et al. 1995, p. 46; Van Hook 1996, pp. 16-17). The same individuals that undertook the initial southward migration begin flying back through the breeding grounds, their offspring beginning the cycle of generational migration from coastal California toward the Rockies and to the Pacific Northwest (Urquhart and Urquhart 1977, p. 1585; Nagano et al. 1993, p. 157; Malcolm et al. 1993, p. 262).

Threats: The primary drivers affecting the health of the two North American migratory populations are primarily loss and degradation of habitat (from conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, senescence and incompatible management of overwintering sites in California, urban development, and drought), continued exposure to insecticides, and effects of climate change (USFWS, 2020a, p. iii).

Status: The western North American monarch population has been monitored at their overwintering sites in Mexico and California since the mid-1990s. While these populations fluctuate year-to-year with environmental conditions, these census data indicate long-term declines in the population abundance at the overwintering sites in both populations. These declining trends led to the petition of the U.S. Fish and Wildlife Service to list the monarch butterfly for protection under the Endangered Species Act of 1973, as amended (USFWS, 2020a, p. ii). On December 15, 2020, the U.S. Fish and Wildlife Service announced that listing the monarch as endangered or threatened under the Endangered Species Act is warranted, but precluded by higher priority listing actions (USFWS, 2020b).

F.4.2.2. *Wayside Aster*

Range: The wayside aster is primarily within the Willamette Valley Physiographic Province (Franklin and Dyrness, 1973, p. 11) and, until recently, it was considered a Willamette Valley endemic (Gamon, 1986, cited by Vance and Larson, 2005, p. 3). There are approximately 24 sites in the City of Eugene, Lane County, and private lands. Thirty extant sites occur on BLM lands on the Eugene and Roseburg Districts, and 2 sites have been located on Corps land (Vance and Larson, 2005, p. 3).

Habitat: The wayside aster typically occurs on dry upland sites dominated by Douglas fir and on edges between forest and meadow at elevations approximately 152 m (500 ft) to 960 m (3,150 ft). The species is a perennial with preferred habitat in open forest conditions thought to have been historically sustained by frequent fire intervals. Gaps in the canopy are particularly important to allow high light levels needed for flowering (Alverson and Kuykendall, 1989, cited by Vance and Larson, 2005, p. 3).

Reproduction: Flowering usually occurs from mid-July to September. Vegetative reproduction is common within populations making it often difficult to differentiate between individuals (Vance and Larson, 2005, p. 6). Although seed production is evident, seeds often appear sterile and seedling recruitment appears limited to nonexistent within certain populations. Habitat fragmentation for the species may be restricting pollen flow between populations as is evidenced by plants with apparently sterile seed. Because inbreeding depression can occur when pollen flow is restricted to a single site, maintaining as many sites as possible is extremely important to the long-term viability of the wayside aster (Kuykendall, 1991, cited by Vance and Larson, 2005, p. 6).

Threats: Threats include canopy closure and light level reduction from fire suppression; competition with noxious and exotic weeds; habitat fragmentation from roadside maintenance and construction; and browsing of stems and seed predation (Vance and Larson, 2005, pp. 3-4).

Status: The wayside aster is at risk of extinction due to its very restricted range and there have been recent widespread declines (Vance and Larson, 2005, p. 9). It is ranked as vulnerable by NatureServe and the Oregon Natural Heritage Information Center ranks the species as Vulnerable, rare, threatened or uncommon in Oregon (NatureServe, 2021; Oregon Natural Heritage Information Center, 2019, p. 71). The species is also listed as a State Threatened species in Oregon (OAR 603 – Division 73), and sensitive in Oregon under both the BLM and the R6 Regional Forester Sensitive Species List.

F.5. PRAIRIE

F.5.1. Habitat

The Willamette Valley Prairie consists of both Upland Prairie and Wet Prairie systems (NatureServe, 2011). Prior to settlement, the Valley was dominated by vast open prairies surrounded by bands of oak woodlands habitats (Hulse et al., 2002, p. 92). The prairies were kept free of encroaching trees and shrubs by the native Kalapuya people who set frequent, low-intensity fires. Annual springtime flooding along the Willamette River rejuvenated and maintained complex riverine and floodplain habitats (Hulse et al., 2002, p. 92). Wet prairie historically covered a third of the total prairie area. It occurs primarily on heavy clay soils of the valley floor that are perennially saturated or flooded during the winter and early spring (Christy and Alverson, 2011, p. 100). As settlers arrived in the valley, the practice of annual burning was curtailed, and river controls were installed to abate flood risk (Christy and Alverson, 2011, p. 97).

Prairies depend on periodic disturbance to maintain themselves on the landscape. In the absence of fire, conifers invade and convert this system to forest (ODFW, 2016). Today, less than one percent of this habitat remains as remnant patches scattered across the valley, making the Willamette Valley Prairie systems some of the most critically endangered ecosystems of the United States (Risser, et al., 2000, p. 47).

F.5.2. Evaluation Species

F.5.2.1. *Dusky Canada Goose*

Range: The dusky is a subspecies of Canada goose that breeds in the southeast Alaskan Copper River Delta and on islands in the Gulf of Alaska. They winter (late October to late April) primarily in the Willamette Valley and along the lower Columbia River of Oregon and Washington (Pacific

Flyway Council 2015, p. 6). The dusky represents one of smallest subspecies populations of Canada geese in North America (Bromley and Rothe 2003, p.1).

Habitat: Dusky Canada geese require high-quality herbaceous plants that meet spatial and temporal distribution to support wintering populations. The Willamette Valley provides a food source of nutrient-rich grass that grows in wet prairie and wetland habitat. The Willamette Valley National Wildlife Refuge Complex was established and is continually managed to protect winter foraging and resting habitat for the dusky (USFWS 2017, p. 6).

Reproduction: The dusky uses the marshy, grass-filled Copper River Delta in Alaska as its sole nesting habitat in the spring. They have very specific habitat preferences and a limited geographic breeding range (Warren, 2006, p. 54).

Threats: Since the 1960's the dusky Canada geese population overwintering in the Willamette Valley have decreased to half its historic levels (Pacific Flyway Council 2008, p.7). Major limiting factors include poor reproduction and high predation in their breeding range, resource competition from the cackling geese and reduced availability of suitable overwintering habitat (i.e., agricultural conversion to other uses or less suitable crops; Pacific Flyway Council 2015, p. 6, 22).

Status: This subspecies is classified as an Oregon Fish and Wildlife Department strategy species with a sensitive critical ranking (OAR 603 – Division 73) and sensitive in Oregon for both the BLM and the R6 Regional Forester Sensitive Species List. It is ranked as vulnerable by NatureServe and the Oregon Natural Heritage Information Center ranks the wintering population in Oregon as vulnerable, rare, threatened or uncommon (NatureServe, 2021; Oregon Natural Heritage Information Center, 2019, p. 16).

F.5.2.2. *Shaggy horkelia*

Range: Shaggy horkelia, ssp. *congesta*, is endemic to western Oregon and has been documented on the Eugene and Roseburg BLM Districts (Blakeley-Smith and Kaye, 2012, p. 6; Kaye, 2002, p. 4) and Fern Ridge and Dorena Reservoirs (R. Cochrane, personal communication, February 22, 2022). It is likely the range of the species has contracted due to its habitat having been destroyed or degraded since the late 1800's and early 1900's. In 1993, 20 historic populations were located, and it was concluded that the species is now absent from the northern half of its former range (Gisler, 2004, p. 128).

Habitat: Within Willamette Valley prairie habitats, populations can be found on elevated portions of wet prairies, dry uplands, open areas, and shady understories (Gisler, 2004, p. 128). The recorded elevation range for the species is between 84 meters (275 feet) to about 518 meters (1,700 feet) (Blakeley-Smith and Kaye, 2012, p. 6).

Reproduction: Shaggy horkelia is a tap rooted perennial forb in the Rose family that reproduces by seed. Flower season peaks in mid-July and seed can be collected at the beginning of September (Blakeley-Smith and Kaye, 2012). Occasionally, the root splits beneath the soil surface and produces rosettes that are connected underground. Field observations indicate solitary bees and syrphid flies are responsible for cross-pollination (Kaye T. , 2002, p. 1). Propagation and establishment in new patches have been successful, as it has good germination and seems to be suited to greenhouse conditions (Gisler, 2004, p. 134).

Threats: The decline of shaggy horkelia is in in part due to habitat loss, small populations, forest succession, and invasive weeds. The primary threat to populations is the genetic consequences of small populations (Blakeley-Smith and Kaye, 2012, p. 8). Related to small-sized populations, prairie habitats found within the Willamette Valley lack connectivity to one another, thus reducing the opportunity for cross-pollination. Wildlife grazing is a potential risk to these small populations, any loss of flowering stems due to grazing could result in lost reproduction opportunities for the entire year. Deer and rodents are the most likely wildlife species to pose a grazing threat since there is no active livestock grazing, (Blakeley-Smith and Kaye, 2012, p. 10). Forest succession in the habitat of shaggy horkelia may also be a threat. In the absence of fire, shrubs and trees out-compete prairie species which results in a conversion to riparian forest (Kaye T. , 2002, p. 19). Invasive species threaten the ecological integrity of prairie habitats because of competitive displacement.

Status: Shaggy horkelia is an Oregon Department of Agriculture candidate species and classified as a U.S. Fish and Wildlife Service Species of Concern. It is ranked as imperiled by NatureServe and the Oregon Natural Heritage Information Center ranks the species in Oregon as imperiled throughout its range in Oregon (Oregon Natural Heritage Information Center, 2019, p. 74).

F.6. DELISTED SPECIES

F.6.1. Evaluation Species

F.6.1.1. *Bradshaw's Lomatium*

Range: Bradshaw's lomatium currently extends from Clark County, Washington, to the southern end of the Willamette Valley. There are currently greater than 11 million Bradshaw's lomatium individuals across 24 known populations, at 71 known sites. Of the 71 known sites, 51 are in either public ownership, public right-of-way, or are owned by a conservation-oriented non-governmental organization. Of the 20 remaining sites, 9 are under conservation easement or are enrolled in the Service's Partners for Fish and Wildlife Program, which provides technical and financial assistance to private landowners to restore, enhance, and manage private land to improve native habitat and conserve listed species. The vast majority of known Bradshaw's lomatium individuals (>10 million plants) occur at a single site in southwest Washington.

Outside of this site, there are approximately 500,000 Bradshaw's lomatium plants distributed across 70 sites in Washington and Oregon.

Habitat: The majority of Bradshaw's lomatium populations occur on seasonally saturated or flooded prairies, adjacent to creeks and small rivers in the southern Willamette Valley. Soils at these sites are dense, heavy clays, with a slowly permeable clay layer located 15-30 cm (6-12 in) below the surface. This clay layer results in a perched water table during winter and spring and is critical to the wetland character of these grasslands, known as tufted hair-grass (*Deschampsia cespitosa*) prairies. Bradshaw's lomatium occurs on alluvial (deposited by flowing water) soils.

Reproduction: Bradshaw's lomatium is perennial herb in the parsley family (Apiaceae). It can reach 20-50 cm (8-20 in) in height, with mature plants having only 2-6 leaves. The yellow flowers are small, measuring about 1 mm (0.05 in) long and 0.5 mm (0.025 in) across, and are grouped into asymmetrical umbels. Bradshaw's lomatium blooms during April and early May, with fruits appearing in late May and June and reproduces entirely from seed. Insects observed to pollinate this plant include beetles, ants, and some small native bees.

Threats: Endemic to and once widespread in the wet, open areas of the Willamette Valley of western Oregon, Bradshaw's lomatium is limited now to a few sites in Lane, Marion, and Benton Counties. Most of its habitat has been destroyed by land development for agriculture, industry, and housing. In addition, water diversions and flood control structures have changed historic flooding patterns, which may be critical to seedling establishment. Reductions in natural flooding and fire cycles also permit invasion of trees and shrubs, and eventual conversion of wet prairies to woodlands.

Status: Bradshaw's lomatium was federally listed as endangered without critical habitat in 1988. When initially listed, there were only 11 populations of Bradshaw's lomatium and fewer than 30,000 plants. A recovery plan was published in 1993 (USFWS, 1993). Due to native prairie restoration, habitat management, reduction of threats by private and public partners and the discovery of new populations, there are more than 24 populations and greater than 11 million plants. In March 2021 it was delisted from the ESA.

F.6.1.2. *Oregon Chub*

Range: Oregon Chub is endemic to the Willamette River basin, and historically were found downstream to the mouth of the Clackamas River near Oregon City and as far upstream to Oakridge. Currently Oregon Chub are found in the alluvial reaches of the Molalla, Yamhill, Luckiamute, Santiam, Mary's, McKenzie, Middle Fork Willamette, Coast Fork Willamette River basins, and the upper mainstem Willamette River. Oregon Chub were historically documented in the Clackamas, Calapooia, and Long Tom Rivers, but have not been located in these basins in over a century.

Habitat: Oregon Chub are primarily found in off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient streams, and flooded marshes. These habitats typically have little or no water flow, are dominated by silt and organic substrate, and contain considerable aquatic vegetation providing cover for hiding and spawning. Average depth is typically less than 1.8 m, and summer water temperatures typically exceed 16°C.

Reproduction: Oregon Chub reach maturity at about 2 years of age. Oregon Chub typically spawn from May through August once water temperatures exceed 16°C. Males over 35mm total length have been observed exhibiting spawning behavior. Females contain 147 to 671 eggs. Oregon Chub spawn in dense aquatic vegetation. Larval Oregon Chub congregate in shallow habitats in the upper layers of the water column, and venture into deeper water as they mature.

Threats: Threats to Oregon Chub have been greatly reduced since the time of listing. However, populations are still threatened by 1) predation and competition by non-native fish; and 2) habitat loss, including impacts from complete reservoir drawdowns, destruction of habitat from flooding, alteration of habitat due to flow and temperature management, and habitat loss due to wetland succession processes.

Status: Oregon Chub were listed as Endangered under the ESA in 1993, downlisted to Threatened in 2010, and in 2015 became the first fish to be removed from the ESA due to recovery. Following the delisting, the framework for Oregon Chub monitoring and management has been provided by the Post-Delisting Monitoring Plan for the Oregon Chub. This plan concluded in 2023, and found that the species remained secure without the ESA protections. The Oregon Chub Working Group is currently drafting a Cooperative Management Plan for the Oregon Chub, which will provide a long-term monitoring and management framework.

F.7. KEYSTONE SPECIES

F.7.1. Evaluation Species

F.7.1.1. *American Beaver*

Range: The North American beaver occurs throughout most of Alaska, Canada, the continental United States and in portions of northern Mexico (Pollock et al., 2003, p. 214). In North America, the only areas where beaver may be absent are the Arctic, the very far north of Canada and parts of Alaska, the dry Great Basin and desert country of Nevada and southern California (Pollock et al., 2003, p. 213). Otherwise, beavers are found throughout northern boreal forests, south to the deserts of northern Mexico, west to the Aleutian Islands, and all the way to the eastern seaboard. North American beaver are present throughout Oregon.

Habitat: The key feature of beaver habitat is the presence of perennial water. Water is essential to the daily life of beavers and can be in the form of a perennial stream, river, lake, or pond, providing year-round access to food resources, protection of lodge and burrow entrances, and general safety from predators (Müller-Schwarze and Sun, 2003, p. 106). In addition, beaver need surrounding riparian areas that can provide food resources, construction materials, and places to build scent mounds. In Oregon, preferred tree species include cottonwood and aspen, willow, alder, and maple. Beaver are generalists and can consume a wide variety of herbaceous plants.

As ecosystem engineers, beavers can utilize a wide variety of habitats which they modify and maintain to meet their needs. Beaver prefer to build dams on small- to medium-sized, low-gradient streams (< 1-2%) sites first. Beaver generally avoid constrained valleys with high-gradient streams (reviewed in Pollock et al. 2003) but will colonize this less-preferred habitat if their population densities are high (Müller-Schwarze and Sun, 2003, p. 106).

Beaver also occupy large rivers but restrict their dam-building to off-channel habitat fed by hyporheic flow, groundwater channels, and tributary channels that flow across the floodplains of the larger river channel (Pollock et al., 2003, p. 217). They also will build seasonal dams across large rivers during low flow conditions.

Reproduction: Beaver reach sexual maturity at 1.5 years. Adults form long-term pair-bonds. Breeding typically occurs in late winter, and the gestation period of beaver is about 100 days. Litters are born May through July, and beaver produce a single litter of one to nine kits per year. Beaver colonies are typically made up of a breeding pair of adult beaver, juvenile yearling beaver, and kits from the current year. Dispersal of two-year-old beaver is the primary mechanism of population expansion.

Threats: Historically, the primary threats to beaver were overharvesting for fur trade coupled with the extensive aquatic and riparian habitat degradation and loss. Ongoing Impacts to habitat occur through the simplification of the river system, including the conversion of off-channel habitats and wetlands to upland habitat for development or agriculture, the construction of revetments, channelization, flood control and flow management. In some areas, competition with livestock limits the forage available for beaver. Beaver are lethally removed for to reduce negative interactions with humans, primarily damage to trees and other crops, and impacts to infrastructure. Although beaver are known to disperse over great distances, fragmentation in suitable habitats may limit the success of dispersal, and cause beaver to be susceptible to predation.

Status: In recent years, there has been a growing recognition of the beneficial role that beavers provide in enhancing ecosystem function and in the creation of diverse habitats. While beaver are widespread throughout the Willamette River basin, opportunities exist to enhance beaver

habitats and promote the use nonlethal management, furthering the benefits provided by this species.

F.7.1.2. *Black Cottonwood*

Range: The black cottonwood range covers large sections of western North America. Distribution extends as far north as Alaska, all the way down the west coast to northern Baja California. Its range further extends east to western Montana, and northern Idaho (USDA, 2021).

Habitat: Black cottonwood grows on alluvial sites, riparian habitats, and moist woods on mountain slopes, at elevations of 0 - 2,100 meters (USDA, 2021). Black cottonwoods are reliant on water from the riparian water table rather than from precipitation, therefore are dependent upon a constant connection to a source of water (Mahoney and Rood, 1993, p. 228). Black cottonwoods form a major component of the canopy of riparian corridor forests east of the Cascades, and in wetter portions of the floodplain west of the Cascades. This important riparian species provides shade, leaf litter, filtration, soil rooting matrix, nesting and foraging habitat, structural diversity, and large wood associated integral to healthy river interactions (DeBell, 1990, pp. 570-573).

Reproduction: Conditions for successful cottonwood regeneration in natural, uncompromised system, occur approximately once every five to ten years (Mahoney and Rood, 1998, pp. 635 - 642). Black cottonwood regeneration is dependent upon a natural hydrologic pattern; cottonwoods release seeds following a peak flow (flood), which historically occurred in the Willamette Valley in early June (Dykaar and Wigington, 2000, pp. 87-88). Peak flows scour banks creating habitat for cottonwoods. Wind and water disperse seeds along the moist newly scoured habitat. Seedling survival depends on continuously favorable conditions during the first month in early summer (USDA, 2021).

Threats: The black cottonwood is most threatened by habitat destruction and hydrologic alterations and disruption of the natural flow cycle. These threats impact seedling establishment and mature tree survival (Mahoney and Rood, 1993, p. 230).

Status: Black cottonwood was chosen as a keystone species for our analysis due to its large role in riparian habitat and processes in the Willamette Valley. It is prevalent throughout riparian habitat in the Basin and has a high likelihood to be affected by WVS impacts.

G. APPENDIX G: EFFECTS ANALYSIS OF PROPOSED MEASURES

This appendix includes a summary of each of the Corps' proposed measures and likely effects on each habitat type and evaluation species included in our FWCAR.

G.1. SUMMARY TABLE OF ALTERNATIVES AND MEASURES

Alternative	Project	Water Quality Measures			Storage and Flow Measures		Downstream Fish Passage Measures			Upstream Measures	
		Use spillway to release warm surface water (temp)	Temp. tower (temp)	Spread spill across spillbays (TDG)	2008 BO Targets	Augment flows using the inactive or power pool	Pass fish over spillway	Pass fish through RO	Drawdown to lowest feasible outlet	Adult fish facility	Lamprey passage features
NAA	Big Cliff			x	x					x	x
	Detroit	x			x						
	Foster	x			x		x			x	x
	Green Peter				x	x					
	Blue River				x						
	Cougar		x		x					x	x
	Fall Creek				x			x	x	x	x
	Dexter			x	x					x	
	Lookout Point				x						
	Hills Creek				x						
	Dorena				x						
	Cottage Grove				x						
	Fern Ridge				x						

Alternative	Project	Water Quality Measures					Storage and Flow Measures					Fish Passage Measures							Basin-wide Measures			
		479	105	174	166	721	718	723	304	30a	30b	639	722	52	392	40	720	714	384	719	9	726
1	Big Cliff							x							x				x	x	x	x
	Detroit		x	x				x	x						x				x	x	x	x
	Foster	x		x				x							x				x	x	x	x
	Green Peter		x	x				x	x				x	x	x				x	x	x	x
	Blue River						x	x											x	x	x	x
	Cougar			x				x	x										x	x	x	x
	Fall Creek						x	x											x	x	x	x
	Dexter			x				x							x				x	x	x	x
	Lookout Point		x	x				x	x						x				x	x	x	x
	Hills Creek							x	x										x	x	x	x
	Dorena						x	x											x	x	x	x
	Cottage Grove						x	x											x	x	x	x
	Fern Ridge							x				x		x					x	x	x	x

Alternative	Project	Water Quality Measures					Storage and Flow Measures					Fish Passage Measures							Basin-wide Measures			
		479	105	174	166	721	718	723	304	30a	30b	639	722	52	392	40	720	714	384	719	9	726
2a	Big Cliff									x									x	x	x	x
	Detroit		x						x	x					x				x	x	x	x
	Foster	x								x					x				x	x	x	x
	Green Peter				x	x			x	x			x	x		x		x	x	x	x	x
	Blue River						x			x									x	x	x	x
	Cougar								x	x					**x**				x	x	x	x
	Fall Creek						x			x									x	x	x	x
	Dexter									x									x	x	x	x
	Lookout Point								x	x					x				x	x	x	x
	Hills Creek								x	x									x	x	x	x
	Dorena									x									x	x	x	x
	Cottage Grove									x									x	x	x	x
	Fern Ridge									x									x	x	x	x

Alternative	Project	Water Quality Measures					Storage and Flow Measures					Fish Passage Measures							Basin-wide Measures			
		479	105	174	166	721	718	723	304	30a	30b	639	722	52	392	40	720	714	384	719	9	726
2b	Big Cliff									x									x	x	x	x
	Detroit		x						x	x					x				x	x	x	x
	Foster	x								x					x				x	x	x	x
	Green Peter				x	x			x	x			x	x		x		x	x	x	x	x
	Blue River						x			x									x	x	x	x
	Cougar									x						**x**	**x**		x	x	x	x
	Fall Creek						x			x									x	x	x	x
	Dexter									x									x	x	x	x
	Lookout Point								x	x					x				x	x	x	x
	Hills Creek								x	x									x	x	x	x
	Dorena									x									x	x	x	x
	Cottage Grove									x									x	x	x	x
	Fern Ridge									x									x	x	x	x

Alternative	Project	Water Quality Measures					Storage and Flow Measures					Fish Passage Measures							Basin-wide Measures			
		479	105	174	166	721	718	723	304	30a	30b	639	722	52	392	40	720	714	384	719	9	726
3a	Big Cliff									x								x	x	x	x	x
	Detroit				x	x			x	x						x	**x**		x	x	x	x
	Foster					x				x									x	x	x	x
	Green Peter				x	x			x	x			x	x		x		**x**	x	x	x	x
	Blue River					x	x			x			x	x		x			x	x	x	x
	Cougar								**x**	x						x	x		x	x	x	x
	Fall Creek						x			x								**x**	x	x	x	x
	Dexter									x								x	x	x	x	x
	Lookout Point				x	x			x	x						x	**x**		x	x	x	x
	Hills Creek					x			x	x			x	x		x		**x**	x	x	x	x
	Dorena						x			x									x	x	x	x
	Cottage Grove						x			x									x	x	x	x
	Fern Ridge									x									x	x	x	x

Alternative	Project	Water Quality Measures					Storage and Flow Measures					Fish Passage Measures							Basin-wide Measures			
		479	105	174	166	721	718	723	304	30a	30b	639	722	52	392	40	720	714	384	719	9	726
3b	Big Cliff									x								x	x	x	x	x
	Detroit				x	x			x	x						x		x	x	x	x	x
	Foster					x				x									x	x	x	x
	Green Peter				x	x			x	x			x	x		x	x		x	x	x	x
	Blue River					x	x			x			x	x		x			x	x	x	x
	Cougar									x						x	x		x	x	x	x
	Fall Creek						x			x									x	x	x	x
	Dexter									x								x	x	x	x	x
	Lookout Point				x	x			x	x						x		x	x	x	x	x
	Hills Creek					x			x	x			x	x		x	x		x	x	x	x
	Dorena						x			x									x	x	x	x
	Cottage Grove						x			x									x	x	x	x
	Fern Ridge									x									x	x	x	x

Alternative	Project	Water Quality Measures					Storage and Flow Measures					Fish Passage Measures							Basin-wide Measures			
		479	105	174	166	721	718	723	304	30a	30b	639	722	52	392	40	720	714	384	719	9	726
4	Big Cliff									x					x				x	x	x	x
	Detroit		x	x					x	x					x				x	x	x	x
	Foster	x		x						x					x				x	x	x	x
	Green Peter			x	x	x			x	x									x	x	x	x
	Blue River						x			x									x	x	x	x
	Cougar			x					x	x					x				x	x	x	x
	Fall Creek						x			x									x	x	x	x
	Dexter			x						x			x		x				x	x	x	x
	Lookout Point		x	x					x	x					x				x	x	x	x
	Hills Creek		x						x	x			x	x	x				x	x	x	x
	Dorena						x			x									x	x	x	x
	Cottage Grove						x			x									x	x	x	x
	Fern Ridge									x		x		x					x	x	x	x

Alternative	Project	Water Quality Measures					Storage and Flow Measures					Fish Passage Measures							Basin-wide Measures			
		479	105	174	166	721	718	723	304	30a	30b	639	722	52	392	40	720	714	384	719	9	726
5	Big Cliff										x								x	x	x	x
	Detroit		x						x		x				x				x	x	x	x
	Foster	x									x				x				x	x	x	x
	Green Peter				x	x			x		x		x	x		x		x	x	x	x	x
	Blue River						x				x								x	x	x	x
	Cougar										x					**x**	**x**		x	x	x	x
	Fall Creek						x				x								x	x	x	x
	Dexter										x		x	x					x	x	x	x
	Lookout Point								x		x				x				x	x	x	x
	Hills Creek								x		x								x	x	x	x
	Dorena										x								x	x	x	x
	Cottage Grove										x								x	x	x	x
	Fern Ridge										x								x	x	x	x

G.2. EFFECTS OF THE CORPS' PROPOSED MEASURES ON HABITATS AND SPECIES

G.2.1. Basin-wide Measures

Measures which would be implemented regardless of the action alternative selected and are not necessarily factored into decisions related to the selection of a preferred alternative. These include both operational measures and structural measures in multiple locations throughout the WVS.

G.2.1.1. *Measure 9: Maintain revetments using nature-based engineering methods*

Summary: The Corp's EWN Initiative enables more sustainable delivery of economic, social, and environmental benefits associated with infrastructure (Corps, 2021b). As routine O&M of existing Corps managed revetments is needed, include nature-based engineering methods. Projects where ecosystem restoration benefits are identified and have a non-Federal cost-share sponsor will be evaluated and implemented. Post construction monitoring will ensure the project performs as intended, both biologically and for bank protection. This measure is being considered for all alternatives at all projects.

Interactions with Riverine/Reservoir Habitat and Species: Restoration actions implemented under this measure could provide benefits to the riverine habitat and species. Beneficial actions under the EWN program could include modification of current levees and construction of setback levees, notching or other modification of current levees to increase riverine connectivity, and operational flow management. These actions could promote floodplain function, including an increase open-water riverine connectivity, which could provide movement opportunities for coastal cutthroat trout, Oregon chub and western ridged mussel host fish, and increase the frequency and duration of disturbance processes necessary to maintain these habitats. Alternatively, the introduction of nature-based engineering has the potential to decrease connectivity with other habitats (e.g., off-channel, wetland), impact disturbance processes, and ultimately decreases overall ecosystem function. In addition, there is high potential for non-native species to thrive, thus increasing native species to increased predation and additional resource competition. Increased riverine bank support could provide channel stability which could support freshwater mussel bed recruitment; however, revetments could decrease shallow, low velocity margin habitat for juvenile coastal cutthroat trout.

Interactions with Off-Channel/Wetland Habitat and Species: Although there are currently no proposed actions under this measure that will impact off-channel and wetland habitat and species, restoration actions under the EWN program could provide benefits. Beneficial actions under the EWN program could include modification of current levees and construction of setback levees, notching or other modification of current levees to increase riverine connectivity, and operational flow management. These actions will promote floodplain

function, including an increase open-water riverine connectivity, which will provide passage for Pacific lamprey, and increase the frequency and duration of disturbance processes necessary to maintain these habitats. Actions under EWN program may also increase the area and inundation period of wetland habitat area, which would benefit the northern red-legged frogs in areas where wetlands early desiccation prevents successful reproduction. Conversely, in areas where late-season desiccation is a control for non-native fish and American Bullfrog, EWN actions may maintain year-round water in off-channel and wetland habitats, enabling non-native species to become established in these habitats.

Interactions with Riparian Habitat and Species: The introduction of EWN within the design of the revetments will provide habitat for native riparian vegetation and decrease hard surfaces (e.g., rock) within the system. Nature-based engineering will also provide habitat for various fish and wildlife species in the river margins at revetment sites. This increased riparian habitat may support adult foothill yellow-legged frogs and creates basking and nesting sites for adult northwestern pond turtles. Wildlife using existing revetments for various life functions including denning, nesting, and foraging and could be impacted by modification.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: Although there are currently no proposed actions under this measure that will impact prairie habitat and species, restoration actions under the EWN program could provide benefits. Beneficial actions under the EWN program could include modification of current levees and construction of setback levees, notching or other modification of current levees, and operational flow management. These actions would increase or restore floodplain functions and increase the duration of near-surface soil saturation and promote natural disturbance processes that will control woody and non-native vegetation.

G.2.1.2. *Measure 384: Gravel Augmentation*

Summary: Gravel augmentation below dams to restore spawning gravels. Adding clean round river gravel increases or improves river substrate conditions for spawning and rearing of native fish species below (downstream) of WVS dams. Gravel would be placed into the wetted channel based on scientific analysis and calculation of a gravel budget for the river. Gravel would be sized appropriately for use by spawning salmon and steelhead, and to the maximum extent feasible, locally sourced. A monitoring program and adaptive management plan will be developed to ensure habitat gains are realized and negative effects are minimized. This measure is being considered for all alternatives at all projects.

Interactions with Riverine/Reservoir Habitat and Species: Given the cumulative decrease of sediment transport for many years, gravel augmentation below dam structures could increase riverine habitat complexity and diversity. More specifically, this measure could provide

increased spawning habitat opportunity for coastal cutthroat trout and could potentially increase in substrate diversity, which may increase suitable habitat for the western ridged mussel. However, the addition of gravel substrates below dams would bury established freshwater mussel beds which often are situated below dam structures (e.g., Dexter Dam; (Searles Mazzacano, 2019, p. 4).

Interactions with Off-Channel/Wetland Habitat and Species: As augmented gravel moves downstream, new gravel depositions may occur at upstream end of off-channel habitats, increasing threshold for flow-through conditions. Given the operational flow limitations, this may limit disturbance processes in off-channel habitats in reaches with gravel augmentation. However, an increase in gravel may increase in-channel disturbance processes, leading to lateral channel movement and may allow for new off-channel habitat formation. Lateral flow and scour will bring new sediment into the channel. In addition, these instream processes will likely create additional subsurface flow pathways over time, increase hyporheic connectivity, which will lower temperatures in mainstem and off-channel habitats. The increase in habitat diversity should increase the habitat availability and suitability for Pacific lamprey and red-legged frog.

Interactions with Riparian Habitat and Species: Adding round river gravel could create exposed bars for vegetation establishment and provide additional substrate in the system. Gravel augmentation may benefit amphibian species that breed and lay their eggs in flowing water. Potentially creates cottonwood seedling habitat if gravel is appropriately sized and becomes exposed after peak flows. Unintended negative impacts if timing and location placement is not considered (i.e., sedimentation and smothering of amphibian eggs/larvae that may be present or road mortality for northwestern pond turtles at along access points).

Interactions with Upland Habitat and Species: No known widespread impacts. Point impacts may occur along roads from gravel sources and points of gravel distribution such as the introduction of non-native plants.

Interactions with Prairie Habitat and Species: No known widespread impacts. Point impacts may occur along roads from gravel sources and points of gravel distribution.

G.2.1.3. *Measure 719: Hatchery Transition Plan*

Summary: Hatchery transition plan to adjust hatchery releases for mitigation and ESA-listed fish. This measure is being considered for all alternatives at all projects.

Interactions with Riverine/Reservoir Habitat and Species: Implementing hatchery release and supplementation to the riverine/reservoir habitat could result in the addition of marine derived nutrients post spawning. Increasing hatchery release of salmonids could potentially provide increased host fish opportunities for other freshwater mussel species. However, additional

supplementation of salmonids has the potential to affect native fish populations, such as the Oregon chub and coastal cutthroat trout due to increased resource competition and predation.

Interactions with Off-Channel/Wetland Habitat and Species: No known impacts.

Interactions with Riparian Habitat and Species: No known impacts.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.1.4. *Measure 726: Adult Outplanting*

Summary: Adult outplanting locations to support upstream passage. This measure is being considered for all alternatives at all projects.

Interactions with Riverine/Reservoir Habitat and Species: Adults released at out planting sites may be concentrated in higher densities and disproportionately predate on other native fish such as the Oregon chub and coastal cutthroat trout.

Interactions with Off-Channel/Wetland Habitat and Species: No known impacts.

Interactions with Riparian Habitat and Species: Adult fish released at outplanting sites may be concentrated in higher densities and disproportionately predate on other native species depending on life-stage and time of year (amphibian eggs and tadpoles, for example). Vehicles or activities using access points may disrupt northwestern pond turtle basking or nesting habitat and cause road mortality.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.2. Water Quality Measures

Measures to improve management of instream temperature and control total dissolved gas. These include operational or structural measures in multiple locations throughout the WVS depending on the alternative.

G.2.2.1. *Measure 105: Water Temperature Control Towers*

Summary: Construct water temperature control tower structures to improve downstream water temperatures. These structures would allow selective withdrawal of water at various temperatures that could be blended to improve downstream water temperature. The purpose of this measure is to achieve Clean Water Act (CWA), total maximum daily load (TMDL), and ESA

water temperature requirements below each identified dam. This measure is being considered for A1 at Detroit, Green Peter, and Lookout Point; A2a, A2b, and A5 at Detroit; A4 at Detroit, Lookout Point, and Hills Creek.

Interactions with Riverine/Reservoir Habitat and Species: Regulated water temperatures could diversify water temperature in the spring and could affect reproduction timing for the western ridged mussel and its associated host fish. Water temperature has been identified to influence of freshwater mussel reproduction timing (Haley et al., 2007, p. 35). Females typically release glochidia (i.e., juvenile mussels) into the water column during spring and fall (Haley et al., 2007, p. 43). This measure could provide more normative water temperatures downstream, thus increasing water quality standards (i.e., meet ESA/CWA standards) and therefore allowing native species such as the Coastal Cutthroat to potentially be more successful. However, an increase in temperature diversity could increase species diversity and may increase the dominance of non-native predatory and competitive fish in these habitats.

Interactions with Off-Channel/Wetland Habitat and Species: May provide greater diversity in water temperature, which will impact water temperatures in secondary channel, and hydrologically connected off-channel and wetlands habitats. This increase in temperature diversity will increase species diversity in impacted reaches. This measure may increase water temperature during the spawning periods for non-native predatory fish, which may lead to successful recruitment in otherwise marginal habitats. This measure may increase water temperature in hydrologically connected habitats near the end of the red-legged frog tadpole and juvenile life history period and may increase the dominance of non-native predatory and competitive fish in these habitats.

Interactions with Riparian Habitat and Species: Regulated water temperatures in the spring may impact downstream habitat suitability, egg/larval survivorship, reproduction timing, and metamorphosis rates of foothill yellow-legged frogs.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.2.2. *Measure 166: Use Regulating Outlets*

Summary: Use lowest Regulating Outlets (RO) to discharge colder water during drawdown operations in fall and winter to reduce water temperatures below dams. Purpose is to provide more normative downstream water temperatures in fall and winter. This measure is being considered for A2a, A2b, A4 and A5 at Green Peter; A3a and A3b at Green Peter, Detroit, and Lookout Point.

Interactions with Riverine/Reservoir Habitat and Species: May provide more normative fall and winter water temperatures in the riverine habitat, which in turn could benefit the coastal cutthroat, Oregon chub and the western ridged mussel (and their host fish) by improving water quality and subsequently allowing native riverine species to be more successful. There could be a benefit to connected secondary and off-channel habitats in North Santiam (Detroit), South Santiam (Green Peter), and the Middle Fork Willamette (Lookout Point).

Interactions with Off-Channel/Wetland Habitat and Species: May provide more normative fall and winter water temperature in secondary channel, and hydrologically connected off-channel and wetlands habitats. Many off-channel and hydrologically connected wetland habitats likely have high temperature diversity and stratification, and some species of non-native fish may utilize off-channel habitats to avoid riverine habitats outside their preferred temperature range. Non-native species may become entrained within these habitats during high flow periods and predate on and compete with Pacific lamprey and northern red-legged frog.

Interactions with Riparian Habitat and Species: Cooler temperatures downstream in the fall and winter will not likely impact adult life history of foothill yellow-legged frog.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.2.3. *Measure 174: Structural Improvements*

Summary: Structural improvements to reduce TDGs. Spill patterns and spillway deflectors will distribute spillbay flows uniformly across the entire spillway. Deflectors will redirect the flow from the plunging flow in the spillway that transports air bubbles deep into the stilling basin to a horizontal jet that maintains entrained air closer to the water surface. Pipe extensions on the downstream side of regulating outlets will submerge releases in the stilling basin and reduce jet impact on the tailwater surface and will slow flow, lower TDG, create more riffles and less scour. Additional boulders and debris jams downstream of projects will create more natural riffles. This measure is being considered for A1 and A4 at Detroit, Foster, Green Peter, Cougar, Dexter, and Lookout Point.

Interactions with Riverine/Reservoir Habitat and Species: Structural improvements to reduce total dissolved gasses downstream of project dams such as, Dexter, Lookout Point, Cougar, Foster, Green Peter, Big Cliff, and Detroit could benefit coastal cutthroat trout, Oregon chub and the western ridged mussel by improving water quality. Habitat complexity could be improved by the creation of natural riffles and slower flows in the tail water reaches, which could also benefit species such as coastal cutthroat trout and the western ridged mussel. The addition of boulders or log structures downstream could provide channel stability, and increase collection opportunities for smaller substrate sizes, therefore increasing suitable habitat for the

western ridged mussel (Searles Mazzacano, 2019, p. 15). However, changes in water temperature may impact the western ridged mussel breeding timing and potentially influence host fish behavior.

Interactions with Off-Channel/Wetland Habitat and Species: No known impacts.

Interactions with Riparian Habitat and Species: The creation of more natural riffles and slower flows could benefit adult foothill yellow-legged frog habitat. However, changes in water temperature may impact amphibian habitat suitability, egg/larval survivorship, and metamorphosis rates. Slower moving water may also benefit northwestern pond turtles' ability to bask and move from water to banks for nesting. Less sediment scouring downstream could create gravel bar habitat allowing for the establishment of cottonwood.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.2.4. *Measure 479: Modify Outlets*

Summary: Modify existing outlets to allow releases at varying depths for temperature control. Purpose is to restore normative water temperatures downstream. This measure is being considered for A1, A2a, A2b, A4 and A5 at Foster.

Interactions with Riverine/Reservoir Habitat and Species: May provide greater diversity in water temperature in the riverine and reservoir habitats, as well as the hydrologically connected off-channel and wetlands habitats. The increase in temperature diversity could increase species diversity and non-natives in the impacted reaches. This measure may increase water temperature in hydrologically connected habitats, which could impact rearing coastal cutthroat trout and Oregon chub and may increase the dominance of non-native predatory and competitive fish in these habitats. In addition, warmer water temperatures could impact breeding timing for the western ridged mussel or its host fish.

Interactions with Off-Channel/Wetland Habitat and Species: May provide greater diversity in water temperature, which will impact water temperatures in secondary channel, and hydrologically connected off-channel and wetlands habitats. This increase in temperature diversity will increase species diversity in impacted reaches. This measure may increase water temperature during the spawning periods for non-native predatory fish, which may lead to successful recruitment in otherwise marginal habitats. This measure may increase water temperature in hydrologically connected habitats near the end of the northern red-legged frog tadpole and juvenile life history period and may increase the dominance of non-native predatory and competitive fish in these habitats.

Interactions with Riparian Habitat and Species: Regulated water temperatures could affect habitat suitability, egg/larval survivorship, reproduction timing, and metamorphosis rates for foothill yellow-legged frogs downstream.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.2.5. *Measure 721: Spring and Summer Surface Spill*

Summary: Use spillway for surface spill in spring and summer to allow for more normative downstream water temperatures from spring through autumn. Releasing a larger volume of warm surface water from the reservoir in the spring can reserve cold deep water for release through ROs later in the fall/winter. This measure is being considered for A2a, A2b, A4 and A5 at Green Peter; A3a and A3b at Detroit, Foster, Green Peter, Blue River, Lookout Point, and Hills Creek.

Interactions with Riverine/Reservoir Habitat and Species: This measure may provide normative water temperature conditions from April 15 through August in the riverine habitats. However, water releases via the spillway may directly impact riverine habitat species such as the coastal cutthroat trout and the western ridged mussel depending on timing, magnitude of fluctuations and frequency of discharge. Increases in flow during this time could directly impact the western ridged mussel during dispersal events when larvae are released into the water column in search of a host fish to complete further development. Further, these flow increases could flush larval mussels downstream and not allow for attachment into the stream bottom. In addition, this measure could increase water temperature in the riverine habitat and may increase the dominance of non-native predatory fish which could impact the coastal cutthroat trout and Oregon chub.

Interactions with Off-Channel/Wetland Habitat and Species: This measure may provide normative conditions from April 15 through August in secondary channel and hydrologically connected off-channel and wetland habitats. Off-channel habitats have a high level of temperature variability; however, the impacts of this measure could prolong the spawning and forage area and period for non-native fish. This measure may increase water temperature in hydrologically connected habitats near the end of the northern red-legged frog tadpole and juvenile life history period and may increase the dominance of non-native predatory and competitive fish in these habitats.

Interactions with Riparian Habitat and Species: Water releases via the spillway may impact riparian habitat depending on timing, magnitude of fluctuations and frequency of discharge. Increased velocities and rising water levels could impact turtle nesting activity and basking. Northwestern pond turtle nests may be flooded resulting in mortality of eggs or hatchlings still

in the nest chamber. Increased flows could affect amphibian egg attachment or sweep away larvae while water levels that drop quickly could result in desiccated eggs or stranding. Warmer downstream temperature conditions beginning in April, could trigger earlier reproduction of foothill yellow-legged frogs or impact breeding if water temperature is too warm.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.3. Flow Measures

Measures to benefit reservoir refill objectives or to improve conditions downstream for fish survival. These include operational measures in multiple locations throughout the WVS depending on the alternative.

G.2.3.1. *Measure 30a: Adaptive Fish Flows*

Summary: Adaptive Fish Flows based on Science of Willamette Instream Flows Team (SWIFT) recommend flows that prioritize adult spring Chinook salmon. Adaptable water releases will regulate downstream water temperature and increase the variability of hydraulic conditions. These alternative base flows incorporate magnitude, seasonal variation, and annual hydrologic conditions to release water for real-time water temperature management. Base flow targets based on hydrologic conditions were developed for wet and dry years. In addition to base flow targets, water releases will be used April – July to reduce downstream water temperature based on past observations of flow, air temperature, and water temperature. This measure is being considered for A2a, A2b, A3a, A3b, and A4 at all projects.

Interactions with Riverine/Reservoir Habitat and Species: Effects of this measure depend on annual flow and temperature characteristics of the water year. In high flow, low temperature years, this measure would provide hydrologic connectivity to habitats comparable to spring high flow events. In low flow, high temperature years, the riverine habitat would be hydrologically disconnected from other habitats unusually early. This would be followed by large increases in flow in late-spring and early-summer to meet downstream temperature targets, reconnecting off-channel habitat. The rapid shift from dry to wet conditions might impact spawning and rearing activities, habitat availability and suitability, and create conditions where large algal blooms would occur during periods with relatively high temperatures, limiting DO and impacting water quality. These factors would limit the quality of these habitats, and the success of coastal cutthroat trout, Oregon chub and western ridged mussel, during low flow, high temperature years.

Interactions with Off-Channel/Wetland Habitat and Species: Effects of this measure depend on the annual flow and temperature characteristics of the water year. In high flow, low

temperature years, this measure would provide hydrologic connectivity to habitats comparable to spring high flow events. In low flow, high temperature years, sites would be disconnected unusually early, wetland habitats would desiccate unusually early. This would be followed by large increases in flow in late-spring and early-summer to meet downstream temperature targets, connecting off-channel habitats and inundating wetland areas. The rapid shift from dry to wet conditions might impact spawning activities, plant growth, habitat availability and suitability, and create conditions where large algal blooms would occur during periods with relatively high temperatures, limiting DO and impacting water quality. These factors would limit the quality of these habitats, and the success of northern red-legged frogs and Pacific lamprey, during low flow, high temperature years.

Interactions with Riparian Habitat and Species: Fluctuating pool elevations may dewater upstream sections of the river and may affect habitat suitability, movement patterns, breeding, incubation, foraging, and overwintering opportunities for wildlife. Altering natural disturbance and flood regime to modify water temperature could affect foothill yellow legged frog reproduction in the spring (i.e., requiring lower flow and higher temperature). In-season hydraulic variability may increase black cottonwood seedling habitat on exposed gravel bars.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: This measure would extend the duration of soil saturation and low-level flooding compared to the pre-dam hydrograph. Channel downcutting may limited near surface groundwater inundation of wet prairie habitats nears rivers, streams, and reservoirs.

G.2.3.2. *Measure 30b: Refined Integrated Temperature and Habitat Flow Regime*

Summary: This is a modification of the Measure 30a, with changes to mainstem and tributary flow targets. Mainstem flow targets and tributary minimum flow thresholds at Detroit/Big Cliff, Lookout Point/Dexter, and Green Peter/Foster are modified from Measure 30a, above. Adaptive Fish Flows based SWIFT recommend flows that prioritize adult spring Chinook salmon. Adaptable water releases will regulate downstream water temperature and increase the variability of hydraulic conditions. These alternative base flows incorporate magnitude, seasonal variation, and annual hydrologic conditions to release water for real-time water temperature management. Base flow targets based on hydrologic conditions were developed for wet and dry years. In addition to base flow targets, water releases will be used April – July to reduce downstream water temperature based on past observations of flow, air temperature, and water temperature. This measure is being considered for A5 at all projects.

Interactions with Riverine/Reservoir Habitat and Species: Effects of this measure depend on annual flow and temperature characteristics of the water year. In high flow, low temperature years, this measure would provide hydrologic connectivity to habitats comparable to spring

high flow events. In low flow, high temperature years, the riverine habitat would be hydrologically disconnected from other habitats unusually early. This would be followed by large increases in flow in late-spring and early-summer to meet downstream temperature targets, reconnecting off-channel habitat. The rapid shift from dry to wet conditions might impact spawning and rearing activities, habitat availability and suitability, and create conditions where large algal blooms would occur during periods with relatively high temperatures, limiting DO and impacting water quality. These factors would limit the quality of these habitats, and the success of coastal cutthroat trout, Oregon chub and western ridged mussel, during low flow, high temperature years. Compared to Measure 30a, the magnitude of these impacts would be slightly reduced in habitats downstream of the Big Cliff, Green Peter, and Foster during low flow years.

Interactions with Off-Channel/Wetland Habitat and Species: Effects of this measure depend on the annual flow and temperature characteristics of the water year. In high flow, low temperature years, this measure would provide hydrologic connectivity to habitats comparable to spring high flow events. In low flow, high temperature years, sites would be disconnected unusually early, wetland habitats would desiccate unusually early. This would be followed by large increases in flow in late-spring and early-summer to meet downstream temperature targets, connecting off-channel habitats and inundating wetland areas. The rapid shift from dry to wet conditions might impact spawning activities, plant growth, habitat availability and suitability, and create conditions where large algal blooms would occur during periods with relatively high temperatures, limiting DO and impacting water quality. These factors would limit the quality of these habitats, and the success of northern red-legged frogs and Pacific lamprey, during low flow, high temperature years. Compared to Measure 30a, the magnitude of these impacts would be slightly reduced in habitats downstream of the Big Cliff, Green Peter, and Foster during low flow years.

Interactions with Riparian Habitat and Species: Fluctuating pool elevations may dewater upstream sections of the river and may affect habitat suitability, movement patterns, breeding, incubation, foraging, and overwintering opportunities for wildlife. Altering natural disturbance and flood regime to modify water temperature could affect foothill yellow legged frog reproduction in the spring (i.e., requiring lower flow and higher temperature). In-season hydraulic variability may increase black cottonwood seedling habitat on exposed gravel bars.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: This measure would extend the duration of soil saturation and low-level flooding compared to the pre-dam hydrograph. Channel downcutting may limited near surface groundwater inundation of wet prairie habitats nears rivers, streams, and reservoirs.

G.2.3.3. *Measure 304: Use Power Pool to Augment Flows*

Summary: To support biological flow targets June 1 to November 30, flows will be augmented by using the power pool to meet minimum flows at Detroit, Green Peter, Lookout Point, Hills Creek, and Cougar. Power pools would store water above projects and drain June - November when natural stream flows are not adequate to provide the biologically justified flow resulting in higher summer downstream flow. This measure is being considered for A1, A2a, A3a, and A4 at Detroit, Green Peter, Cougar, Lookout Point, and Hills Creek; A2b, A3b, and A5 at Detroit, Green Peter, Lookout Point, and Hills Creek.

Interactions with Riverine/Reservoir Habitat and Species: With increased regulated flows, natural disturbance processes are lost and could favor non-native species. Regulated flows provide stability and prevents natural processes such as erosion, deposition and flooding. Lack of disturbance in the riverine section may favor non-native competitive and predatory fish. Peak flow events may occur weeks earlier or later than normal, which could affect the reproduction timing of native species such as coastal cutthroat, Oregon chub and the western ridged mussel. However, flow stability during the summer and fall (i.e., increase in the pre-dam hydrograph) could provide connectivity to habitats such as secondary (e.g., wetland) or off-channel habitat, therefore increasing habitat availability and complexity for coastal cutthroat trout, Oregon chub and the western ridged mussel. An increase in water volume could improve water quality and decrease instream temperatures downstream. However, the fluvial processes that create and maintain riverine habitat that is hydrologically connected to off-channel and wetland habitats has been greatly reduced and the mainstem channel has been incised and downcut, thus the pre-dam hydrograph may no longer be suitable to maintain these habitats. The potential benefits of stable flow could be outweighed by increasing the prevalence and dominance of non-native species downstream.

Interactions with Off-Channel/Wetland Habitat and Species: This measure will increase the connectivity of secondary, off-channel, and hydrologically connected wetland habitats during low flow periods. In addition, this measure will decrease the likelihood of these habitats desiccating during low flow periods. However, overall stability and lack of disturbance in these habitats may favor non-native competitive and predatory fish and amphibian species, as well as successional vegetation. Low instream flow may encourage lateral channel migration, and stable flows may inhibit the creation of new off-channel habitat. Under this measure there is an overall increase in instream flow compared to the pre-dam hydrograph. However, the fluvial processes that create and maintain off-channel and wetland habitats has been greatly reduced, connectivity of these habitats to the mainstem river channel is reduced, and the mainstem channel has been downcut, thus the pre-dam hydrograph may no longer be suitable to maintain these habitats. In addition, this measure will alter the natural spring hydrograph during a period when flooding often occurs, which will reduce off-channel connectivity and habitat availability. Management under this measure may desiccate wetlands prior to the completion of northern red-legged frog tadpole metamorphosis and juvenile development.

Augmented flows during low flow periods could benefit predatory and competitive species such as American bullfrog and non-native fish.

Interactions with Riparian Habitat and Species: With increased regulated flows, natural disturbance processes are lost, thus favoring non-native species and successional vegetation to upland habitat. Regulated flows prevent natural erosion, deposition, and flooding. Peak flow events may occur weeks earlier or later than normal, which also inhibit regeneration of native vegetation and benefit non-native species. Regulated water flow could affect the timing of foothill yellow-legged frog reproduction. Increasing summer flow might prevent beaver from building seasonal dams across large rivers during natural low-flow conditions. Cottonwood seed dispersal coincides with peak flood events, regulated flows will not expose new shoreline and seedlings will not develop long roots the receding water table. Flood-intolerant species along the shoreline and on the floodplain may outcompete cottonwood.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.3.4. *Measure 718: Use Inactive Pool to Augment Flow*

Summary: Augment instream flows by using inactive pool (the water stored below the minimum conservation pool) to meet minimum flows from June 1 to November 30. Inactive pools would store water above projects and drain June – November when natural stream flows are not adequate to provide the biologically justified flow resulting in higher summer downstream flow. This measure is being considered for A1, A3a, A3b, and A4 at Blue River, Fall Creek, Dorena, and Cottage Grove; A2a, A2b, and A5 at Blue River and Fall Creek.

Interactions with Riverine/Reservoir Habitat and Species: This measure will provide increased riverine habitat during typical base flow period and increased connectivity downstream. However, altering the natural spring hydrograph by regulated flows prevent natural disturbance processes such as erosion, deposition, and flooding, could favor non-native species. Peak flow events may occur weeks earlier or later than normal, which could impact the reproduction timing of native species such as coastal cutthroat trout, Oregon chub and the western ridged mussel. However, flow stability during the summer and fall could provide connectivity to habitats such as secondary (e.g., wetland) or off-channel habitat, therefore increasing habitat availability and complexity for coastal cutthroat trout, Oregon chub and the western ridged mussel. However, an increase in connectivity in riverine habitats could result in less habitat availability in the reservoir habitat and warmer water temperatures. A decrease in reservoir habitat could lead to an increase in sediment exposure. In addition, an increase in water volume could improve water quality and decrease temperatures downstream. The potential benefits of stable flow could be outweighed by increasing the prevalence and dominance of non-native species downstream.

Interactions with Off-Channel/Wetland Habitat and Species: This measure will provide increased habitat connectivity, and seasonally result in fewer off-channel and wetland habitats seasonally isolated or desiccated. While northern red-legged frogs may benefit from additional habitat, system stability may increase in American bullfrog presence. In addition, stable flows may allow successional native and non-native aquatic vegetation to proliferate in habitats that would have otherwise desiccated. Stable flows may also slow lateral channel movement, hindering the formation of additional off-channel habitats. Under this measure, instream flows will be increased compared to pre-dam hydrograph. However, systemic reductions in processes that create off-channel and wetland habitats, reduced floodplain connectivity, and downcutting of the mainstem channel; the pre-dam hydrograph is no longer sufficient to maintain off-channel and wetland habitats. Under this measure, downstream flow management will be more stable, and result in the desiccation of fewer habitats over time. However, natural disturbance processes will be lost, and flow stability may favor non-native fish and non-native amphibians, as well as successional vegetation. Increase in American bullfrog presence may impact northern red-legged frog in some locations.

Interactions with Riparian Habitat and Species: With increased regulated flows, natural disturbance processes are lost, thus favoring non-native species and successional vegetation to upland habitat. Regulated flows prevent natural erosion, deposition, and flooding. Peak flow events may occur weeks earlier or later than normal, which also inhibit regeneration of native vegetation and benefit non-native species. Regulated water flow could affect the timing of foothill yellow-legged frog reproduction. Increasing summer flow might prevent beaver from building seasonal dams across large rivers during natural low-flow conditions. Cottonwood seed dispersal coincides with peak flood events, regulated flows will not expose new shoreline and seedlings will not develop long roots the receding water table. Flood-intolerant species along the shoreline and on the floodplain may outcompete cottonwood.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: This measure will provide an overall increase in habitat compared to pre-dam hydrograph. However, downcutting of channel may have limited near surface inundation of wet prairie habitats nears rivers, streams, and reservoirs. During dry years, this will provide a longer period of near surface inundation and higher groundwater elevation.

G.2.3.5. *Measure 723: Reduce Minimum Flows to Maximize Storage*

Summary: Reduce minimum flows to equipment-based minimums on projects and congressionally authorized minimum flow on the mainstem Willamette River. The additional regulation of flow will capture more spring runoff in reservoirs rather than passing more of the inflows at all locations. The natural spring flood hydrograph will be altered; spring flows

downstream will be even lower at all projects. This measure is being considered for A1 at all projects.

Interactions with Riverine/Reservoir Habitat and Species: This measure would reduce the open-water hydrologic connectivity, reduce water elevations, and alter normative seasonal flooding. Stable flows and reduced disturbance processes may increase dominance of non-native species in the riverine habitat. Reducing flow in riverine habitat has the potential to decrease habitat connectivity, complexity, and availability downstream for coastal cutthroat, Oregon chub and western ridged mussels. A decrease in inundation and desiccation caused by consistently lower flows could reduce bank stability and facilitate lateral channel movement, thus a potential increase in connectivity. However, an increase storage would increase reservoir habitat and decrease riverine habitat, thus an overall decrease in habitat complexity. An increase in reservoir storage could lead to an increase of non-native species and result in warmer water temperatures and decreased water quality downstream. This measure would greatly alter the natural spring hydrograph, a period when flooding often occurs during normative conditions. This reduction would limit the open-water hydrologic connectivity and decrease connectivity to off-channel habitats earlier in the season. This would reduce the quantity and quality of habitat for rearing coastal cutthroat, Oregon chub and could impact the breeding timing of the western ridged mussel.

Interactions with Off-Channel/Wetland Habitat and Species: This measure would reduce the open-water hydrologic connectivity, reduce water elevations, and alter normative seasonal flooding in off-channel and wetland habitats. Stable flows and reduced disturbance processes may increase dominance of non-native species in off-channel and wetland habitats. During low flow periods described by this measure, desiccation may reduce bank stability and allowing for increased lateral channel movement that would create additional off-channel habitats. However, the stability in flow would reduce the hydrologic energy of the system and hamper the ability of the river to create new off-channel habitats. This measure would greatly alter the natural spring hydrograph, a period when flooding often occurs during normative conditions. This reduction would limit the open-water hydrologic connectivity and habitat availability of off-channel habitats and desiccate wetlands earlier in the season. This would reduce the quantity and quality of habitat during the northern red-legged frog breeding season and may result in desiccation of these habitats before juvenile tadpoles metamorphose.

Interactions with Riparian Habitat and Species: Regulated water flow could affect reproduction timing of foothill yellow-legged frogs in the spring. Slower moving water may benefit northwestern pond turtle’s ability to bask and move from water to banks for nesting.

Interactions with Upland Habitat and Species: Lower water surface elevation could create areas that promote the establishment of non-native species in riparian area and spreading to upland habitat and competition for wayside aster.

Interactions with Prairie Habitat and Species: Compared to the pre-dam hydrograph, this measure would reduce seasonal flooding of wet prairie habitats, limiting disturbance processes and creating drier conditions that favor woody or non-native vegetation. Seasonal patterns of flooding, inundation, and soil saturation will be reduced below the WVS projects.

G.2.4. Downstream Passage Measures

Measures to allow fish to migrate past Willamette Valley System barriers to downstream river reaches. These include operational or structural measures in multiple location throughout the Willamette Valley System depending on the alternative.

G.2.4.1. *Measure 40: Deep Fall Drawdown*

Summary: Deep fall drawdown to 7.6 m over the ROs or 7.6 m over the Cougar diversion tunnel to improve downstream fish passage July - October. During the spawning season September to mid-October, the lower discharge from the dam will be maintained at or below the maximum flows for spawning. After the spawning season, the draft rate will be revised as needed to achieve the November 15 target elevation. Provides flushing of sediment and movement downstream and potentially high sediment within the channel. This measure is being considered for A2a at Green Peter; A2b and A5 at Green Peter and Cougar; A3a and A3b at Detroit, Green Peter, Blue River, Cougar, Lookout Point, and Hills Creek.

Interactions with Riverine/Reservoir Habitat and Species: Altering the natural fall hydrograph by a deep drawdown in summer/early fall could benefit riverine and reservoir habitat. Increasing flushing flows (i.e., sediment flushing) could facilitate downstream movement of both native and non-native fish past the dams, which could benefit coastal cutthroat, Oregon chub and host fish for the western ridged mussel. In the reservoir habitat, this could result in the reduction of non-native species that prey and out compete native species. However, non-native fish may enter off-channel habitats in large numbers. In addition, the Fall Creek drawdown could reduce the accessibility, availability and quality of off-channel habitat for Oregon chub and juvenile coastal cutthroat downstream of the dam, as fine sediment moving into off-channel locations, reduces high flows in a managed system with no ability to flush material out. A high sediment load could bury established western ridged mussel beds or increase the sediment load in the water column to levels difficult for filtration. There is a high potential for decreased water quality downstream as low dissolved oxygen events have been observed in past drawdowns at Fall Creek. Additionally, if precipitation does not arrive by early fall, there is potential to reduce water quantity downstream.

Interactions with Off-Channel/Wetland Habitat and Species: This measure may facilitate the movement of non-native fish through the reservoirs, where they may enter off-channel and hydrologically connected wetland habitats in large numbers. In addition, the Fall Creek drawdown transported massive amounts of fine sediment from the reservoir, reducing the

quantity and quality of off-channel habitats downstream of the dam. The limited energy of managed high flow events was not sufficient to mobilize this fine substrate and transport it downstream, and the fine substrate was rapidly colonized and stabilized by successional vegetation, further limiting the ability of the river system to restore off-channel habitats. In addition, extremely low dissolved oxygen events occurred during the drawdown of Fall Creek Reservoir. These impacts could reduce habitat suitability for northern red-legged frog and Pacific lamprey in managed reaches below WVS dams.

Interactions with Riparian Habitat and Species: Deeper fall reservoir drawdowns may alter habitat availability, type, and conditions for wildlife. Dewatered areas may become unsuitable for some species of wildlife (e.g., amphibians, overwintering turtles).

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: May transport fine sediment to the margins of wet prairie habitat during high flow event during reservoir drawdowns, or subsequent high flow events.

G.2.4.2. *Measure 392: Downstream passage Construction*

Summary: Construct a floating screen structure or a floating surface collector to facilitate migratory fish passage downstream. Designs assume there is either a temperature tower to accommodate reservoir fluctuations and gravity-fed outflows or a pumped flow. This measure is being considered for A1 at Big Cliff, Detroit, Foster, Green Peter, Dexter, and Lookout Point; A2a at Detroit, Foster, Cougar, and Lookout Point; A2b and A5 at Detroit, Foster, and Lookout Point; A4 at Detroit, Big Cliff, Foster, Cougar, Dexter, Lookout Point, and Hills Creek.

Interactions with Riverine/Reservoir Habitat and Species: May alter communities in connected habitats downstream of reservoirs by facilitating the movement of native and non-native predatory and competitive fish species which could impact coastal cutthroat trout and the host fish of the western ridged mussel.

Interactions with Off-Channel/Wetland Habitat and Species: May alter communities in connected habitats downstream of reservoirs by facilitating the movement of native and non-native predatory and competitive fish species.

Interactions with Riparian Habitat and Species: Construction of new infrastructure may result in loss and fragmentation of suitable wildlife habitat in riparian areas.

Interactions with Upland Habitat and Species: Construction of new infrastructure may result in loss and fragmentation of suitable wildlife habitat and impact upland habitat by mowing, road construction, invasive species introduction, etc.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.4.3. *Measure 639: Restore Passage at Drop Structures*

Summary: Restore upstream and downstream passage at drop structures to improve fish passage infrastructure on drop structures. This measure is being considered for A1 and A4 at Fern Ridge.

Interactions with Riverine/Reservoir Habitat and Species: Restoring passage structures at Fern Ridge would increase habitat connectivity between the confluence of the Willamette River and the Long Tom River upstream to Fern Ridge dam. This would improve upstream and downstream passage for coastal cutthroat and potentially for the western ridged mussel host fish species. Oregon chub could benefit from the increase in connectivity in the lower river.

Interactions with Off-Channel/Wetland Habitat and Species: This measure would improve passage for fish between the confluence of the Willamette River and Long Tom River upstream to Fern Ridge dam, enabling Pacific lamprey and other fish to utilize off-channel habitats within this reach.

Interactions with Riparian Habitat and Species: No known impacts.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.4.4. *Measure 714: Spillway Passage*

Summary: Discharge water via the surface spillway for fish passage in spring and early summer to increase the number and the survival of migratory fish. This measure is being considered for A2a, A2b, and A5 at Green Peter; A3a at Big Cliff, Green Peter, Fall Creek, Dexter, and Hills Creek; A3b at Big Cliff, Detroit, Dexter, and Lookout Point.

Interactions with Riverine/Reservoir Habitat and Species: Water releases via the surface spillway may impact aquatic organisms depending on the timing, magnitude of fluctuations and frequency of discharge. Warmer summer surface spill could trigger biological cues and impact reproduction timing for the western ridged mussel.

Interactions with Off-Channel/Wetland Habitat and Species: Surface spill may impact aquatic organisms depending on the timing, magnitude, and frequency of fluctuations. Surface spill may allow passage of non-native aquatic species using warmer surface water.

Interactions with Riparian Habitat and Species: Water releases via the spillway may impact wildlife depending on the timing, magnitude of fluctuations and frequency of discharge.

Warmer summer surface spill could impact foothill yellow-legged frog reproduction if water temperatures are too warm.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.4.5. *Measure 720: Spring Drawdown*

Summary: Delay refill/draft and hold at 7.6 m over the top of the ROs for six weeks (three weeks at Green Peter). Spring drawdown provides flushing of sediment and movement and increases the number and the survival of migratory fish passing downstream. This measure is being considered for A2b and A5 at Cougar; A3a at Detroit, Cougar, and Lookout Point; A3b at Green Peter, Cougar, and Blue River.

Interactions with Riverine/Reservoir Habitat and Species: This measure may facilitate the movement of native and non-native fish through the reservoirs and into the downstream riverine habitat and potentially increase competition on native fishes such as coastal cutthroat trout and Oregon chub. Further, there is high potential to increase the dominance of non-native predatory species into the unconnected riverine section prior to the spawning season for the Oregon chub. In addition, the Fall Creek drawdown transported massive amounts of fine sediment from the reservoir, reducing the quantity and quality of riverine margin habitat for western ridged mussel and potentially burying individuals or mussel beds. The limited energy of managed high flow events was not sufficient to mobilize this fine substrate and transport it downstream, and the fine substrate was rapidly colonized and stabilized by successional vegetation, further limiting the ability of the river system to restore off-channel habitats. In addition, extremely low dissolved oxygen events occurred during the drawdown of Fall Creek Reservoir which could impact all species. This measure has a potential conflict with measure 30 and creates conditions in which reservoir elevations for adaptive flow management are not attainable following a spring reservoir drawdown.

Interactions with Off-Channel/Wetland Habitat and Species: This measure may facilitate the movement of non-native fish through the reservoirs, where they may enter off-channel and hydrologically connected wetland habitats in large numbers, just prior to their spawning season. In addition, the Fall Creek drawdown transported massive amounts of fine sediment from the reservoir, reducing the quantity and quality of off-channel habitats downstream of the dam. The limited energy of managed high flow events was not sufficient to mobilize this fine substrate and transport it downstream, and the fine substrate was rapidly colonized and stabilized by successional vegetation, further limiting the ability of the river system to restore off-channel habitats. In addition, extremely low dissolved oxygen events occurred during the drawdown of Fall Creek Reservoir. This measure has a potential conflict with measure 30 and

creates conditions in which reservoir elevations for adaptive flow management are not attainable following a spring reservoir drawdown.

Interactions with Riparian Habitat and Species: Potentially high sediment within channels could alter foothill yellow-legged frog reproduction timing. Increased flows could dislodge/sweep away amphibian egg masses and larvae while water levels that drop quickly could result in desiccated eggs/stranding. Increased velocities and/or rising water levels could impact nesting turtle activity, and herptile basking. Northwestern pond turtle nests may be flooded resulting in mortality of eggs or hatchlings still in the nest chamber. Dewatered areas may become unsuitable for some species of wildlife (e.g., amphibians, overwintering turtles).

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: May transport fine sediment to the margins of wet prairie habitat during high flow event during reservoir drawdowns, or subsequent high flow events. This event may cause disturbance during the spring growth season, combining high flow events with an influx of nutrients. This measure has a potential conflict with measure 30 and creates conditions in which reservoir elevations for adaptive flow management are not attainable following a spring reservoir drawdown.

G.2.5. Upstream Passage Measures

Measures to allow fish migrating upstream to be transported above Willamette Valley System barriers. These include only structural measures in multiple locations throughout the Willamette Valley System depending on the alternative.

G.2.5.1. *Measure 52: Adult Lamprey Passage*

Summary: Provide Pacific lamprey passage and infrastructure by incorporating lamprey passage at existing and new AFFs. Structural lamprey modifications such as rounded corners in turning pools, rounded side edges of orifices, and replacement of diffuser screens with lamprey-friendly screens would be included in new projects. This measure is being considered for A1 at Green Peter and Fern Ridge; A2a, A2b, A5 at Green Peter; A3a and A3b at Green Peter, Blue River, and Hills Creek; A4 at Fern Ridge and Hills Creek.

Interactions with Riverine/Reservoir Habitat and Species: Providing passage and infrastructure at AFFs would be beneficial for Pacific lamprey. Infrastructure improvement would increase connectivity and provide access to additional suitable habitat.

Interactions with Off-Channel/Wetland Habitat and Species: This measure will enable Pacific lamprey to utilize historic habitats.

Interactions with Riparian Habitat and Species: No known impacts.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.5.2. *Measure 639: Restore Passage at Drop Structures*

Summary: Restore upstream and downstream passage at drop structures to improve fish passage within the Long Tom River downstream of Fern Ridge Dam. Fish passage modifications may include removal, or construction of an adjoining fish ladder or bypassing the drop structures via modified culverts and using the oxbow river features at the two Long Tom River drop structures. This measure is being considered for A1 and A4 at Fern Ridge.

Interactions with Riverine/Reservoir Habitat and Species: Restoring passage structures at Fern Ridge would increase habitat connectivity between the confluence and the dam on the Long Tom River. This would improve upstream passage for Coastal cutthroat trout and potentially for host fish for the western ridged mussel. Oregon chub and Coastal cutthroat trout could benefit from the increase in connectivity in the lower river.

Interactions with Off-Channel/Wetland Habitat and Species: This measure would improve passage for fish between the confluence of the Willamette River and Long Tom River upstream to Fern Ridge Dam, enabling Pacific lamprey and other fish to utilize off-channel habitats within this reach.

Interactions with Riparian Habitat and Species: No known impacts.

Interactions with Upland Habitat and Species: No known impacts.

Interactions with Prairie Habitat and Species: No known impacts.

G.2.5.3. *Measure 722: New Adult Fish Facilities*

Summary: Construct new AFFs to provide upstream fish passage, including lamprey, for improved fish survival. Provide adult upstream passage above Green Peter Dam for adult fish paired with a temperature management measure so water temperatures are adequate for fish attraction into the facility. Construct an adult fish collection facility at the base of Blue River Dam to support a trap and haul program for adult Chinook salmon above Blue River Dam (this measure will be paired with a downstream fish passage measure). Replace the existing Dexter AFF to facilitate best management practices for handling adult spring Chinook returns and reprogramming away from hatchery/broodstock purposes to support passage actions upstream of Dexter. Provide adult upstream passage above Hills Creek Dam for adult fish paired with a temperature management measure, so water temperatures are adequate for fish attraction into the facility. This measure is being considered for A1, A2a, A2b, and A5 at Green Peter; A3a and A3b at Green Peter, Blue River, and Hills Creek; A4 at Hills Creek.

Interactions with Riverine/Reservoir Habitat and Species: This measure would increase connectivity and provide access to additional suitable habitat for both native and non-native species. More specifically, it will enable upstream passage for Coastal cutthroat trout and potentially for the western ridged mussel host fish. Oregon chub and Coastal cutthroat trout could benefit from the increase in connectivity in the lower river.

Interactions with Off-Channel/Wetland Habitat and Species: This measure will enable Pacific lamprey to utilize historic habitats.

Interactions with Riparian Habitat and Species: There are currently no spring Chinook or winter steelhead above Green Peter Dam, introduction of ocean-derived nutrients could increase riparian habitat health. Salmon carcasses would provide nutrients and energy to biota within the riparian habitat.

Interactions with Upland Habitat and Species: Construction activities may impact upland habitat by mowing, road construction, invasive species introduction, etc.

Interactions with Prairie Habitat and Species: No known impacts.

H. APPENDIX H. EFFECTS OF EACH MEASURE AND CUMULATIVE EFFECT OF EACH ALTERNATIVE BY CONSERVATION OBJECTIVE AND HABITAT TYPE

Table 16. Key to measure summary tables.

Value	Description
++	Impacts overwhelmingly positive to habitats or focal species, and often support ecosystem and landscape function. Negative impacts are relatively minor in scope.
+	Measures often include positive and negative impacts to habitats or focal species, and minor effects to ecosystem and landscape function, but generally support positive outcomes. This includes some measures with minor positive outcomes.
o	Measure generally has little impact to habitats or focal species. This category also includes measures with generally comparable positive and negative outcomes.
-	Measures often include positive and negative impacts to habitats or focal species, and minor effects to ecosystem and landscape function, but generally result in negative outcomes. This includes some measures with minor negatives outcomes.
--	Impacts overwhelmingly negative to habitats or focal species, and often lead to a decline in ecosystem or landscape function. Positive impacts are relatively minor in scope.
	There were no likely impacts to habitat or focal species for measures in this alternative.
	Measure was not included under this alternative.

Table 17. Water Quality

Habitat Type	Measure	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/ Reservoir	105		+	+	+			+	+
	166			++	++	++	++	++	++
	479		-	-	-			-	-
	721			--	--	--	--	--	--
	174		++					++	
	Cumulative effects	-	+	o	o	-	-	+	o
Off-Channel/ Wetland	105		o	o	o			o	o
	166			-	-	-	-	-	-
	479		-	-	-			-	-
	721			-	-	-	-	-	-
	174								
	Cumulative effects	-	o	-	-	-	-	-	-
Riparian	105		o	o	o			o	o
	166			o	o	o	o	o	o
	479		-	-	-			-	-
	721			--	--	--	--	--	--
	174		++					++	
	Cumulative effects	-	+	-	-	-	-	+	-
Prairie	105								
	166								
	479								
	721								
	174								
	Cumulative effects								
Upland	105								
	166								
	479								
	721								
	174								
	Cumulative effects								

Table 18. Flow

Habitat Type	Measure	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/ Reservoir	30a			--	--	--	--	--	
	30b								--
	304		-	-	-	-	-	-	-
	718		-	-	-	-	-	-	-
	723		--						
	Cumulative effects	-	--	--	--	--	--	--	--
Off-channel/ Wetland	30a			--	--	--	--	--	
	30b								--
	304		-	-	-	-	-	-	-
	718		-	-	-	-	-	-	-
	723		--						
	Cumulative effects	-	--	--	--	--	--	--	--
Riparian	30a			--	--	--	--	--	
	30b								--
	304		--	--	--	--	--	--	--
	718		--	--	--	--	--	--	--
	723		-						
	Cumulative effects	-	--	--	--	--	--	--	--
Prairie	30a			+	+	+	+	+	
	30b								+
	304								
	718		+	+	+	+	+	+	+
	723		--						
	Cumulative effects	-	-	+	+	+	+	+	+
Upland	30a								
	30b								
	304								
	718								
	723		--						
	Cumulative effects	-	--						

Table 19. Downstream Passage

Habitat Type	Measure	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/ Reservoir	40			--	--	--	--		--
	392		-	-	-			-	-
	714			-	-	-	-		-
	720				--	--	--		--
	Cumulative effects	-	-	-	-	--	--	-	-
Off-channel/ Wetland	40			--	--	--	--		--
	392		-	-	-			-	-
	714			--	--	--	--		--
	720				--	--	--		--
	Cumulative effects	-	-	-	-	--	--	-	-
Riparian	40			--	--	--	--		--
	392		-	-	-			-	-
	714			--	--	--	--		--
	720				--	--	--		--
	Cumulative effects	-	-	-	--	--	--	-	--
Prairie	40			o	o	o	o		o
	392		-	-	-			-	-
	714								
	720				--	--	--		--
	Cumulative effects	-	-	-	-	o	-	-	-
Upland	40								
	392		-	-	-			-	-
	714								
	720								
	Cumulative effects	-	-	-	o			-	o

Table 20. Upstream Passage

Habitat Type	Measure	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/ Reservoir	52		++	++	++	++	++	++	++
	639		++						
	722		++	++	++	++	++	++	++
	Cumulative effects	-	++	++	++	++	++	++	++
Off-channel/ Wetland	52		++	++	++	++	++	++	++
	639		++						
	722		++	++	++	++	++	++	++
	Cumulative effects	-	++	++	++	++	++	++	++
Riparian	52								
	639								
	722		+	+	+	+	+	+	+
	Cumulative effects	-	+	+	+	+	+	+	+
Prairie	52								
	639								
	722		-	-	-	-	-	-	-
	Cumulative effects	-	-	-	-	-	-	-	-
Upland	52								
	639								
	722		-	-	-	-	-	-	-
	Cumulative effects	-	-	-	-	-	-	-	-

Table 21. Basin-wide measures

Habitat Type	Measure	NAA	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b	Alt 4	Alt 5
Riverine/ Reservoir	384		++	++	++	++	++	++	++
	719								
	9		++	++	++	++	++	++	++
	726								
	Cumulative effects	-	++	++	++	++	++	++	++
Off-channel/ Wetland	384		++	++	++	++	++	++	++
	719								
	9		++	++	++	++	++	++	++
	726								
	Cumulative effects	-	++	++	++	++	++	++	++
Riparian	384		++	++	++	++	++	++	++
	719								
	9		++	++	++	++	++	++	++
	726								
	Cumulative effects	-	++	++	++	++	++	++	++
Prairie	384		-	-	-	-	-	-	-
	719								
	9		++	++	++	++	++	++	++
	726								
	Cumulative effects	-	+	+	+	+	+	+	+
Upland	384		-	-	-	-	-	-	-
	719								
	9								
	726								
	Cumulative effects	-	-	-	-	-	-	-	-

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4.4 NMFS Coordination Act Report

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232

May 28th, 2025

Col. Larry Dale Caswell, Jr., Portland District Commander
U.S. Army Corps of Engineers (USACE), Portland District
P.O. Box 2870
Portland, Oregon 97208-2870

Re: Request for Fish and Wildlife Coordination Act planning aid for the USACE's Willamette River System Operations and Maintenance Final EIS

Dear Col. Larry Dale Caswell, Jr:

The National Marine Fisheries Service (NMFS) has completed a final draft of the Fish and Wildlife Coordination Act 2(b) Report (FWCAR) for the Willamette Valley System (WVS) Project. NMFS understands that the FWCAR will be included in the Environmental Impact Statement (EIS).

This FWCAR is the culmination of work from across NMFS programs, and it documents how the WVS EIS alternatives (the No Action Alternative, four Alternatives, and two Sub-alternatives) would impact fish species and habitats under NMFS' jurisdiction. The FWCAR also includes conservation recommendations that would benefit species and habitats impacted by operation and maintenance of the WVS under the proposed EIS alternatives. Both the analysis and conservation recommendations described in the FWCAR were informed by input from species experts from the Willamette Branch of the NMFS West Coast Region and the Northwest Fisheries Science Center. The recommendations presented in this report were based on the Preferred Alternative found in the Draft EIS for the WVS. The draft FWCAR was transmitted to USACE for review on January 24th, 2023. All comments were considered and many were accepted or incorporated.

We appreciate the opportunity to conduct this important work for you and provide information for the selection of your preferred alternative in the forthcoming Final EIS. If you have any questions regarding the enclosed draft FWCAR, please contact our WVS FWCA Technical Lead, Josie Thompson (telephone: (503) 230-5409; email: Josie.Thompson@noaa.gov).

Sincerely,

Kathleen Wells
Assistant Regional Administrator
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FINAL DRAFT

FISH AND WILDLIFE COORDINATION ACT SECTION 2(B) REPORT

ON THE

USACE's WILLAMETTE RIVER SYSTEM OPERATIONS AND MAINTENANCE FINAL EIS

PREPARED FOR:
U.S. ARMY CORPS OF ENGINEERS – PORTLAND DISTRICT

PREPARED BY:
NOAA's National Marine Fisheries Service, West Coast Region
Portland, Oregon Office

May 28th, 2025

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ACRONYMS AND ABBREVIATIONS

AFF	Adult Fish Facility
AI	Agricultural Irrigation
BOR	Bureau of Reclamation
BO (or Bi-Op)	Biological Opinion
BPA	Bonneville Power Administration
Corps or USACE	U.S. Army Corps of Engineers
CRR	Cohort Replacement Rate
CTGR	Confederated Tribes of the Grande Ronde
CWA	The Clean Water Act
DADM	Days Average Daily Maximum
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DO	Dissolved Oxygen
DOC	Department of Commerce
DPE	Dam Passage Efficiency
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FBW	Fish Benefit Workbook
FCRPS	Federal Columbia River Power System
FMP	Fishery Management Plan
FMWQT	Flow Management Water Quality Team
FR	Final Rule
FSC	Floating Surface Collector
FSS	Fish Selectivity Screen
FWCA	Fish and Wildlife Coordination Act
FWCAR/Report	Fish and Wildlife Coordination Act Section 2(b) Report
GBT	Gas Bubble Trauma
HGMP	Hatchery Genetic Management Plan
HOR	Hatchery Origin
HUC	Hydrologic Unit Code
LCFRB	Lower Columbia Fish Recovery Board
LCM	Life Cycle Model
M&I	Municipal and Industrial
MSA	Magnuson-Stevens (Fishery Conservation and Management) Act
NAA	No Action Alternative
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOR	Natural Origin
NWFSC	Northwest Fisheries Science Center

O&M	Operations and Maintenance
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
OSU	Oregon State University
PAH	polycyclic aromatic hydrocarbon
PBF	Physical and Biological Features
PCB	Polychlorinated biphenyls
PIT	Passive Integrated Transponder
PFMC	Pacific Fishery Management Council
RO	Regulating Outlet
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
RST	Rotary Screw Trap
SEIS	Supplemental Environmental Impact Statement
SMU	Species Management Unit
SRKW	Southern Resident Killer Whales
TDG	Total Dissolved Gas
TMDL	Total Maximum Daily Load
USACE/Corps	U.S. Army Corps of Engineers
USFWS/Service	U.S. Fish and Wildlife Service
USGS	United State Geological Survey
UWR	Upper Willamette River
VSP	Viable Salmonid Population
WBR	Willamette Basin Review
WLC-TRT	Willamette Lower Columbia -Technical Review Team
WRDA	Water Resources Development Act
WRI	Water Resources Institute
WVS	Willamette Valley System

MEASUREMENT ABBREVIATIONS

cm	centimeter
ft	feet
km	kilometer
km2	square kilometer
m	meter
m3	cubic meter
m/s	meter per second
m3/s	cubic meter per second
RKM	river kilometers
RM	river miles

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (Corps) operates the 13 federal projects that comprise the Willamette River Basin Flood Control Project's Willamette Valley System (WVS) to serve authorized project purposes including flood control, irrigation, water supply, navigation, flow augmentation, hydroelectric power generation, recreation, and fish and wildlife resource conservation (Corps, 2000, pp. 2.6 - 2.20).

Operation of the WVS has negatively impacted important ecological and physical processes (e.g., water flow, nutrient cycling, natural disturbance) that maintain habitat structure and function to support ecologically, socioeconomically, and culturally valuable fish and wildlife resources throughout the Willamette River Basin (Basin). Impacts to fish, wildlife, and plant species listed as threatened and endangered under the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. § 1531 et. seq.), have been well-documented in past Biological Opinions written by the National Marine Fisheries Service (NMFS) (NMFS 2008) and the U.S. Fish and Wildlife Service (Service) (USFWS 2008). For many years, the Corps has implemented some of the suggested conservation measures to protect, mitigate, and enhance fish and wildlife resources affected by project operations. However, operation of the WVS continues to negatively impact NMFS trust resources (ESA-listed species and their designated critical habitats, as well areas designated as essential fish habitat [EFH]). None of the ESA-listed species impacted by operation of the WVS have moved closer to their conservation and recovery goals, and current operations have done little to improve their status.

This Fish and Wildlife Coordination Act Report (FWCAR) focuses on identifying impacts and providing conservation recommendations for fish, wildlife, and plant resources (trust resources) affected by current operations and the alternatives identified in the Corps public scoping process for the draft Environmental Impact Statement (DEIS) for the WVS (Corps 2022a). NMFS has considered the No Action Alternative (NAA) (i.e., current operations) and compared it to the Preferred Alternative (Alternative 5, similar to Alternative 2b with altered flow measures). In development of this FWCAR, NMFS coordinated with federal, state, tribal, and local entities to collect relevant data to assess the ecological impacts of current and future operations of the WVS. This FWCAR includes NMFS' evaluation of the potential short-term and long-term, and positive and negative impacts of the Preferred Alternative on the overall health of NMFS trust resources in the Study Area (Section 5). NMFS used key conservation issues for evaluating species found within the Study Area (and within each affected sub-basin), the proposed measures of the Preferred Alternative, and model predictions for the overall analysis of impacts to trust resources (Section 5).

NMFS concludes that the Preferred Alternative is likely to negatively impact NMFS' trust resources present within the Study Area; however, these impacts could be reduced if the implementation schedule was shortened and passage structures could be completed in less time (i.e. 10 years for all three versus 20). For instance, NMFS identified primarily decreasing trends in the overall health of Chinook salmon and steelhead populations and their critical habitats within almost all sub-basins within the Study Area. Most habitats are likely to experience further decreasing trends in overall health under the Preferred Alternatives 2b/5, though it is possible that some of the Chinook salmon and steelhead population abundances could improve, if implementation timelines are improved. While no alternative was projected to be wholly

beneficial to NMFS' trust resources, some measures associated with the Preferred Alternative could improve overall population abundances compared to the NAA but not close to the level of recovery goal abundances. To enhance the resiliency of ecological and physical processes and fish, wildlife, and plant resources negatively impacted by the WVS, NMFS recommends the Corps implement additional conservation measures that will likely improve the overall health of NMFS' species, their habitats, and ecosystems in the affected sub-basins, and help them recover from the impacts of the WVS's presence and operation over time. With this FWCAR, NMFS includes a list of conservation recommendations that identify measurable actions to avoid, minimize, or mitigate negative impacts of the alternatives on fish, wildlife, and plant resources (Section 6). We grouped these conservation recommendations into general categories and specific sub-basin categories.

General conservation recommendations include:

- Increasing minimum flows to meet the 2008 WVS Reasonable and Prudent Alternative minimum flows requested by NMFS
- Monitoring and adaptive management of downstream temperature management measures and downstream temperature mitigation through habitat restoration
- Applying temperature and flow models to the Preferred Alternative using future predicted climate scenarios (50+ years)
- Evaluating the feasibility and costs and benefits of deauthorizing each WVS project or set of projects
- Revising the "Adapt Hatchery Program" measure (Measure 719) to maintain population resiliency in years of low adult returns
- Prioritizing construction of fish selectivity screen (FSS) structures at all three proposed locations and planning for earlier completion
- Creating and fully funding a complete Research, Monitoring, and Evaluation Plan for monitoring the effectiveness of temperature, flow, and fish passage measures
- Improving estimates for juvenile fish survival and injury rates through all potential routes of "passage" at each WVS project
- Completing genetic pedigree research on success of adult out-planting (reintroduction) strategies (locations, sex ratios, natural-origin vs. hatchery-origin) and applying the results to future efforts

Based on our analysis, reducing negative impacts to NMFS trust species will effectively reduce associated negative impacts on fish, wildlife, and plant resources basin-wide.

1. PURPOSE, SCOPE, AND AUTHORITIES

1.1. PURPOSE

The U.S. Army Corps of Engineers, Portland District (Corps) is preparing a 30-year continued operation and maintenance (O&M) plan for the Willamette River Basin Flood Control Project's Willamette Valley System (WVS). Pursuant to the Fish and Wildlife Coordination Act (FWCA), 16 U.S.C. §§ 661-667i, NMFS is engaging with partners to develop specific, measurable, time-oriented conservation recommendations for the Corps to consider for the protection of fish resources in the Basin. The Willamette Project was initially authorized by the Flood Control Act of 1938 as set forth in HD 544, Seventy-fifth Congress, third session. Subsequent supporting authorities for construction and operation of the WVS and its 13 federal dams are provided in (USACE 1992).

The Corps has prepared an Environmental Impact Statement (EIS) in accordance with the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et. seq.), with a supplemental EIS (SEIS) to follow. This EIS analyzes the potential environmental consequences from the proposed alternatives and establish guidelines for review and/or consultation for individual actions covered under the WVS during the 20-year timeframe. The Corps is the lead agency for the NEPA process and NMFS is a cooperating agency.

This document is NMFS' FWCA §2(b) Report for the proposed operation and maintenance of the WVS, and it fulfills NMFS' shared responsibilities under the FWCA. With this report, NMFS communicates the potential impacts of the Preferred Alternative (Alternative 5) on fish resources and the habitats on which they depend, highlighting the value of these resources and their significance to collaborators (e.g., federal and state agencies, local entities, tribes, and the general public) in the Basin. NMFS also provides conservation recommendations for the Corps' consideration. The purpose of providing these conservation recommendations is to minimize further loss of, or damage to, trust resources in the Basin and to support future management and restoration of those resources (FWCA 1931).

1.2. SCOPE

The geographic area of our analysis includes the mainstem Willamette River, major tributaries, and riparian habitat affected by dam modifications and operations. The information presented in Section 2 of this report further defines areas included in and excluded from our analysis. Appendix A includes a timeline that illustrates key milestones in our engagement among our programs, the Corps, and interested parties for FWCAR development.

The suite of alternatives considered by the Corps are described below; however, for the purposes of this analysis, we will focus on the effects of the Preferred Alternative in the current Draft Environmental Impact Statement (DEIS), which is alternative 5. We also highlight any measures not included in the Preferred Alternative that would benefit our trust resources.

1.2.1. No Action Alternative (NAA)

The NAA is required by NEPA to provide the existing condition of the WVS for comparison of environmental effects of the proposed alternatives. The NAA consists of the current actions within the WVS and the conditions that would result from no change of the continued O&M and configuration of the WVS. Included within the NAA are all ongoing, scheduled, and routine maintenance actions for federal infrastructure, including construction that has recently been completed or will be in the foreseeable future. Current actions and operations occurring in the WVS include those agreed to in previous Endangered Species Act (ESA) consultations between the action agencies (Corps, Bonneville Power Administration [BPA], and Bureau of Reclamation), NMFS, and the USFWS (USACE 2000; NMFS 2008a; USFWS 2008). However, the results in the Draft EIS for the NAA are modeled results rather than being based on current and past information. The current operating conditions of the WVS do not adequately protect ESA-listed fish species, specifically Upper Willamette River (UWR) Chinook salmon and UWR steelhead, or designated critical habitat for these species (USACE 2022a).

1.2.2. Alternative 1: Improve Fish Passage through Storage-Focused Measures

The purpose of Alternative 1 is to maximize the refill volumes of conservation pools at WVS reservoirs to meet authorized purposes that depend on full reservoirs, including municipal and industrial water supply, irrigation, recreation, and water quality (USACE 2022a). Alternative 1 focuses on allowing more water storage for multiple purposes, including improving fish passage through WVS dams to increase the survival of ESA-listed fish species. It includes operational measures that would reduce flows to Congressionally authorized minimum flows and increase the likelihood of refilling the WVS reservoirs to their maximum conservation pool levels in the spring. This would provide increased conservation season storage that would meet multiple project objectives. Implementation of Alternative 1 would not affect the flood risk management mission of the WVS. The use of juvenile fish collection facilities to provide downstream passage was selected as a preferred measure under this alternative, as was the use of water temperature control structures needed for the juvenile fish collection facilities. The structures would allow for fish collection over various water levels throughout the year, with the intent of minimizing effects on project storage from operations for fish passage and water quality.

The measures for this alternative and the locations where they would be implemented are shown in the Draft EIS Table 2.4-7 (USACE 2022b).

1.2.3. Alternatives 2a and 2b: Integrated Water Management Flexibility and ESA-Listed Fish Alternative

Alternatives 2a and 2b were developed to improve fish passage through WVS dams using a combination of modified operations and structural improvements, along with other measures to balance water management flexibility and meet ESA-listed fish related obligations. Downstream fish passage is provided through a combination of structural and operational measures. Upstream passage is provided at Green Peter Dam with the construction of a new adult fish facility (AFF). Pacific lamprey (*Entosphenus tridentatus*) passage and infrastructure is provided at three dams (USACE 2022a). Alternatives 2a and 2b are similar; however, they propose different measures at Cougar Dam. Alternative 2a proposes constructing structural downstream fish passage at Cougar

Dam (i.e., a floating fish collection screen). Alternative 2b changes operations at Cougar Dam by implementing deep spring and fall drawdowns at the reservoir so fish can pass through the Diversion Tunnel.

The measures for these alternatives and the locations where they would be implemented are shown in Draft EIS Tables 2.4-8 and 2.4-9 (USACE 2022b).

1.2.4. Alternatives 3a and 3b: Improve Fish Passage through Operations-Focused Measures Using Regulating Outlet at Cougar Dam (3a) or Diversion Tunnel at Cougar Dam (3b)

Alternatives 3a and 3b were developed to improve fish passage through the WVS dams by modifying operations rather than focusing on storage (Alternative 1) or adding or substantially changing existing structures (Alternative 4). These alternatives include operational measures that allow for increased survival of ESA-listed fish while maintaining the Corps' flood risk management mission. Fish passage measures include deeper fall season reservoir drawdowns, spring drawdowns, and the use of spillways to facilitate downstream fish passage (USACE 2022a). No structural downstream fish passage measures were considered within Alternatives 3a or 3b. Upstream fish passage is provided by means of existing trap-and-haul facilities. Operational measures in Alternatives 3a and 3b are intended to improve downstream fish passage, increase water management flexibility, optimize conservation season draft rates, and reduce impaired water quality below the WVS dams to benefit ESA-listed fish species. Some operational measures may require the modification of existing infrastructure, or the construction of adult fish facilities for benefits to be realized from the proposed operational measures.

Alternatives 3a and 3b propose slightly different combinations of operations in their spring downstream passage measures. Alternative 3a proposes downstream fish passage elements at a different combination of projects and includes drawdown drafting to 10 feet over the top of the Cougar Dam Regulating Outlet for deep fall and spring drawdown measures. Alternative 3b includes drafting to the Cougar diversion tunnel for deep fall and spring drawdown, a much deeper drawdown than proposed under Alternative 3a.

The measures for these alternatives and the locations at which they would be implemented are shown in the Draft EIS Tables 2.4-10 and 2.4-11 (USACE 2022b).

1.2.5. Alternative 4: Improve Fish Passage with Structures-Based Approach

Alternative 4 takes a structures-based approach to improve fish passage through the WVS dams to increase the survival of ESA-listed fish. It also contains operational measures, such as adjusting conservation season draft rates, water temperature control towers, and structures to reduce total dissolved gas (TDG), and use of regulating outlets at Green Peter Dam to discharge cold water and use the spillway to release warm surface water. Fish passage measures include constructing upstream and downstream passage facilities at drop structures at Fern Ridge Dam and providing Pacific lamprey passage and infrastructure (USACE 2022a).

The measures for this alternative and the locations where they would be implemented are shown in the Draft EIS Table 2.4-12 (USACE 2022b).

1.2.6. Alternative 5: Preferred Alternative Refined Integrated Water Management Flexibility and ESA-Listed Fish Alternative (Includes Operational Downstream Passage at Cougar – Drawdown to Diversion Tunnel)

Alternative 5 is the Corps' Preferred Alternative. The Preferred Alternative was developed to improve fish passage through the WVS dams using a combination of modified operations and structural improvements, along with other measures to balance water management flexibility and meet ESA-listed fish related obligations. The Preferred Alternative was developed after the formulation and analysis of all other action alternatives to allow for modeling results to inform formulation of the Preferred Alternative. Following the review of the alternatives' modeling results, Alternative 2b was selected as the Preferred Alternative. However, after engaging with BPA, NMFS, and USFWS, the Corps determined that the integrated temperature and habitat flow regime (Measure #30a) proposed in Alternative 2b should be refined to improve outcomes for ESA-listed species. The Preferred Alternative, Alternative 5, is exactly the same as Alternative 2b, except that the integrated temperature and habitat flow regime (Measure #30a) has been replaced by the refined integrated temperature and habitat flow regime (Measure #30b). Alternative 5 is also referred to as the Refined Hybrid Alternative with Cougar Diversion Tunnel Modification or the Preferred Alternative.

The measures for this alternative and the locations where they would be implemented are shown in the Draft EIS Table 2.4-13 (USACE 2022b).

1.3. AUTHORITIES

1.3.1. Fish and Wildlife Coordination Act

The FWCA authorizes the Secretaries of the Departments of Interior and Commerce to provide assistance to federal and state agencies to protect trust fish, wildlife, and plant resources, assess possible damage to wildlife resources associated with the implementation of federal water resource development projects like those that comprise the WVS, and define protective and enhancement means and measures for these resources.

The FWCA recognizes the importance of fish, wildlife, and plant resources and their value and significance to interest groups. Further, the FWCA requires that fish and wildlife conservation be given equal consideration with other water resource development project and program elements through early coordination, joint planning efforts, data exchange, interagency cooperation, and the development of specific measures and project alternatives for fish and wildlife conservation and rehabilitation (FWCA 1931).

Additionally, the FWCA authorizes the Secretary of Commerce to provide assistance to, and cooperate with, federal agencies and other groups in developing, preserving, rearing, and stocking fish and wildlife and to protect their habitat in the course of federal activities, such as the modification of a body of water, natural river, or such activities proposed in the WVS DEIS.

During any given project period, the FWCA authorizes NMFS to make other investigations of fish, wildlife, and plant resources, including lands and waters, and to accept contributions of funds and donations of land to meet FWCA purposes.

To ensure fish, wildlife, and plant resources receive equal consideration, the FWCA requires the Corps to coordinate with the U.S. Fish and Wildlife Service (USFWS), NMFS, and other groups or cooperating agencies regarding the potential impacts of the proposed project and associated actions on fish, wildlife, and plant resources (NMFS and USFWS, 2018).

For this report, coordination and interagency cooperation resulted in data-sharing, collaborative analysis, report production and review, and our development of conservation recommendations, which are non-binding (i.e. discretionary). Despite the fact that our conservation recommendations are discretionary, we suggest the Corps fully evaluate their ability to incorporate as many conservation recommendations into the Preferred Alternative as possible.

We anticipate the Corps will initiate and complete various consultations, restoration projects, and mitigation projects to address the WVS and its impacts over time. Mitigation projects will depend on local opportunities and other factors and those designed for one suite of habitats or species may lead to negative impacts on others. Potential conflicts and tradeoffs are not predictable and were not considered in this analysis; however, we will rely on future opportunities through NEPA, the FWCA, Section 7 ESA consultation, and other authorities to review and provide comments on specific project proposals and their various components (e.g., alternatives, impacts) as they arise.

1.3.2. Congressional Authority

The U.S. Congress provides the authority for the Corps to construct, operate, and maintain the 13 federal WVS projects to meet multiple purposes (Table 1-1). Purposes include flood control and power generation, water supply, irrigation, navigation, recreation, and fish and wildlife conservation. Not every project is authorized for all purposes.

Table 1-1. Authorized Federal Flood Storage and Hydropower Purposes by Willamette Valley System Project and Sub-basin.

Project Name	Sub-basin (HUC8)	River	Flood Control?	Power Generation?
Detroit	North Santiam	North Santiam River	Y	Y
Big Cliff	North Santiam	North Santiam River	N	Y
Green Peter	South Santiam	Middle Santiam River	Y	Y
Foster	South Santiam	South Santiam River	Y	Y
Blue River	McKenzie	Blue River, trib. To McKenzie	Y	Y

Project Name	Sub-basin (HUC8)	River	Flood Control?	Power Generation?
Cougar	McKenzie	SF McKenzie	Y	Y
Fall Creek	Middle Fork Willamette	Fall Creek	Y	N
Hills Creek	Middle Fork Willamette	Middle Fork Willamette River	Y	Y
Lookout Point	Middle Fork Willamette	Middle Fork Willamette River	Y	Y
Dexter	Middle Fork Willamette	Middle Fork Willamette River	N	Y
Dorena	Coast Fork Willamette	Row River	Y	Non-federal
Cottage Grove	Coast Fork Willamette	Coast Fork Willamette River	Y	N
Fern Ridge	Upper Willamette	Long Tom River	Y	N

Since the previous EIS in 1980, modifications to operations and structural improvements have been made to the WVS. The Corps has identified the need for the preparation of an updated EIS with new information that is available on the environmental effects of O&M and a large amount of new information regarding ESA-listed species since the 2008 Willamette Valley System biological opinions from USFWS (USFWS 2008) and NMFS (NMFS 2008). On August 9, 2021, the Corps formally requested an Initiation of Coordination under the FWCA (USACE 2021, p. 1).

1.4. COOPERATING AGENCIES AND TRIBES

Early in the NEPA process, the Corps requested cooperation from federal and state agencies, local entities, and tribes that have either jurisdiction by law in the Study Area, or special expertise on relevant environmental issues, to participate in DEIS and final EIS development (40 CFR § 1501.6).

We invited several of the designated cooperating agencies to collaborate during the analysis and for this reporting effort (Table 1-2).

Table 1-2. Cooperating agencies and Tribes invited to contribute to the NMFS FWCAR.

General Affiliation	Specific Agencies and Tribes
Government Agency	Oregon Department of Fish and Wildlife
Government Agency	Oregon Department of Environmental Quality
Tribe	Confederated Tribes of the Grand Ronde

2. STUDY AREA AND BASIN EXTENT

The report is focused on these areas included in the Preferred Alternative:

- Below and between reservoirs in tributaries and the mainstem downstream to Willamette Falls
- Any areas that would be used/accessed by NMFS trust resources if passage was not blocked by dams/projects included in the Preferred Alternative
- Areas affected by changes in flows and temperatures, etc. between Willamette Falls and the Lower Columbia estuary, as well as NMFS trust resources that occupy that area.

The Study Area includes all river reaches, riparian zones, and floodplain areas located downstream of the 13 Willamette Project dams, including the mainstem Willamette River and the tributaries affected by these facilities (i.e., mainstem reaches of the North Santiam and South Santiam rivers, Santiam River, McKenzie River, South Fork McKenzie River, Blue River, Fall Creek, Hills Creek, Middle Fork Willamette River, Row River, Coast Fork, Willamette River, and the Long Tom River) (Figure 2-1). This Study Area also encompasses the 42 miles of streambank revetments maintained by the Corps and the adjacent stream reaches affected by those revetments. Upstream of the 13 Willamette Project dams, the Study Area includes stream reaches and land areas permanently or seasonally inundated by Willamette Project reservoirs in dry, average, and wet years, and all reaches of tributaries located upstream of Willamette Project dams that are designated as critical habitat (Figure 2-1). This report will focus on areas where NMFS' trust species will be most greatly affected by the Preferred Alternative, which includes the Willamette River mainstem and four major sub-basins: North Santiam, South Santiam, McKenzie, and Middle Fork Willamette.

The management of the WVS for flood risk reduction and other purposes included in the Draft EIS affects the natural hydrograph in the major Willamette tributaries and the Willamette River mainstem. Technically, under all Draft EIS alternatives, natural stream flows (and river temperatures) will be affected from the uppermost reservoirs to the mouth of the Columbia River. Therefore, the designated Study Area also includes the Lower Willamette River and the Columbia River mainstem between river mile 0 and the Willamette River confluence. However, the effect of the Preferred Alternative between the Willamette River confluence and the mouth of the Columbia is minimal because the average annual Willamette River flow is only 12 percent of average annual Columbia River flow. Therefore, this report will primarily focus on the area above the Willamette River confluence and the trust resources found there. Evaluation of effects to trust species found in the Lower Columbia River will be limited to minor water quality and quantity effects and addressed more generally.

Channel confinement, isolation of the Willamette River from most of its floodplain, obliteration of side channels and/or severing of side channel connections, and elimination or degradation of both seasonal and permanent wetland habitats within the floodplain began as early as 1872 and has significantly changed the system. For example, along the 15.5-mile reach of the Willamette River between Harrisburg and the McKenzie River confluence, the length of shoreline has declined from over 155 miles of shoreline in 1854 to less than 40 miles currently (Sedell and Froggatt, 1984; Sedell et al., 1990; USFWS 2008).

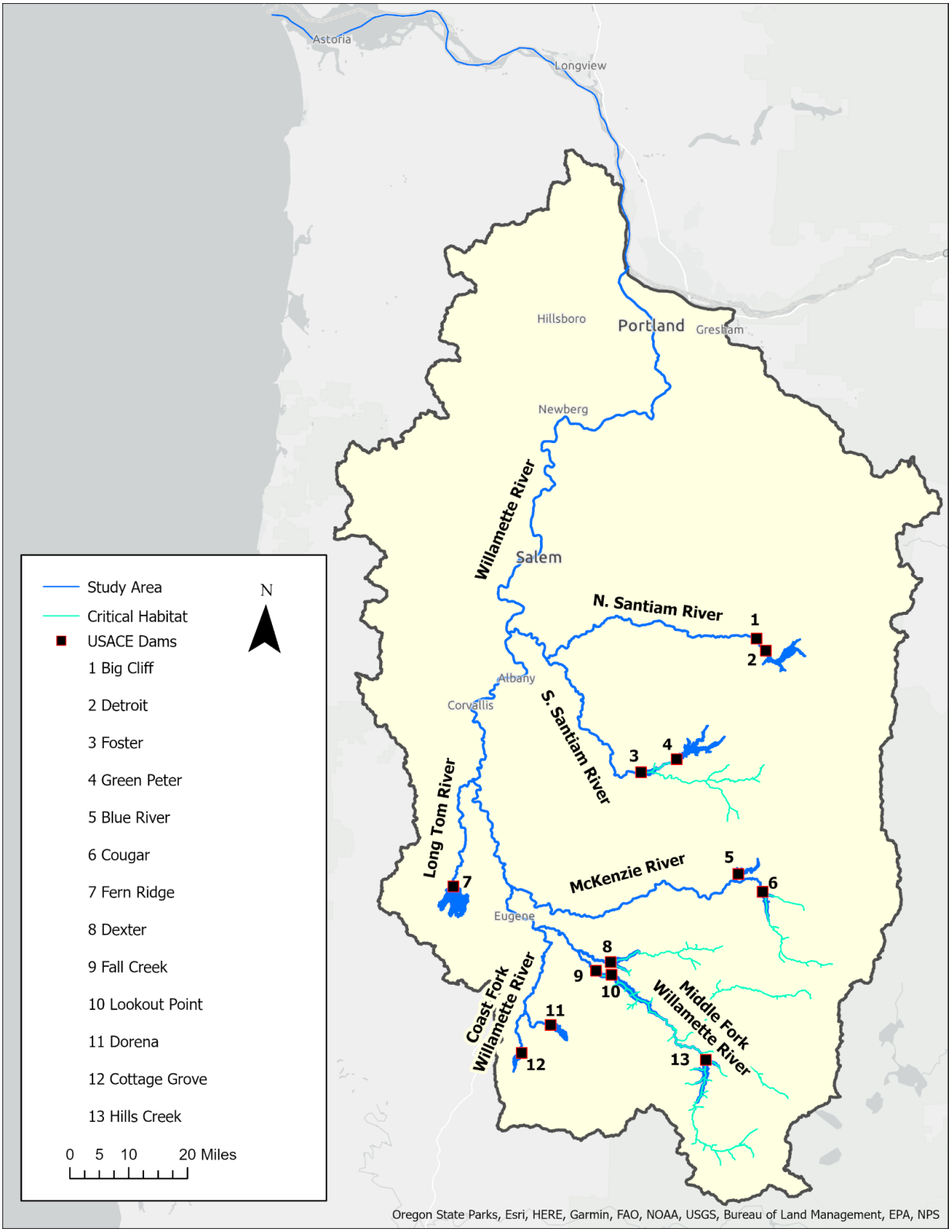


Figure 2-1. Map of the Study Area or area impacted by the Preferred Alternative for the operation of the Willamette Valley System (including current, volitionally-inaccessible critical habitat).

The construction and operation of the WVS, in combination with the construction and maintenance of revetments, has facilitated floodplain development, encroachment, urbanization and rural development because of the annual protections against flooding. We cannot assume, however, that all floodplain development, encroachment, urbanization, and rural development was due to the construction and operation of the Willamette Project since a great deal of development occurred before the Project was completed despite the known risk of flooding (USACE 2000; USFWS 2008).

The impacts of urbanization on aquatic ecosystems are severe and long-lasting. Urbanization virtually eliminates natural vegetation in affected areas, which in turn disrupts hydrologic and erosional processes, as well as the physical characteristics of aquatic habitats. Urban developments, including roads, buildings, sidewalks, and other impervious surfaces, greatly reduce water infiltration, which alters the routing and storage of water in the affected basin. Many of the resulting changes are intended to make the land more amenable to specific human uses (e.g., transportation, human habitation), but other important resource values (e.g., water supplies, fisheries, wildlife) may be damaged by unintended effects on aquatic ecosystems, including increased peak flows; channel erosion; loss of riparian habitats that results in increased stream temperatures; increased nutrient inputs; landslides; pollution; and channelization (Spence and Hughes, 1996; USFWS 2008).

Many species of non-native fish have been introduced to and are common throughout the Willamette Valley, including largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), crappie (*Pomoxis* spp.), bluegill (*Lepomis macrochirus*), and walleye (*Sander vitreus*). Many of these introduced species are known to prey on and compete for habitat with native species. Some non-native plant and animal species are invasive. Without natural predators or controls, they can establish on many sites, grow quickly, and spread to the point of disrupting fish communities or ecosystems. In this report, we also reference non-native species that have been introduced to the area and can cause damage to an ecosystem.

2.1. WILLAMETTE SUB-BASINS

Based on the Study Area, seven fourth-level sub-basins were identified (8-Digit HUC, hydrologic unit code): Coast Fork Willamette, Middle Fork Willamette, Upper Willamette, Middle Willamette, McKenzie, North Santiam, and South Santiam. Ten major tributaries with a stream Level < 5 and Order > 6 were identified in addition to the Mainstem Willamette River.

3. METHODS

3.1. EVALUATION SPECIES

We will evaluate effects on all NMFS trust species (ESA-listed and non-ESA-listed) occurring within the Study Area, as well as effects to species that are: a) known to directly or indirectly affect trust species as predators, competitors, or keystone species; and b) presumed to be significantly affected by measures within the Preferred Alternative (Table 3-1).

Table 3-1. Official species list used to consider the effects of the WVS DEIS on NMFS trust species including species common name and known presence. UWR = Upper Willamette River; NS = North Santiam River sub-basin; SS = South Santiam River sub-basin; McK = McKenzie River sub-basin; Mid-Fk. = Middle Fork Willamette River sub-basin; Coast Fk. = Coast Fork Willamette sub-basin; Will. MS = Willamette River mainstem (above Willamette Falls Dam).

Category	Species / Species Group	Presence In Affected Study Area							
		NS	SS	McK	Mid. Fk.	Coast Fk.	Will. MS	Below Will. Falls	Lower Col. R.
NOAA Trust Species Which Will Experience Greatest Effects of the Preferred Alternative	UWR Chinook salmon - Threatened ESU	X	X	X	X		X	X	X
	UWR Steelhead - Threatened DPS	X	X				X	X	X
	Unlisted Chinook Salmon	X	X				X	X	X
	Unlisted Steelhead	X	X	X	X		X	X	X
	Unlisted Coho Salmon	X					X	X	X
Resident Forms of Trust Species	Kokanee (resident form of sockeye salmon)	X	X						
	Wild Rainbow Trout (resident form of steelhead)	X	X	X	X	X	X		
NOAA Trust Species Which Will Experience Minor Effects	Salmonids in Lower Columbia River							X	X
	Green Sturgeon (small effect)								X
	Eulachon (small effect)								X

Category	Species / Species Group	Presence In Affected Study Area							
		NS	SS	McK	Mid. Fk.	Coast Fk.	Will. MS	Below Will. Falls	Lower Col. R.
	Southern Resident Killer Whales	Potential effect due to Chinook salmon being a primary prey species.							
Coldwater, Native, Non-Trust Species That Affect Salmonids	Pacific Lamprey (+)	X	X	X	X	X	X	X	X
	Brook Lamprey (+)	X	X	X	X	X	X	X	X
	Bull Trout (-)			X	X				
Native, Non-Trust Species - Salmonid Predator	Hatchery Rainbow Trout	X	X	X	X	X	X		
	Northern Pikeminnow	X	X	X	X	X	X	X	X
Introduced, Non-Trust Species - Salmonid Predators	Large Mouth Bass	X	X	X	X	X	X	X	X
	Small Mouth Bass	X	X	X	X	X	X	X	X
	White Crappie	X	X	X	X	X	X	X	X
	Black Crappie	X	X	X	X	X	X	X	X
	Warmouth	X	X	X	X	X	X	X	X
	Bluegill	X	X	X	X	X	X	X	X
	Pumpkinseed Sunfish	X	X	X	X	X	X	X	X
	Green Sunfish	X	X	X	X	X	X	X	X
	Yellow Perch	X	X	X	X	X	X	X	X
	Bullhead Catfish	X	X	X	X	X	X	X	X
	Walleye			X	X		X	X	X

3.2. COORDINATION and INFORMATION SHARING

3.2.1. Virtual Meeting

The FWCA requires NMFS and USFWS to consult and coordinate with other groups, including the Corps, cooperating agencies, federal and state agencies, tribes, private entities, and academic institutions to augment its understanding of the potential impacts of the proposed alternatives on fish, wildlife, and plant resources. Because of the short window of time available to complete this assessment and report, one multi-agency workshop was coordinated and held on October 25, 2022, via virtual video conference to gather input from partner groups. Representatives from each agency included in Table 1-2 were in attendance. Biweekly coordination meetings were

held with the Corps separately on the following dates: October 12, October, 26, and November 9, 2022. In each meeting progress updates were shared, and resources were requested as needed.

The goal of our coordination through these workshops was to enhance the information available for analysis and yield a more complete understanding of the ecological, socioeconomic, and cultural values of these resources, and their potential risk as a result of proposed changes to the WVS. During the workshop, we provided an overview of the FWCA, detailed NMFS' role and objectives, and defined the purpose and goals for the workshop. The discussion centered on a request for the groups to identify their high-priority natural resource issues and priorities in the Study Area, especially in regard to resources that could be impacted by the operation and management of the WVS.

We requested participants identify and describe fish, wildlife, and plant resources and habitats, or specific locations or sites with special value to them and the agencies they represent; discuss how changes to existing conditions could potentially impact these resources; and suggest measures to conserve, protect, and enhance ecological and physical processes, habitats, and species. We also asked for information (e.g., data, reports from past surveys or studies, white papers, gray literature, species population assessments, expert knowledge) to fill information gaps. Appendix B includes our workshop agenda.

3.3. DATA MODELING / ASSESSMENT METHODS

We used data from different sources including modeling efforts led by the Corps and by NMFS' Northwest Fisheries Science Center, in addition to existing databases, primary literature, technical experts who participated in the virtual workshops, the draft EIS for the WVS, NMFS documents (e.g., past consultations, Biological Assessments) and gray papers, and maps. We performed a series of qualitative assessments using available information to examine how the Preferred Alternative measures will impact NMFS' trusts resources in comparison to their current status (Ford 2022) under the "no action alternative" (NAA). This was done for each of the four areas being most greatly impacted by the WVS, as well as the mainstem Willamette River.

We assessed the potential impacts of each proposed measure included in the Preferred Alternative within each sub-basin. Most assessments were qualitative (positive or negative); however, we used EIS model outputs in our assessment of some measures, where those model results were applicable, as well as the Northwest Fisheries Science Center's (NWFSC's) life cycle model (LCM) results (NWFSC 2022).

We also considered the current status of populations and their importance to the conservation and recovery of species groups, as a whole, in our effects analysis (i.e. major effects to more critical populations had the greatest significance). We also considered the NWFSC model results, and caveats, along with our qualitative results.

3.4. ASSESSMENT OF MEASURES & CUMULATIVE IMPACTS

A qualitative analysis will determine if all the Preferred Alternative measures, taken together as a whole, may improve or degrade the current status of the primary trust resources within each

basin, and whether the improvements may address current limiting factors in the recovery of trust resources. These results will then be used to look at cumulative effects of the Preferred Alternative as a whole, along with climate change effects. Environmental conditions that are likely to be worse in the future and may impact the intended effects of Preferred Alternative measures will be noted.

4. RESOURCES

4.1. Habitat Within the Study Area for NMFS' Trust Species

NMFS trust species and resources include ESA-listed species groups and their designated critical habitats, as well as fish species included under a fisheries management plan (FMP) by the Magnuson-Stevens Fishery Conservation and Management Act (MSA), which designates essential fish habitat (EFH) for all Chinook and coho salmon.

4.1.1. NMFS' Trust Species Habitat & USFWS FWCAR Habitat Types

The FWCAR drafted by USFWS grouped habitat into the following categories: Riverine/Reservoir, Wetland/Off-Channel, Riparian, and Upland, Prairie. NMFS trust species occupy two of these five categories and are affected by activities that occur in nearly all of them, except for Prairie habitat. In order to provide a nexus with the USFWS report, we have included a list of the habitats essential to the existence of NMFS trust species, which exist within each of the USFWS habitat categories.

Within each of the USFWS habitat types, more specific critical habitats for NMFS trust species exist:

- Riverine - Spawning, incubating, rearing, migrating
- Reservoir: Generally, not natural habitat for NMFS' trust resources but currently used for rearing and migration because of the presence of the dam projects.
- Off-Channel / floodplain: Rearing, refuge habitat.
- Riparian: Comprises important trust resource habitat elements and input to riverine areas (shading, downed trees, bank stabilization, etc.)
- Upland: NMFS trust species do not reside in or near upland habitat, but effects to upland habitat (timber, mining, development) affect trust species habitat.

4.1.2. Upper Willamette River Chinook Salmon and Steelhead Critical Habitat

Essential features of UWR Chinook salmon and UWR steelhead habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access (to migrate upstream and downstream), water velocity, space, and safe passage that are associated with viability for the Chinook salmon ESU (evolutionarily significant unit) and steelhead DPS (distinct population segment). Conservation value is determined by evaluating habitat quantity and quality and the relationship to other habitat areas and with respect to the population occupying that area. These areas contain physical and biological elements that support one or more life stages of an ESA-listed species and were identified as essential to the conservation of the species (e.g., spawning gravels, water quality and quantity, side channels, forage species). Salmon habitat is dynamic and should be protected and restored for conservation. Figure 4-1 shows the current habitat

necessary to support existence of UWR Chinook salmon and UWR steelhead, which has also been designated as critical habitat.

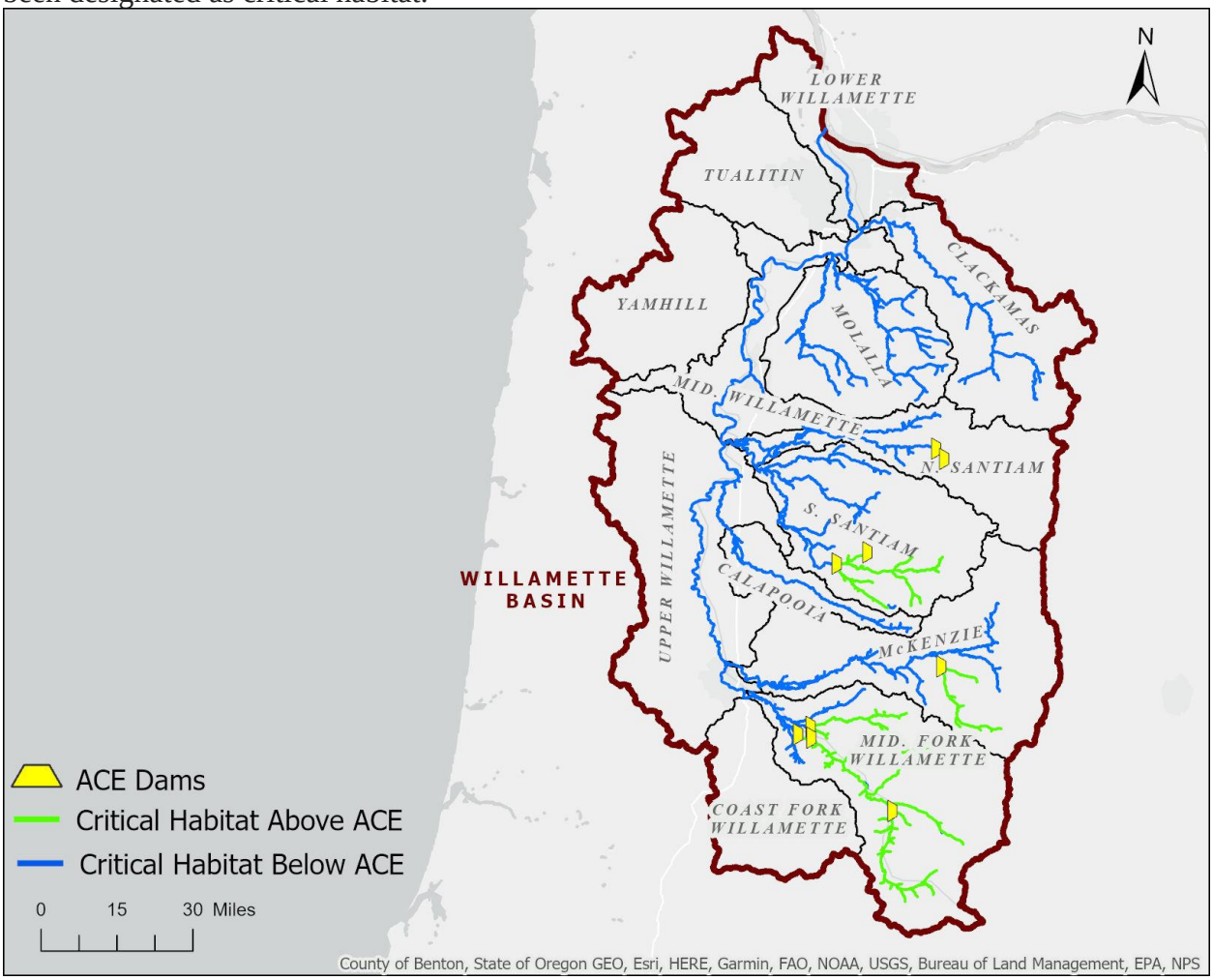


Figure 4-1. Map of critical habitat for both ESA-listed groups of Upper Willamette River Chinook salmon and steelhead, including sub-basins less affected by the Preferred Alternative (Clackamas, Molalla and the Calapooia). ACE (USACE) dams in the WVS currently block volitional access to critical habitat.

In evaluating the quantity and quality of habitat features, NMFS (2005) examined the condition of the physical and biological features (PBFs). The PBFs are essential to conservation because they support one or more of the species' life stages (NMFS 2005), as described below:

Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without them,

juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (e.g., predator avoidance, competition) that help ensure their survival.
Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.

4.1.3. Lower Columbia River ESA-Listed Species Critical Habitat

ESA-listed Lower Columbia River coho and Chinook salmon ESUs (Evolutionarily Significant Units), and the Lower Columbia River steelhead DPS (distinct population segment), include fish populations that inhabit the Clackamas River basin, which is a tributary to the lower Willamette River. These fish have the same categories of critical habitat as Upper Willamette Chinook salmon and steelhead, and their designated critical habitat includes the mainstem Willamette River (below Willamette Falls) and Lower Columbia River through which they migrate and rear (NMFS 2005 and 2016a) (50 CFR 226.212(t)).

For all 13 ESA-listed salmon and steelhead ESUs that migrate through the lower Columbia River, critical habitat also includes: estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater.

4.1.4. NMFS Essential Fish Habitat (EFH) for Chinook and Coho Salmon

The Magnuson Stevens Fisheries Conservation and Management Act calls for the designation of "essential fish habitat" (EFH) for all commercially caught and managed fish species (DOC 2007). This includes Chinook and coho salmon from the Willamette River and Columbia basin. 660.412 - EFH identifications and descriptions for Pacific salmon EFH is identified for anadromous Pacific salmon stocks managed by the Pacific Fishery Management Council (PFMC) under the Pacific Coast Salmon Fishery Management Plan (FMP). These managed salmon include most of the Chinook salmon (*Oncorhynchus tshawytscha*) stocks and all of the coho salmon (*O. kisutch*) stocks from Washington, Oregon, Idaho, and California. The geographic extent of freshwater EFH is specifically identified in the FMP as all water bodies currently or historically occupied by PFMC-managed salmon in Washington, Oregon, Idaho, and California; including aquatic areas above all artificial barriers that are not specifically excluded.

4.1.5. Green Sturgeon Critical Habitat

Currently, the majority of the southern distinct population segment (sDPS) of green sturgeon (*Acipenser medirostri***s)** spawning occurs within the mainstem Sacramento River, placing the species at increased risk of extinction from stochastic events. As subadults and adults, sDPS green sturgeon migrate seasonally along the west coast, congregating in bays and estuaries in

Washington, Oregon, and California during the summer and fall months. Tagged Southern DPS green sturgeon have been detected as far up the Columbia River as RKM 74 and are able to access the lower Columbia River upstream of RKM 74 (to Bonneville Dam), though data are not available to determine the number of Southern DPS green sturgeon moving upstream of RKM 74 or the relative levels of southern DPS and northern DPS fish in this area. There is no known presence of green sturgeon in the Willamette River (74 FR 52299). During the winter and spring months, green sturgeon congregate off of northern Vancouver Island, B.C., Canada. Huff et al. (2012) modeled the seasonal distribution of subadult and adult green sturgeon in coastal waters and identified waters shallower than 200 meters (656 feet) along the Oregon and Washington Coasts as a high-use area. This includes the waters of the Columbia River plume. The modeled distribution was confirmed by the distribution of green sturgeon as bycatch in the limited entry trawl and California halibut fisheries (Huff et al. 2012).

Green sturgeon likely inhabit estuarine waters to feed and optimize growth (Moser and Lindley 2007), and these habitats appear to be important to subadult and adult green sturgeon. Individual green sturgeon exhibit diel movements, using deeper water during the day and moving to shallower water during the night to feed.

4.1.6. Critical Habitat for Southern Resident Killer Whales (SRKWs)

On September 19, 2019, NMFS (2019a) proposed to revise the critical habitat designation by adding six additional areas along the U.S. West Coast (84 FR 49214), and on August 2, 2021, the Final Rule for the designations was issued (86 FR 41668). In the most recent 5-year status review, NMFS (2016b) evaluated information on the status of the DPS including threats and research results and publications and concluded that SRKWs should remain listed as endangered. Southern Residents are not directly affected by the implementation of the proposed action. However, there are potential effects to their prey base. The analysis below examines the potential for exposure (overlap in time and space with Southern Residents and their prey base), and the significance of that exposure.

Although Southern Residents consume a variety of fish (22 species) and one species of squid (Ford et al. 1998, 2000, 2016; Ford and Ellis 2006, Hanson et al. 2010), salmon are their primary prey. Their dietary habits are the subject of ongoing research, including direct observations, analysis of scales and tissues sampled from prey remains, and the collection and analysis of fecal material. Scale and tissue samples collected in inland waters of Washington and British Columbia indicate a high percentage of Chinook salmon from local populations (the Fraser River and Puget Sound) during May to September (Hanson et al. 2010).

Although we have relatively little data for Southern Residents during winter, Chinook salmon appear to remain the most important component of the diet for the K and L pods that occupy outer coastal waters during this period (Hanson et al. 2021). Before 2013, only three prey samples from feeding events had been collected on the U.S. outer coast, but from 2013 to 2015, Hanson et al. (2021) used satellite tags to locate and follow the whales to obtain prey and fecal samples including times when they were present on the outer coast (outside of Salish Sea). Chinook salmon were again the dominant prey, and Southern Residents from the K and L pods occurred off the Columbia River in March, when many Upper Willamette River Chinook salmon are returning to the Columbia River mouth, along with other spring Chinook salmon ESUs like

Lower Columbia spring Chinook (Hanson et al. 2013). However, this study did not demonstrate that Upper Willamette Chinook occur frequently in the SRKW diet during their period of spatio-temporal overlap (Hanson et al. 2021). Of the outer coast samples (Oregon and Washington, primarily), 54 prey remains samples were collected from January to May, and 43 were identified as Chinook salmon, 10 as steelhead, plus one chum salmon and one halibut. A majority of these samples were collected off of Washington shores. Genetic origin was determined for 33 of the 43 Chinook salmon samples, and Columbia River stocks accounted for 53.6 percent of those samples, about a third of which were from spring run fish (versus two thirds from summer or fall runs). Willamette River origin spring Chinook salmon were not detected in the samples, but this does demonstrate the possibility that Willamette River Chinook salmon are periodically encountered and consumed by SRKWs (Hanson et al. 2021). Due to the difficulty of obtaining samples for these analyses, sample sizes are relatively small, and therefore, may not portray an entirely accurate picture of the Chinook salmon stocks that comprise the SRKW diet. Since there is an overlap in the spatio-temporal occurrence of SRKW pods and Chinook salmon from the Columbia (including spring Chinook and Willamette spring Chinook), any action that continues to limit or diminish the productivity and viability of Willamette spring-run Chinook salmon also negatively affects SRKWs in some small way, and one of the top conservation strategies identified for the recovery of SRKWs is to increase the abundance of all Chinook salmon stocks that inhabit the whales' winter range.

4.2. SPECIES

Chinook salmon and steelhead are the two NMFS trust species most affected by WVS' presence and operations and will continue to be impacted into the future. Leading up to the upcoming status review for these two ESUs, NMFS' Northwest Fisheries Science Center published a viability report for all ESA-listed salmon and steelhead ESUs in the Pacific Northwest. Out of 18 ESUs, 3 were assigned a recent viability trend of "declining" (vs. unchanged or increasing); 2 of these 3 were UWR Chinook salmon and steelhead, and the third was Snake River sockeye salmon, a critically endangered species (Ford 2022).

4.2.1. Upper Willamette River (UWR) Chinook salmon (*Oncorhynchus tshawytscha*) and Unlisted Chinook salmon

On March 24, 1999, NMFS listed the UWR Chinook salmon evolutionarily significant unit (ESU) as threatened (64 FR 14308). That status was affirmed on June 28, 2005, (70 FR 37160) and updated on April 14, 2014 (79 FR 20802). The most recent status review, NMFS (2024a) concluded that this ESU should retain its threatened status. Critical habitat was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the status of UWR Chinook salmon. More information can be found in the recovery plan (ODFW and NMFS 2011) and the most recent status review and viability assessment (NMFS 2024a; Ford 2022).

The UWR Chinook salmon ESU includes all naturally spawned spring-run Chinook salmon originating from the Clackamas River sub-basin and from the Willamette River sub-basins upstream of Willamette Falls, as well as six artificial propagation programs (70 FR 37160). Seven demographically independent populations have been identified: Clackamas, Molalla, North Santiam, South Santiam, Calapooia, McKenzie, Middle Fork Willamette. The Clackamas, North Santiam, and Middle Fork have additionally been identified as "core populations", and the

McKenzie population is both a core population and a genetic legacy population. The six propagation programs in ESU include: McKenzie River Hatchery Program, North Santiam River Program, South Santiam River Program, Molalla River Program, Willamette Hatchery Program and the Clackamas Hatchery Program.

UWR Chinook salmon differ from other Columbia River basin Chinook salmon according to both genetic and life-history data (Schreck et al. 1986, Utter et al. 1989, Waples et al. 1993, Myers et al. 1998). Research has shown that the ESU exhibits several different life-history pathways. Many juveniles from spring Chinook salmon populations reach the Willamette mainstem migration corridor as yearlings, but some juveniles found in the lower Willamette River are subyearlings (Friesen et al. 2004). These early migrants can begin moving and migrating through their natal streams and as early as December or January, enter the Willamette River mainstem as early as May and head to the lower Columbia as early as June (Schroeder et al. 2005). Early subyearling migrants have been captured in the upper estuarine zone of the lower Columbia River and have also been captured in nearshore ocean samples in June (NMFS 2020).

Fall subyearling migrants usually remain in the Willamette sub-basins through their first spring and summer; some spend their first winter in the Willamette River, while others move past Willamette Falls on the lower Willamette River before winter and likely rear in the Columbia River or estuary before entering the ocean as early as March (as they approach one year of age). The fall subyearling migrants may have chosen to move downstream earlier but do not due to being trapped in the reservoirs (behind the dams) until they are able to detect an exit through the dams. Yearling migrants make their biggest downstream moves from the sub-basins to the Lower Columbia in March through May (after they approach one year of age) but rear in their natal sub-basins (or are trapped in them) (NMFS 2020)

Adult UWR Chinook salmon enter the Willamette River in January through April and ascend Willamette Falls in April through August (ODFW and NMFS 2011, Rose 2015). They return to their natal sub-basins from April to September, and if they survive, spawn there from mid-August through October, primarily in September and early October (NMFS 2008a). The eggs of their young typically incubate starting as early as mid-August to as late as mid-March and Middle Fork Chinook tend to emerge earlier than Chinook salmon fry from other basins (USACE 2022c).

Around the time of the ESA-listings, the UWR Chinook salmon ESU likely numbered less than 10,000 natural-origin fish, compared to a historical abundance estimate of 300,000 (Myers et al. 2003), and significant natural production occurred only in the Clackamas and McKenzie populations (McElhany et al. 2007). The first status review NMFS concluded that all populations were at a very high risk of extinction, except for the Clackamas and the McKenzie, which were at moderate and low risks, respectively. In the 2015 status review, NMFS found that while a few populations had experienced slight improvements in status, there was a decline in overall abundance of natural-origin spawners in the ESU (NMFS 2016c) and the viability statuses remained unchanged. The McKenzie River population, previously viewed as a stronghold within the ESU, had experienced declines in abundance, and this was of particular concern. In contrast to most of the other populations in this ESU, McKenzie River Chinook salmon have access to much of their historical spawning habitat, although access to historically high-quality habitat

above Cougar Dam (on the South Fork McKenzie River) is still limited by poor downstream juvenile passage (NWFSC 2015, NMFS 2016c).
In the 2015 status review (NWFSC 2015, NMFS 2016c), juvenile passage and survival data at the dams were also limited and highly variable. Only at Foster Dam (South Santiam River) and Fall Creek Dam (Middle Fork Willamette River) were spawner replacement levels achieved in some years. Small improvements were noted in the North and South Santiam River populations. These increases were in contrast to the other population abundance trends and the counts at Willamette Falls (see Figure 4-2), but returns (to the fish facilities in each sub-basin) still ranged only in the high hundreds of fish. Improvement in the status of the Middle Fork Willamette River population related solely to the return of natural adults to Fall Creek; however, the capacity of the Fall Creek basin alone is insufficient to achieve the recovery goals for the Middle Fork Willamette River population (NWFSC 2015). For the 2010–15 period, natural-origin returns to the Clackamas River remained flat, despite adults having access to much of their historical spawning habitat.

In terms of spatial structure, the 2015 status review noted that access to historical spawning and rearing areas remained restricted by large dams in the four populations that were historically the most productive (North Santiam, South Santiam, McKenzie and Middle Fork Willamette), and thus, spawning and rearing was confined in these populations to more lowland reaches where land development, water temperatures, and water quality may be limiting. Pre-spawning mortality levels were generally high in the lower tributary reaches, where water temperatures and fish densities are generally the highest. Areas immediately downstream of high-head dams may also be subject to high levels of TDG. Hatchery production had remained relatively stable since earlier status reviews, although a number of operational changes had been made at hatcheries that could reduce hatchery impacts eventually (NWFSC 2015, NMFS 2016c). Given the prospect of long-term climate change, the most recent status review noted that the inability of many populations to access historical headwater spawning and rearing areas may put this ESU at greater risk (NWFSC 2015, NMFS 2016c).

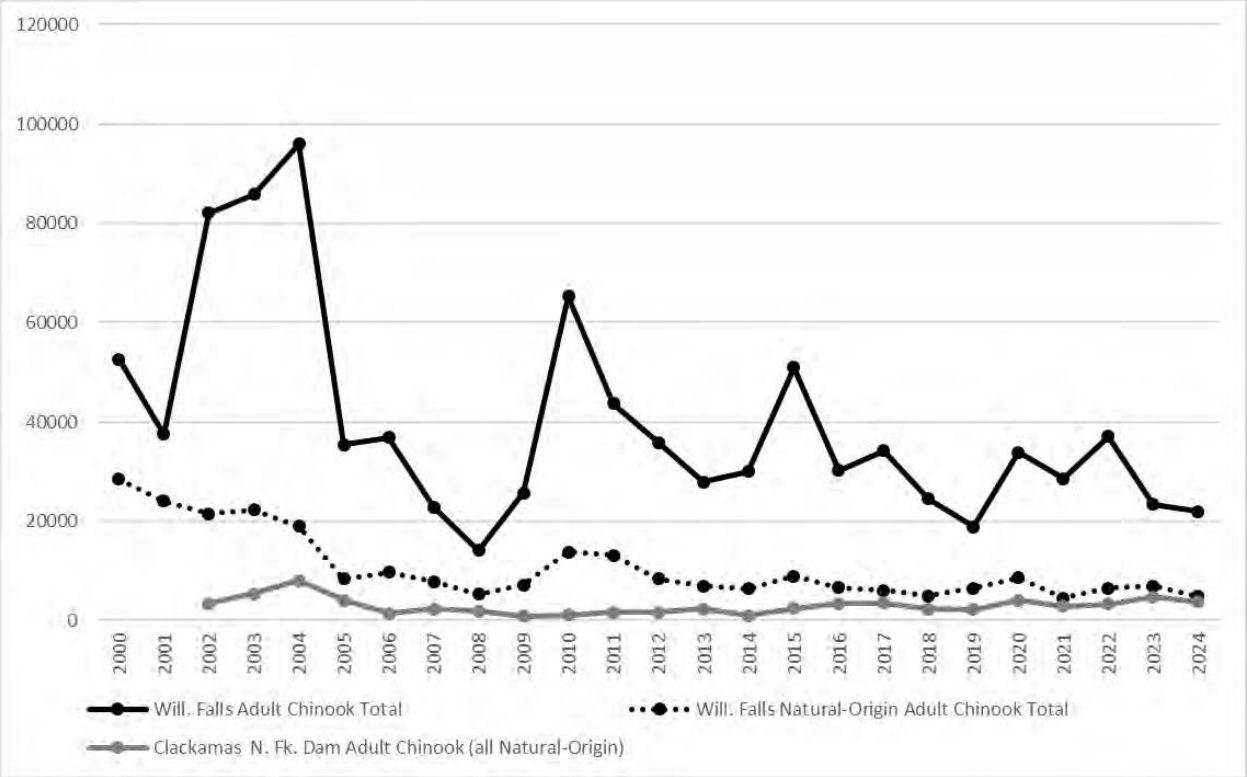


Figure 4-2. Annual total counts of adult UWR Chinook salmon returns to the Willamette Falls Dam and the Clackamas River North Fork Dam. Six of the seven ESA-listed UWR Chinook salmon populations must pass Willamette Falls Dam prior to reaching their natal sub-basin, not including the Clackamas population.

The NWFSC's 2022 viability assessment for Upper Willamette Chinook salmon showed few changes from the 2015 status review for most populations other than the Clackamas population, which is very minimally affected by the Preferred Alternative and operation of the WVS (Ford 2022) (see Figure 4-2). Abundance levels for all other populations besides the McKenzie remain at 11 percent or less of their recovery goals (Ford 2022). The Calapooia River population is presumed to be functionally extinct and the Molalla River's abundance remains critically low (but also uncertain). Despite increased Chinook salmon adult returns to the adult fish facility in the North Santiam in 2022, natural-origin abundances in the North and South Santiam Rivers have declined over time. The Middle Fork Willamette River is at a very low abundance (less than 1 percent of recovery goal abundance), even with the inclusion of natural-origin spring-run Chinook salmon spawning in Fall Creek. While returns to Fall Creek Dam number in the low hundreds, prespawn mortality rates are very high in the basin. In the McKenzie River, the spring-run Chinook salmon population appears to be relatively stable, having reversed a short-term downward abundance trend that was of concern during the last review. But the McKenzie River population remains well below its recovery goal, despite having volitional access to much of its historical spawning habitat. Demographic risks remain "high" or "very high" for most populations, except the Clackamas and McKenzie Rivers, which are at "low" and "low-to-moderate" risk, respectively.

Understanding the limiting factors and threats that affect the UWR Chinook salmon ESU provides important information and perspective regarding the status of the species. One of the

necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed. The recovery plan for UWR Chinook salmon (ODFW and NMFS 2011) identifies key and secondary limiting factors and threats for each population by area and life stage. These include:

- Restricted access to historical spawning and rearing habitat by the Willamette Project flood control/hydropower dams. Willamette Project dams block or delay adult fish passage to major portions of the historical holding and spawning habitat for UWR Chinook salmon in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette sub-basins. In addition, most Willamette Project dams have limited facilities or operational provisions for safely passing juvenile Chinook salmon downstream of the facilities. In the absence of effective passage programs, UWR Chinook salmon will continue to be confined to lowland reaches, where land development, water temperatures, and water quality are limiting, and where pre-spawning mortality levels are generally high (NMFS 2016c). In addition to the federal Willamette Project dams, several municipal hydropower or flood control facilities in tributaries also cause adverse effects.
- Hydropower-related limiting factors extend to the Columbia River estuary, where adverse effects on estuarine habitat quality and quantity are related to the cumulative effects of Columbia River basin dams. Effects include an altered seasonal flow regime and Columbia River plume due to flow management (ODFW and NMFS 2011).
- Land use practices including agriculture, timber harvest, mining and grazing activities, diking, damming, development of transportation, and urbanization, which have reduced access to historically productive habitats and reduced the quality of remaining habitat by weakening important watershed processes and functions (ODFW and NMFS 2011).
- Predation by birds, native and non-native fish, and marine mammals, including increasing marine mammal predation at Willamette Falls (NMFS 2016c). Though sea lion numbers at Willamette Falls have been very low in recent years.
- High proportions of hatchery spawners, although recent improvements offer the potential for collecting more hatchery origin adults and removing them from the natural-spawning component of the North and South Santiam populations (NMFS 2016c).
- Harvest, although overall harvest rates on UWR spring Chinook salmon have dropped from the 50-60 percent range in the 1980s and early 1990s to around 30 percent since 2000 (NMFS 2016c).
- Climate change effects, including increased stream temperatures, changes in precipitation/streamflow, and years of low ocean productivity (NMFS 2016c).

Unlisted Chinook Salmon

Fall Chinook salmon were introduced above Willamette Falls in 1964, but hatchery releases were discontinued over 20 years ago. Based on the Willamette Falls fish count data, the current 5-year-average of fall Chinook salmon passage at Willamette Falls dam is 2,490 adults and 504 jacks (https://myodfw.com/willamette-falls-fish-counts). These are likely natural-origin fish descended from the past hatchery releases. Based on information received from ODFW staff, two fall Chinook salmon were recorded at the Minto Adult Fish Facility on the North Santiam this past year (2022). It is likely that these unlisted Chinook salmon spawn in the mainstem Willamette River or the lower reaches of the tributary sub-basins, but little information exists.

4.2.2. Upper Willamette River (UWR) steelhead (*Oncorhynchus mykiss*) and unlisted *O. mykiss*

On March 25, 1999, NMFS listed UWR steelhead as threatened (64 FR 14517) and reaffirmed that status on January 5, 2006 (71 FR 834). The status was upheld on April 14, 2014 (79 FR 20802). The most recent status review, in 2016, concluded that this DPS should retain its threatened status (81 FR 33468). Critical habitat for UWR steelhead was designated August 22, 2011 (76 FR 52317). The UWR steelhead DPS includes all naturally spawned anadromous, winter-run *O. mykiss* originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to, and including, the Calapooia River. There is only one major population group in this DPS, composed of four historical populations: Molalla, North Santiam, South Santiam, and Calapooia (Myers et al. 2006). All four populations remain extant and produce low to moderate numbers of natural-origin steelhead each year. Steelhead returning to the west side Willamette basin tributaries (in Tualatin, Yamhill, Rickreall and Luckiamute) are part of the "Willamette Winter Steelhead SMU", but are not part of a historically independent population, as they function as a population sink for the historical populations. In the larger metapopulation context, fish produced in these west side sub-basins presumably functioned as dependent populations of the UWR DPS. Winter steelhead hatchery releases within the boundary of the UWR steelhead DPS ended in 1999; however, though there is still a hatchery program for non-native summer steelhead.

Before construction of a fish ladder at Willamette Falls in the early 1900s, flow conditions allowed steelhead to ascend Willamette Falls only during the late winter and spring. As a result, UWR steelhead evolved as winter-run fish, returning to freshwater in December through April, passing Willamette Falls as early as December or January but typically from February to mid-May, and spawning in March through mid-July, with peak spawning in April and early May. They typically migrate farther upstream than Chinook salmon and can spawn in smaller, higher gradient streams and side channels. UWR steelhead may spawn more than once, although the frequency of repeat spawning is relatively low. Juvenile steelhead rear in headwater tributaries and upper portions of the sub-basins for 1 to 4 years (most often 2 years), then begin migrating from the North and South Santiam sub-basins predominantly from mid-March to mid-June and then relatively quickly through the mainstem Willamette and Columbia River estuary to the ocean. UWR steelhead typically forage in the ocean for 1 to 4 years (most often 2 years) (ODFW and NMFS 2011). There is currently insufficient data to adequately characterize residence time of juvenile UWR steelhead in these reaches and we assume rearing juveniles could be present in any of the reaches downstream of the WVS dams at any time of year.

At the time of listing of this DPS, NMFS noted concerns with genetic integrity of the DPS from the construction of fish ladders at Willamette Falls as early as 1885, which facilitated the successful introduction of out-of-basin steelhead into the upper Willamette river basin. Blockage of historical spawning habitat by the Willamette Project dams and other smaller dams or impassable culverts throughout the region was also noted, as was habitat degradation related to forestry, agriculture, and urbanization in the Willamette Valley. After fluctuating for several decades, abundance of natural-origin winter steelhead ascending the Willamette Falls fish ladder had been declining steeply since 1988, (Busby et al. 1996), and the run in 1996 was the lowest in

30 years (~1800 winter-run), although since then there have been several particularly poor years of returns (~800 in 2017, ~1800 in 2018) (see Figure 4-3).

In the 2015 status review for UWR steelhead (NMFS 2016c), NMFS noted that overall, the declines in abundance had continued through the period 2010 to 2015 and that populations in this DPS had experienced long-term declines in spawner abundance. Although the declines were relatively moderate, the review noted that continued declines would be a cause for concern, and that there was considerable uncertainty in many of the abundance estimates for this DPS (with the possible exception of tributary dam counts) (NWFSC 2015). Radio-tagging studies suggested that a considerable proportion of winter-run steelhead ascending Willamette Falls do not enter the spawning areas that constitute this DPS; the review noted that these fish might be non-native, early winter-run steelhead that have colonized the western tributaries, misidentified summer-run steelhead, or late winter-run steelhead that have colonized tributaries not historically part of the DPS (NWFSC 2015).

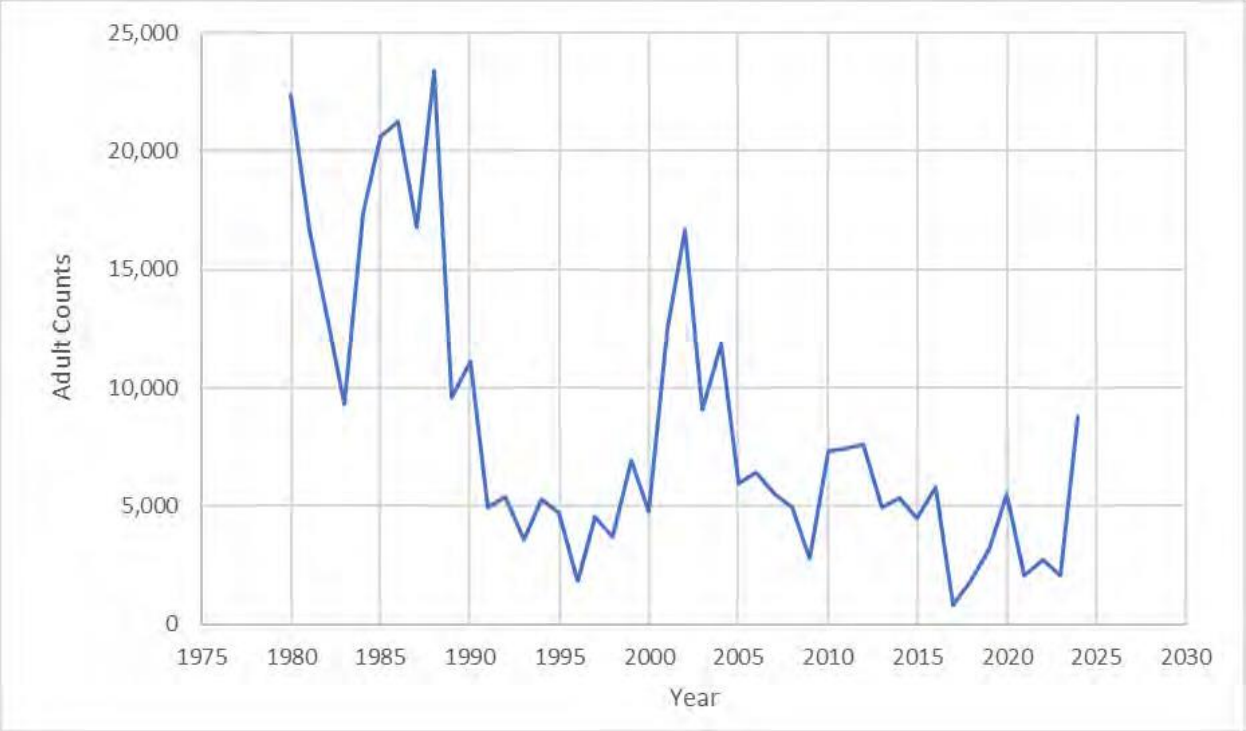


Figure 4-3. Total annual counts of all adult winter steelhead passing Willamette Falls Dam since 1980. Hatchery releases of winter steelhead have not occurred in the Willamette basin above Willamette Falls since 1999, making 2005 the last possible year for hatchery-origin adult returns. *Note: Not all adult winter steelhead that pass Willamette Falls Dam are considered to be part of the primary Upper Willamette steelhead DPS.*

In terms of spatial structure, access to historical spawning and rearing areas remain restricted by large dams in the North and South Santiam sub-basins. The 2015 review noted that improvements to fish passage at Bennett Dam and operational temperature control at Detroit Dam might be providing some stability in abundance for the North Santiam River population but that it was unclear if sufficient high-quality habitat was available below Detroit Dam to support

the population reaching its recovery goal. Similarly, the 2015 review noted that the South Santiam River population might not be able to achieve its recovery goal without access to historical spawning and rearing habitat above Green Peter Dam and/or improved juvenile downstream passage at Foster Dam (NWFSC 2015).

As noted above, winter steelhead hatchery programs in the Upper Willamette River basin had been terminated in the late 1990s, an action that has helped alleviate diversity concerns related to hatchery fish. At the time of the 2015 review, the only steelhead programs in the upper Willamette River were releasing non-native summer steelhead. Annual total releases had been relatively stable at around 600,000 fish since 2009, although the distribution had changed, with fewer fish being released in the North and South Santiam Rivers and corresponding increases in the McKenzie and Middle Fork Willamette Rivers. The recovery plan for UWR Chinook salmon and UWR steelhead cites hatchery-origin releases of summer steelhead as a limiting factor for recovery (ODFW & NMFS 2011). Releases of large numbers of hatchery-origin summer steelhead may temporarily exceed rearing capacities and displace winter juvenile steelhead. However, the Willamette Basin Hatchery Genetic Management Plan includes measures to reduce hatchery-origin and natural-origin interactions on steelhead spawning grounds (NWFSC 2015).

Abundance and life history data for Upper Willamette steelhead populations remains very limited at the time of this report draft, partially because of challenges associated with winter steelhead spawning surveys. Adult counts were also available from observations at Willamette Falls, Bennett Dam, the Minto Dam fish facility (North Santiam River), and Foster Dam (South Santiam River). While steelhead counts at Willamette Falls provide a DPS-wide estimate of abundance, there is some uncertainty in distinguishing native late-winter steelhead from non-native early-winter steelhead and unmarked non-native summer steelhead (Johnson et al. 2018, Weigel et al. 2019), and radio-tagging studies suggest that a considerable proportion of “winter” steelhead ascending Willamette Falls do not enter the tributaries that are considered part of this DPS.

Populations in this DPS have experienced long-term declines in spawner abundance. The underlying causes of these declines are not well understood. Returning adult winter steelhead do not experience the same deleterious water temperatures as the spring-run Chinook salmon, and pre-spawn mortalities are not likely to be significant. Overall, none of the populations in the DPS are meeting their recovery goals and access to historical spawning and rearing habitat above Detroit and Green Peter (as well as improved downstream passage) may be necessary in order to move closer to those goals (Ford 2022). While the viability of the ESU appears to be declining, the recent uptick in abundance may provide a short-term demographic buffer. In the absence of substantial changes in accessibility to high-quality habitat, the DPS will remain at “moderate-to-high” risk. Overall, the Upper Willamette River steelhead DPS is therefore at “moderate-to-high” risk, with a declining viability trend (Ford 2022).

Understanding the limiting factors and threats that affect the UWR steelhead DPS provides important information and perspective regarding the status of the species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed. The recovery plan for UWR steelhead (ODFW and NMFS

2011) identifies key and secondary limiting factors and threats for each population by area and life stage. These include:

- Restricted access to historical spawning and rearing habitat in the North and South Santiam sub-basins by the Willamette Project flood control/hydropower dams operated by the Corps of Engineers. Willamette Project dams block or delay adult fish passage to major portions of the historical holding, rearing, and spawning habitat for UWR steelhead in the North Santiam and South Santiam sub-basins. In addition, most Willamette Project dams have limited facilities or operational provisions for safely passing juvenile steelhead downstream of the facilities. In the absence of effective passage programs, most UWR steelhead continue to be confined to lowland reaches, where land development, water temperatures, and water quality are limiting, and mortality levels are generally high (NMFS 2016c).
- Hydropower-related limiting factors extend to the Columbia River estuary, where adverse effects on estuarine habitat quality and quantity are related to the cumulative effects of Columbia River basin dams. Effects include an altered seasonal flow regime and smaller Columbia River plume due to flow management (ODFW and NMFS 2011).
- Land use practices including agriculture, timber harvest, mining and grazing activities, diking, damming, development of transportation, and urbanization, which have reduced access to historically productive habitats and reduced the quality of remaining habitat by weakening important watershed processes and functions (ODFW and NMFS 2011).
- Predation by birds, native and non-native fish, and marine mammals, including increasing marine mammal predation at Willamette Falls (NMFS 2016c, Brown et al. 2017). Piscivorous birds, including Caspian terns (*Hydroprogne caspia*) and cormorants (*Phalacrocoracidae*), and fishes, including northern pikeminnow (*Ptychocheilus oregonensis*), take significant numbers of juvenile steelhead. Steelhead smolts are especially vulnerable to Caspian tern predation in the Columbia River (Evans et al. 2018). Pikeminnow are significant predators of yearling juvenile migrants in the Willamette and Columbia rivers (Friesen and Ward 1999). The magnitude of pinniped predation for UWR steelhead in the estuary is not known, though the presence of California sea lions (*Zalophus californianus*) and Steller sea lions (*Eumetopias jubatus*) at the Astoria Mooring Basin has been increasing over the past few years. Similarly, the number of sea lions observed at Willamette Falls has also been increasing.
- The presence of hatchery-reared fish and the offspring of hatchery-origin fish that may have spawned in the wild, and which may affect the growth and survival of juvenile late-winter steelhead. In the North and South Santiam rivers, juveniles are largely confined by dams to below much of their historical spawning and rearing habitat. Releases of large numbers of hatchery-origin summer steelhead may temporarily exceed rearing capacities and displace winter juvenile steelhead.
- Historical harvest, although significant reforms were implemented in the early 1990s. While harvest may have been a listing factor for winter steelhead, the reforms that have been implemented have reduced fishery harvest impacts such that it is no longer identified as a limiting factor. The current exploitation rates on natural-origin steelhead from sport fisheries are in the range of 0 to 3 percent, and steelhead are not intercepted in ocean fisheries to a measurable degree. There is some additional incidental mortality in

the commercial net fisheries for hatchery Chinook salmon and steelhead in the lower Columbia River (ODFW and NMFS 2011).

- Climate change effects, including increased stream temperatures, changes in precipitation/streamflow, and years of low ocean productivity (NMFS 2016c).

Unlisted Steelhead and Rainbow Trout

Radio-tagging studies suggested that a considerable proportion of winter-run steelhead ascending Willamette Falls do not enter the spawning areas that constitute the Upper Willamette steelhead DPS; these fish might be early winter-run steelhead that have colonized the western tributaries, misidentified summer-run steelhead, or late winter-run steelhead that have colonized tributaries but are not historically part of the DPS (Jepson et al. 2015; NWFSC 2015). One known unlisted, but self-sustaining, population of winter steelhead is present in the Middle Fork Willamette basin. This naturally reproducing population became established in the 1950s, following introductions of hatchery fish. These fish are found in the mainstem Middle Fork, Little Fall Creek, and Fall Creek. Winter steelhead returning to Fall Creek's Adult Fish Facility are transported to areas above the dam.

Hatchery summer steelhead are still produced and released in the North Santiam (Minto Hatchery located below Big Cliff Dam), the South Santiam (South Santiam Hatchery located below Foster Dam), the McKenzie (below Leaburg Dam to Hendricks), the Middle Fork Willamette, and the Upper Willamette mainstem, primarily for maintaining recreational fishing opportunities. Measures have been taken to reduce interbreeding between the unlisted hatchery summer steelhead and the ESA-listed UWR winter steelhead in these basins, but introgression still occurs between listed winter steelhead and hatchery summer steelhead as well as between listed and unlisted winter steelhead (Johnson et al. 2021).

The resident form of the species *Oncorhynchus mykiss* (referred to as rainbow or redband trout, depending on location) is sympatric (occupies the same areas) with anadromous *O. mykiss*, or steelhead, in some areas of the UWR steelhead DPS. However, the WLC-TRT (Willamette Lower Columbia -Technical Review Team) did not include the resident form in their delineation of populations within the UWR steelhead DPS, and the NMFS DPS policy and decision to list steelhead separately was recently upheld by the 9th Circuit. Resident *O. mykiss* have not been considered in the viability assessments or recovery strategies for steelhead. However, wild rainbow trout populations may play a part in the viability of some of the UWR steelhead populations, as rainbow trout can provide another conservation buffer for UWR steelhead, and actions that improve steelhead habitat will benefit rainbow trout. Although resident *O. mykiss* are not expressly addressed in the UWR Recovery Plan, ODFW and NMFS recognize the potential importance that these fish may play in the viability of UWR steelhead in some populations. A future rainbow trout conservation planning process, if funded, could build off of the strategies and actions identified in this plan that address tributary habitat issues for steelhead.

Kostow (2003) summarized the information available on the inter-relation or isolation between resident rainbow trout and steelhead throughout the Columbia River basin and found several examples of interactions between the two forms, though the levels to which resident and anadromous *O. mykiss* interactions occur in a particular population and how significant those

interactions are to the viability of that population have not been quantified. There are several documented examples of each form producing offspring that adopted the other form's adult life-history (Ruzycki et al. 2003, Blouin 2003, Ardren 2003, Berg 2001, Viola and Schuck 1995, McMichael et al. 1999, as cited in Kostow 2003). There are also occurrences of steelhead adults spawning with rainbow trout (Kostow 2003).

Both natural-origin and hatchery-stocked rainbow trout are present in the North and South Santiam basins. The reservoirs and some tributaries are stocked with hatchery rainbow trout on an annual basis primarily for recreational fishing purposes. The hatchery fish are thought to be less piscivorous than the naturally occurring rainbow trout (Ward et al. 2018), though predation on juvenile salmonids still occurs (Murphy et al. 2021). The native or naturally occurring rainbow trout in the Santiam basins primarily occur above the federal dams and represent the remnant population of *O. mykiss* that occurred there prior to the construction of the dams. Similarly, there is a hatchery rainbow trout program on the mainstem McKenzie and they are also released into most of the Middle Fork Willamette reservoirs for recreational fisheries. The McKenzie also has a strong wild population of native rainbow trout in the upper part of the watershed.

4.2.3. Coho Salmon - *Oncorhynchus kisutch*

Though coho salmon found to be present in the Willamette basin above Willamette Falls Dam are not ESA-listed fish, they are still a NMFS trust species because of their status as an anadromous species that is also commercially important (PFMC 2022). Also, coho salmon in the Clackamas basin are included in the ESA-listed Lower Columbia River (LCR) coho salmon ESU. On June 28, 2005, NMFS listed the LCR coho salmon ESU as a threatened species (70 FR 37160). The threatened status was reaffirmed on April 14, 2014. The most recent status review, in 2016, concluded that this ESU should retain its threatened status (81 FR 33468). Critical habitat was designated on January 24, 2016 (81 FR 9252).

Coho salmon have been observed passing the fish ladder at Willamette Falls dam since counting there began in the 1960's, but an increase has been observed (on-average) starting in the early 2000s, despite the fact that there are no releases of hatchery coho in the Willamette basin above the falls (Keefer et al. 2018). Recent annual total counts of adults (not jacks) at Willamette Falls number ~21,000 in 2021, 11,800 in 2020, 7,500 in 2019, 2,500 in 2018, 3,000 in 2017, and a very small proportion of them are clipped (known hatchery fish). Though coho salmon spawning and rearing in the Willamette basin above the Falls are not ESA-listed, they could potentially play an important role in the future recovery of ESA-listed coho salmon. On the North Santiam, coho salmon are found in the lower reach tributaries up to the Little North Fork Santiam, and at least 300 coho salmon were recorded at the Minto Fish Facility this year (2022). They are also commonly found in the west-side tributaries to the Willamette basin like the Tualatin, Yamhill, and Rickreall. These unlisted coho salmon are not thought to be competitive with the ESA-listed salmonids, or pose any threats to their recovery, in the Willamette basin.

Coho salmon are typically categorized as either early- or late-returning stocks. Early-returning adult coho salmon enter the Columbia River in mid-August and begin entering tributaries in early September, with peak spawning from mid-October to early November. Late-returning coho

salmon pass through the lower Columbia from late September through December and enter tributaries from October through January. Most spawning occurs from November to January (LCFRB 2010). Coho salmon generally spawn in intermediate positions in tributaries, typically further upstream than chum salmon or fall-run Chinook salmon, but often downstream of steelhead or spring-run Chinook (ODFW 2010). They particularly favor small, rain-driven, lower elevation streams characterized by relatively low flows during late summer and early fall, and increased river flows and decreased water temperatures in winter (LCFRB 2010). On their return, adult fish often mill near river mouths or in lower river pools until the first fall freshets occur (LCFRB 2010). Juveniles typically rear in freshwater for more than a year. After emergence, coho salmon fry move to shallow, low-velocity rearing areas, primarily along stream edges and inside channels. Juvenile coho salmon favor pool habitat and often congregate in quiet backwaters, side channels, and small creeks with riparian cover and woody debris. Side-channel rearing areas are particularly critical for overwinter survival, which is a key regulator of freshwater productivity (LCFRB 2010).

4.2.4. Southern Resident Killer Whales - *Orcinus orca*

(See information above in 3.2 "Habitat Types" for why SRKWs are being included in this assessment.) The Southern Resident killer whale DPS (SRKW DPS or Southern Residents) was listed as endangered on February 16, 2006 (70 FR 69903). A recovery plan was completed in 2008 (NMFS 2008b). In the most recent 5-year status review, NMFS (2016b) evaluated information on the status of the DPS including threats and research results and publications and concluded that SRKWs should remain listed as endangered.

4.2.5. Kokanee - *Oncorhynchus nerka* - Green Peter and Detroit Lake Reservoirs

Kokanee are a land-locked version of sockeye salmon that were introduced to the Willamette basin to create a new recreational fishing opportunity. Kokanee feed primarily offshore in the midwater column and lake bottom on zooplankton and small-bodied insects (though juveniles can be found schooling nearshore). They also exhibit diel migrations (going deeper at night). A healthy kokanee population can have a strong impact on *Daphnia* populations and alter zooplankton community structures (Buktenica and Larson 2009). Kokanee populations tend to be cyclic in nature. They can rapidly overpopulate, resulting in reduced growth and condition. They live up to 5 years and commonly reach sexual maturity at age 4, at which time they spawn and die (post-spawning). They typically spawn in the fall along the lake shorelines or by running upstream from their lake habitat (Brown 1971).

Kokanee are present in both Detroit and Green Peter reservoirs. They may also be found in the reservoirs below these two reservoirs (Big Cliff and Foster); however, they are not able to spawn in Big Cliff Reservoir because of a lack of habitat. These populations have been in a down-cycle for the last few years. The effects of the kokanee populations on juvenile salmonids migrating or rearing in the reservoirs is not known.

4.2.6. Non-Trust Species That Co-Occur with, and Can Impact, Trust Species

Healthy Pacific lamprey and brook lamprey (*Lampetra richardsoni*) populations can provide freshwater ecosystems with many benefits that are linked to salmonid population recovery.

Lamprey, like salmon, supply streams with marine-derived nutrients through decomposition of their carcasses upon completion of their life cycle. These nutrients are then assimilated by aquatic insects. Various fish, mammal, and bird species are known to prey upon both lamprey and salmonids of various life stages, which means that healthy lamprey abundances can also buffer salmonids from predation pressure (Clemens and Wang 2021). Similar to the UWR ESA-listed Chinook salmon and steelhead, Pacific lamprey are anadromous, and they share similarities in their habitat requirements, including free-flowing river systems without passage-blocking structures like dams. Brook lamprey are distributed throughout streams in the Willamette basin, and though they are not anadromous, they can also be blocked from passing into more productive habitats by dams.

Pacific lamprey can now pass the Bennett Dams in the North Santiam. They are also collected at the South Santiam Hatchery and are known to be present in the McKenzie, Middle Fork, and Coast Fork Willamette sub-basins. Pacific lamprey have been tracked by ODFW in the mainstem McKenzie River all the way above the South Fork McKenzie confluence. Excellent lamprey habitat is currently present in the first 5 miles of the South Fork above Cougar Dam, but lamprey cannot access it. Similarly, excellent lamprey habitat can be found in a significant portion of the North Fork Middle Fork Willamette, Salt Creek, Salmon Creek (all tributaries to the Middle Fork Willamette above Lookout Point Dam), and in the mainstem Middle Fork all the way from the Hills Creek Dam to Echo Creek. However, lamprey are also currently blocked from passing Dexter Dam and are unable to access any of this habitat. Interestingly, one of the largest spawning populations of Pacific lamprey in the Upper Willamette basin is present in Mosby Creek, a tributary to the Row River below Dorena Dam.

Other than northern pikeminnow, all of the abundant piscivorous warmwater fish species found throughout the lower reaches of the Willamette basin (and the reservoirs) are introduced (see Species List, Table 3-1). All of these species are known to prey on small fish, but studies have shown that certain species seem to target juvenile salmonids more than others (i.e. smallmouth bass, largemouth bass, crappie, northern pikeminnow, and walleye) (Friesen and Ward 1999; Winther et al. 2019; Murphy et al. 2021). Hatchery rainbow trout and hatchery summer steelhead found in the Upper Willamette Basin are not considered to be trust species, though they do have impacts on NMFS trust species in the basin. For more details on those effects see Section 4.2.2 and also sections in Chapter 5.

4.2.7. Green Sturgeon Southern DPS and Eulachon

Two species unlikely to be affected by the preferred alternative include ESA-listed southern DPS green sturgeon and eulachon (*Thaleichthys pacificus*). Green sturgeon are not commonly found in the Lower Columbia River more than a few miles above the river mouth, and their designated critical habitat in the Lower Columbia River does not even extend up to the Willamette River confluence. Eulachon are not known to enter the Willamette River but do spawn in some parts of the Columbia River and in certain tributaries (not including the Willamette River). The Preferred Alternative would marginally affect flows in the Lower Columbia River but not at a magnitude significant enough to affect either of these species.

5. IMPACTS ON RESOURCES – EFFECTS OF THE PREFERRED ALTERNATIVE

5.1. NO ACTION ALTERNATIVE

This section focuses on areas where the Study Area and NMFS trust resources overlap, including the mainstem of the Willamette River (primarily to Willamette Falls but insignificant effects do extend to the mouth of the Columbia River), and the following four Willamette River sub-basins: the North Santiam River, the South Santiam River, the McKenzie River, the Middle Fork Willamette (minor mention of anything happening in the Coast Fork or below Fern Ridge).

5.1.1. Current Conditions in Mainstem Willamette and Study Area

The mainstem Willamette River supports juvenile life stages of winter steelhead and spring Chinook salmon (and some coho salmon). Because of their diverse life history strategies, juvenile Chinook salmon can be found in the Willamette River almost any day of the year (Schroeder et al. 2016). Habitat degradation in these areas affects rearing potential and migration characteristics for Chinook salmon fry, and Chinook salmon and steelhead parr and smolts.

Streamflow & Water Quality

Flows in the Willamette Basin have been greatly altered by the construction and operation of dams. With the exception of a few run-of-river projects, dams are typically "high-head" projects that are intended to capture and hold flow to release at desired times, as opposed to discharging outflow at the same rate inflows are received (NMFS 2008). Since the completion of WVS flood control dams, the range of peak flows in the mainstem Willamette River have been greatly reduced relative to pre-dam conditions (Figure 5-1).

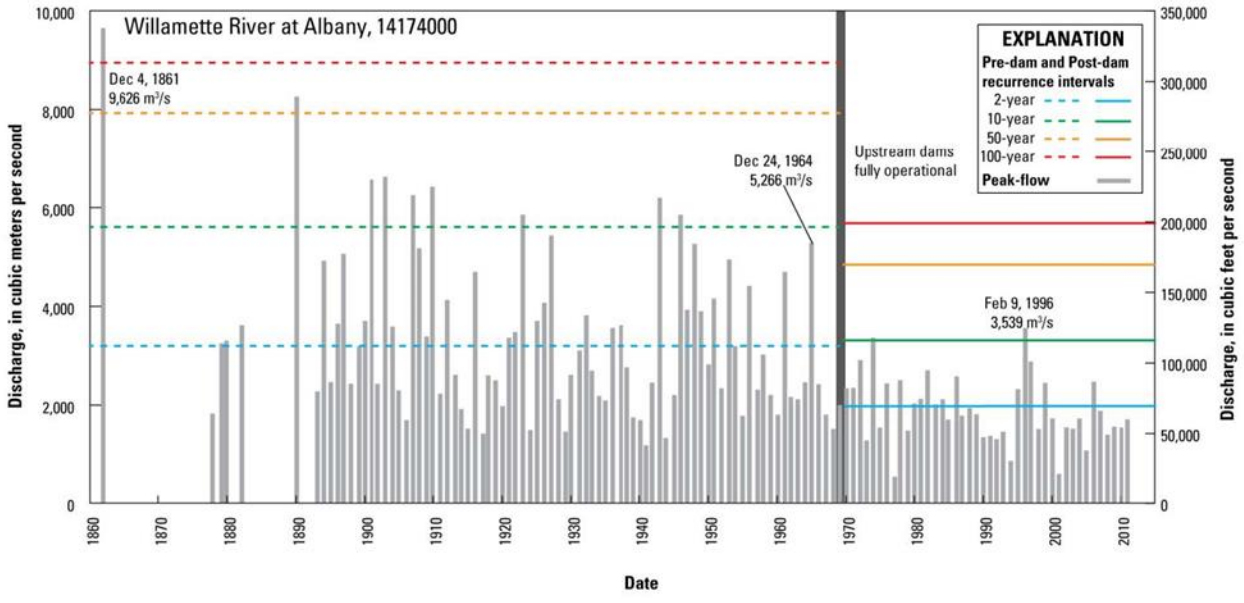


Figure 5-1. Peak annual discharge flow on the Willamette River mainstem measured by the U.S. Geological Survey (USGS) streamflow-gaging station at Albany, Oregon. Figure 18 from Wallick et al. 2013.

Minimum flow targets (from the 2008 NMFS Biological Opinion) have not been met in all years, both in the mainstem and in tributary reaches below dams. The inability to meet these targets is often attributed to reservoir refill requirements, but other operational requirements can also be a factor. Striking a balance among meeting flow targets, reservoir refill targets, fish passage operational needs, and water quality targets (including temperatures) can be challenging and is not always feasible. From 2009 to 2018, 5 years, or 50 percent, were classified as being "adequate" or abundant water storage years, during which minimum flow targets could be met. However, in 3 of these 5 "adequate" years, there were many days in May and June when the minimum flows (at Salem) were not met. Given the record of Salem flow targets being missed in May and June, even in adequate years, since 2008, it is likely that minimum flows in the Willamette River will continue to be below minimum flow targets more often than expected at the time of the 2008 Biological Opinion.

In addition to 2008 Biological Opinion minimum flow targets, flow management requirements have also been put forth in a separate Section 7 NMFS Consultation and Biological Opinion for the Willamette Basin Review (WBR) (NMFS 2019b). This Biological Opinion resulted in a Reasonable and Prudent Alternative (RPA) with stipulations for future storage supply agreements with municipal and industrial (M&I) users in the WVS. The Biological Opinion's RPA requirements included: 1) the need to specify restrictions in the agreements, some of which are equivalent to those currently applied to new and renewed water use contracts issued by the Bureau of Reclamation (BOR); 2) communicating with new water contract applicants to make certain they are aware that requested water releases may be curtailed or completely cut off if the existing NMFS minimum flow objectives are not met at any point in the coming year; 3) written agreement from NMFS that studies determining the flow needs of ESA-listed species are complete and that additional water is available during most years for M&I use without adversely affecting UWR Chinook salmon or steelhead or their designated critical habitats; 4) determining whether 2008 Biological Opinion minimum flow objectives will be met in the coming year given the reservoir fill and amount of 'joint use' water available, when forecasting the available water in April of each year; 5) managing uncontracted water to meet 2008 Biological Opinion minimum flow objectives (or as revised by future consultations), if NMFS (2008a) minimum flow objectives are predicted to not be met in the April forecast, OR if this is insufficient, the Corps must make more stored water available to meet 2008 BiOp minimum flow objectives by reducing stored water available for AI and M&I contracts or using water currently stored for power production; and 6) coordinating these decisions with the Flow Management Water Quality Team (FMWQT).

The Willamette Project's reservoirs are drafted each fall for flood control and refilled each spring for other uses. Seasonal storage and release of water has affected the streamflow characteristics of each affected tributary and the mainstem Willamette River. The Project can also cause unusually large discharge changes over very short periods. These hydrologic effects seasonally modify fish habitat characteristics in the stream reaches downstream. The life histories of native species are closely correlated with the pre-dam hydrograph (Poff et al. 1997). Current operations alter the timing and magnitude of spring freshets, and thereby, contribute to habitat quality and access impairment for salmonids in the Willamette River. Natural spring freshets are also critically important because higher spring flows are correlated with faster downstream travel times and earlier arrival times to critical rearing habitats in the estuary and ocean (Scheuerell et

al. 2009). Scheuerell et al. (2009) found that this migration timing plays an important role in determining juvenile-to-adult survival for Columbia River Chinook salmon and steelhead, with early migrators typically experiencing much higher survival.

Toxic contaminants from urban and industrial practices reduce habitat quality for steelhead and spring Chinook salmon parr and smolts. Toxic contaminants are an issue in the lower Willamette River and other sites of intense urban or industrial development. An intensive study of sediments in Portland Harbor (the stretch of the Willamette River from Sauvie Island to the Fremont Bridge) reported findings of pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbon (PAHs), and other chemicals at levels that exceed state and federal sediment quality screening levels and are harmful to the ecosystem. Wastewater runoff and discharge from agricultural and urban land uses also degrades habitat quality in the Willamette basin, particularly in downstream reaches. The mid-Willamette River is currently listed on the Oregon Department of Environmental Quality (DEQ) Clean Water Act 303(d) list of water quality limited water bodies. DEQ-listed water quality problems identified in the action area include bacteria (fecal coliform), lead, mercury, dissolved oxygen, and temperature. Wastewater treatment effluents and runoff from agricultural lands contribute to nutrient loads (ODA 2016) that promote harmful bacteria or algal blooms. Municipal and industrial wastewater discharges and runoff from urban or suburban areas can be sources of metals, pesticides, and other toxics, with toxic equivalents increasing with increasing urbanization (i.e., population density, road density) (Waite et al. 2008). Research into the discharge of total nitrogen, total phosphorous, and suspended sediment loads by USGS from 1993–2003 showed large inputs from the point sources of municipal wastewater treatment plants and industrial outfalls. Nonpoint sources also contributed to a steady increase down the mainstem, with the largest increase between Salem and Portland (Wise et al. 2007).

Water development influences water temperatures through storage, diversion, and irrigation return flows. These changes in water temperatures have significant implications for anadromous fish survival. Among the primary water temperature effects of WVS operations are resulting changes to the seasonal timing of downstream water temperatures in tributaries. These changes are due to stratification of water temperatures in the reservoir during the summer months and existing elevations in stratified reservoirs that outlets can draw from. During typical WVS operations, water released in the late-spring and early summer is cooler than what it would be in a natural riverine system and then warmer in the fall once warm water near the reservoir surface can be discharged. Cooler water temperatures in late-spring and early summer can delay upstream migration of UWR Chinook salmon. Eggs from spring-spawning UWR steelhead also develop more slowly at reduced temperatures (though colder temperatures are not as detrimental as temperatures that are too warm) (Turner et al. 2007). For fall spawning species like UWR Chinook salmon, warmer fall temperatures can delay spawning and accelerate incubation. Warmer fall temperatures can exceed the thermal tolerance for incubating eggs, thereby reducing their viability, and also increase thermal stress on adults holding below dams. For both species, these temperature effects modify emergence timing to times and conditions for which they are not evolved. The availability of food, water velocities, and predator abundance and feeding efficiency vary seasonally. Therefore, altered emergence timing reduces the potential value of rearing habitat downstream of dams when emerged alevins are present.

Of particular concern in the mainstem Willamette River is how water temperature can affect the prevalence of parasites. At water temperatures above 15ºC, a parasitic myxosporean, *Ceratomyxa shasta,* becomes highly virulent, and research has shown that the risk of juvenile salmonids succumbing to *C. shasta* infection can double as temperatures rise from 13 to 15ºC, and then multiply again by a factor of ~5 between 15 and 18ºC (Ray et al. 2012).
These effects of dams on seasonal temperature conditions in the Willamette Basin are variable among sub-basins and have been partially addressed in some areas. Temperature operations, during which warm surface water is mixed with cooler lower dam outlet water to achieve closer to normative downstream temperatures, have been implemented at Detroit Dam in the North Santiam River and at Fall Creek Dam in the Middle Fork Willamette River. Such operations are able to partially compensate for the effects of the dams by providing warmer water temperatures in the spring and early summer months and preserving cooler reservoir water for release in the summer. However, the ability to provide these temperature benefits is limited by the reservoir elevation and existing infrastructure because once water elevations fall below surface outlets (typically in August or September) such operations are no longer possible. This is the reason why annual maximum temperatures in below dam reaches often occur in September and October (later than pre-dam maximums) (Rounds 2010).

Spill operations (and regulating outlet flow operations) at WVS dams can cause downstream waters to become supersaturated with dissolved atmospheric gasses. Supersaturated total dissolved gas (TDG) conditions can cause gas bubble trauma (GBT) in adult and juvenile salmonids resulting in injury or death (Weitkamp and Katz 1980). Biological monitoring at dams on the Columbia and Snake rivers shows that the incidence of GBT in both migrating smolts and adults remains between 1–2 percent when TDG concentrations in the upper water column do not exceed 120 percent of saturation (NMFS 2020). When those levels are exceeded, there is a corresponding increase in the incidence of signs of GBT symptoms (NMFS 2020). At times, TDG in WVS dam discharges does exceed 110 percent of saturation concentration but rarely exceeds 120 percent. For example, in 2023, 110 percent saturation levels were exceeded below dams in the south Santiam, South Fork McKenzie, and 115 percent saturation levels were exceeded below Dexter in the Middle Fork Willamette (USACE 2024). TDG measurements below Big Cliff Dam, however, exceeded 120 percent in 3 different months in 2023 (USACE 2024). Both juvenile and adult Chinook salmon and steelhead are subject to the effects of gas supersaturation. For juveniles, water conditions downstream of dams become supersaturated by water flowing over the spillway or water released under pressure from regulating outlets. Juveniles that pass through the dam outlets will be subject to any gas supersaturation downstream that is created by dam operations. In addition, eggs, alevins, and juveniles that were incubating or rearing downstream of dams may also be subject to gas supersaturation. The downstream extent of any supersaturation created by dam operations depends on the topography of the river (rapids tend to release gas). Similarly, adults moving upstream congregate near the base of some dams prior to adult collection (as at Foster, Cougar, Fall Creek, or Dexter Dam) or spawning. The duration of exposure can vary considerably, but in most cases, adults are not present during periods of high TDG.

Habitat Degradation

In general, the factors that pose the greatest threats to Willamette Basin salmon and steelhead (and many other native species) come from a loss of access to, or quality of, habitat and

important ecological and physical processes. These habitats and processes continue to be negatively impacted by water diversion projects for irrigation, power generation, and water supply, particularly throughout the Willamette Valley (Jaeger et al. 2017). The Big Cliff and Detroit dams block access to 43 percent and 48 percent of historically available habitat for Chinook salmon and steelhead, respectively, in the North Santiam sub-basin; Foster and Green Peter dams block access to 40 percent of historically available habitat in the South Santiam for Chinook salmon and 17 percent or more for steelhead; Cougar Dam blocks access to 9 percent of historically available habitat for Chinook salmon in the South Fork McKenzie; and the four federal dams in the Middle Fork block access to over 70 percent of the Chinook salmon's historical habitat in the whole sub-basin (ODFW and NMFS 2011). More importantly, the estimated amount of spawning habitat (or historic production) above these dam projects that Chinook salmon and steelhead have lost access to is significantly higher (71 percent, 85 percent, 25 percent, and 95 percent loss for Chinook salmon in each of the four sub-basins) (ODFW and NMFS 2011).

Historically, the Willamette River and its tributaries consisted of an intact and productive mainstem and was dominated by ecological features such as gravel bars, islands, runs, pools with backwaters, side channels, and sloughs. These combined features increased overall habitat complexity and ecosystem function (Gregory et al. 2002). Prior to the construction of the 13 hydropower projects and 42 miles of revetments (USFWS 2008), the Willamette River and its tributaries flowed without constraint. Dam construction and related infrastructure, and continuing WVS project operations and maintenance, have degraded river habitats and diminished aquatic (e.g., migratory fishes) species populations. Climate change will increasingly impact aquatic resources; warmer temperatures will reduce winter snowpack and will further impact overall water availability and water quality for aquatic species (OSU 2022).

Historically, the alluvial lowlands of the Willamette Valley were a highly complex, dynamic mosaic of braided riverine channels, with extensive off-channel and wetland habitats surrounded by riparian forests, up to 3 kilometers wide (Sedell and Froggatt, 1984). Geomorphic processes, such as erosion, avulsion, and deposition during flood events created new off-channel habitats as the river network meandered through the floodplain, contributing substantial inputs of large wood and coarse sediment. Wetland habitat was created through vegetative succession of alluvial remnants and maintained by frequent disturbance processes. Willamette Valley off-channel and wetland habitats support diverse communities of plant and animal species that are obligate to these habitats or depend on them for a portion of their life history. Extensive human activities in the Willamette River Basin have substantially reduced off-channel and wetland habitats. Starting in the 1830s, wetlands were ditched, tiled, filled, and drained for agriculture. Miles of revetments were constructed to further increase the agricultural and urban use of former floodplain habitats, along with logging of the floodplain forests. Reduction of maximum flow levels, along with diking and levee/revetment construction, has all but eliminated overbank flows in the Willamette River. The loss of overbank flows has restricted access to off-channel areas that historically contained seasonal wetlands and forested backwaters, reduced large woody debris recruitment, and contributed to a change in food web structure and function.

Current reservoir and flow management operations will continue to disrupt ecological processes and further impact aquatic species populations. More specifically, the channelization of riverine

habitats, network of revetments and infrastructure, reduced sediment transport, reduced magnitude of floods, and lack of large wood input will inhibit the fluvial geomorphic processes that foster a healthy functional river system and create new off-channel habitat. As natural riverine processes continue to be altered, there will be a continual loss of habitat diversity over time that will impact native aquatic species populations.

Based on research by Gregory and Wildman (2007), floodplain alcoves in the mainstem Willamette River can provide fish with critical "coldwater refuges", or waters that are defined as being 2°C colder (or more) than the mainstem. As of 2015, Gregory and Hulse (2016) found that 39 percent of Willamette River mainstem floodplain alcoves met this criteria, but none of the side channels measured met this criteria. Some of these alcoves were low in dissolved oxygen (DO), though 80 percent contained adequate DO. They also found that one-third of the sloughs in Willamette River mainstem met both cold-water refuge and DO criteria for native fishes. This also meant that twice as many sloughs in the Willamette River did not meet this criteria and provided more favorable habitat for introduced non-native species (in warm water sloughs fish communities were 85 percent non-native). Salmonids were ten times more abundant in cold water sloughs versus warm, highlighting their critical importance in salmon habitat conservation and restoration (Gregory and Hulse 2016).

Healthy riparian vegetation increases habitat complexity, protects banks from erosion, provides nutrients, and filters runoff. Large wood enables the establishment of riparian forests by stabilizing bars and islands and redirects flow toward the floodplain to create variable hydraulic and substrate environments (Wallick et al. 2013). Woody debris creates important habitat for beavers, amphibians, fish, and aquatic invertebrates (Pollock et al. 2017). Shading and cover from riparian vegetation maintains favorable water temperature for fish, and beaver dams can buffer base flows by creating groundwater storage (Beechie et al. 2013). Under natural conditions on unregulated rivers, upland species are prevented from encroaching on the riparian corridor because of periodic flooding and the high water table.

Under current conditions, riparian forests will continue to succeed to upland forests because of the altered hydrograph that prevents the ecological processes that form and maintain riparian communities (Dykaar and Wigington, 2000; Fierke and Kauffman 2005). Habitat connectivity may also be reduced with the degradation of riparian habitat or the continued installation (and repair) of levees and revetments that disconnect lowland and riparian habitats. Revetments currently line a large portion of streambank in the following river sections found in the Study Area: North Fork Santiam River from Stayton to the Willamette confluence, South Fork Santiam from Lebanon to the Willamette confluence, the McKenzie River from above the Mowhawk River confluence to its confluence with the Willamette mainstem, the Middle Fork Willamette just above the Fall Creek confluence and near its confluence with the Willamette, and major portions of the mainstem Willamette River. The mainstem channel has been constrained by revetments in 96 out of 187 river miles (Hulse et al. 2002).

Peak flow events occurring at different times can alter reproduction timing of riparian plant species. The life histories of native species are closely correlated with the pre-dam hydrograph (Poff, et al. 1997). Peak flow events occurring at different times can also inhibit regeneration of native vegetation and benefit invasive species (i.e., reed canary grass inhibiting cottonwood

understory re-initiation (Fierke and Kauffman 2005). Suppressing regeneration of riparian forests can lead to a widespread loss in structural complexity of riparian forests, as well as to a loss of native species diversity from the invasion and establishment of non-native plant species (Theobold et al. 2010).

Hatchery Management

Several hatcheries were built in the upper Willamette Basin for spring Chinook salmon production to mitigate blocked access to spawning habitat, losses in natural fish production, and help sustain local fisheries. These hatcheries are owned by USACE and operated by ODFW. Recent monitoring for compliance with Hatchery and Genetic Management Plans (HGMPs) and ESU population status were reported in Sharpe et al. (2017, 2018), where specific metrics were monitored, and management goals were set to minimize potential negative genetic effects of hatchery origin fish (HOR) on populations of natural-origin (NOR) spring UWR Chinook salmon and steelhead. The Willamette Hatchery Program includes the production of Chinook salmon in addition to summer steelhead and rainbow trout. The current operations were assessed by NMFS in 2019 through a Biological Opinion (NMFS 2019c). All of the hatcheries and release locations occur on tributaries to the Willamette River mainstem and are discussed in further detail in each of the corresponding "No Action Alternative" sub-sections under the "Population Traits" sections.

Disease and Parasites

When juvenile Chinook salmon rear in reservoirs, it increases their likelihood of becoming infected with an ectoparisitic copepod (*Salmincola californensis*). Monzyk et. al. (2015) sampled many different species of salmonids present in Detroit, Cougar, Fall Creek, and Lookout Point reservoirs in 2012 and 2013. They found that Chinook salmon juveniles had increasing infection prevalence over the year, with 84 percent of age-0 Chinook salmon juveniles infected by the fall season (compared with 11 percent infection for Chinook salmon that stayed in streams above the reservoir), and 94 percent of age-1 Chinook salmon infected by the fall.

Recent studies have documented high levels of pre-spawning mortality (PSM) among returning spring-run Chinook salmon adults in a number of UWR sub-basins. Schreck et al. (2013) discuss a number of potential causal (primarily pathogenic) factors that may be responsible for pre-spawning mortality. Bowerman et al. (2018) analyzed pre-spawning mortality in the UWR Basin and found that it positively correlated with water temperature and the proportion of spawning fish that were of hatchery origin (pHOS).

Predation & Competition

Alterations to instream water temperature regimes, combined with sediment and large wood starvation, continue to negatively impact instream conditions (e.g., habitat suitability and availability), providing more opportunities for non-native species to become dominant.

Predatory warmwater fish species that prey upon juvenile salmonids are numerous in the lower ends of Willamette River tributaries or confluences, especially as temperatures increase seasonally and generally over time. Though not in the primary Study Area, there were several

studies conducted in the Lower Willamette River, by Friesen (2005) that found smallmouth bass, given their relative abundance, diet, and ubiquity, posed the most significant potential threat to juvenile salmonids in terms of predation in the lower Willamette. Walleye appeared to be too rare in the lower Willamette River to have an effect on salmonid survival, and neither northern pikeminnow nor largemouth bass appeared to prey on salmonids. Since that time, the abundance of some of these species have increased significantly in the Columbia and Snake Rivers, which are connected to the lower Willamette River (Winther et al. 2019). In the nearby Lower Columbia River, the native northern pikeminnow has long been identified as the most significant predator of juvenile salmonids followed by non-native smallmouth bass and walleye (in Friesen and Ward 1999; ISAB 2011, 2015). However, Winther et al. (2019) reported smallmouth bass as having the greatest overall predatory impact of all piscivorous species monitored by the state agencies in the Columbia and Snake rivers. USGS models of smallmouth bass and juvenile salmon habitat overlap predicted that 60 percent of Chinook salmon fry habitat overlaps with smallmouth bass habitat in the Willamette River mainstem (White et al. 2022). In their study of warmwater predators in the Middle Fork Willamette reservoirs, Murphy et al. (2021), found that bass and crappie, preyed more heavily on Chinook salmon fry in the spring than native fish predators (including northern pikeminnow), and of the native species in the reservoirs, only rainbow trout showed evidence for predation on Chinook salmon.

Friesen (2005) found that, in terms of competition for food resources in the Lower Willamette River, introduced resident fishes do not appear to adversely affect juvenile salmonids. The current high abundance of prey items, especially daphnia, was predicted to preclude competition even if the diets of the various species did overlap. However, in a resource-limited environment, smallmouth bass and hatchery salmonids seemed most likely to compete with naturally produced salmonids. Diets of unmarked and hatchery Chinook salmon did overlap significantly, though unmarked fish exhibited a more selective feeding behavior and consumed larger amounts of prey.

Harvest (in and outside of Willamette)

Chinook salmon are subject to ocean, estuary, and freshwater harvest. Changes in non-terminal ocean fisheries can influence age structure, and certain fisheries (i.e. gill nets) can also result in size/age selective harvest. The Northwest Fisheries Science Center estimates the overall ocean (fisheries) exploitation rate for Chinook salmon to be 10.2 percent of all returning adults (based on the mean harvest rates between 2001 to 2018) (NWFSC 2022). Because of their ESA-listed status, natural origin Willamette River spring Chinook salmon are not directly harvested in the freshwater commercial or recreational fisheries but are subject to a net entanglement or hook mortality when they are encountered. ODFW (2020) estimates an incidental mortality rate of 10.0 percent for all unmarked Chinook salmon that are caught in recreational salmon fisheries on the Columbia River and 12.2 percent for those caught in the Willamette River recreational salmon fisheries. In addition, the incidental mortality rate for unmarked spring-run Chinook salmon caught and released from the Columbia River tangle net fishery is estimated at 14.7 percent of all fish encountered and at 40.0 percent for the large-mesh gill net fishery (ODFW 2013).

Although there is no longer a directed fishery for natural-origin spring-run Chinook salmon, selective marking has allowed for a relatively higher harvest rate on hatchery-origin fish, and therefore, a higher encounter rate for natural-origin fish.

There is no directed fishery for winter steelhead in the ocean or lower Columbia River, but there is incidental mortality for steelhead captured in the commercial net fisheries for hatchery Chinook salmon and steelhead in the lower Columbia River. Tribal fisheries occur above Bonneville Dam and do not impact UWR steelhead (NWFSC 2015). Recreational fishing for hatchery (summer) steelhead is open year-round in the North and South Fork Santiam rivers and is also open for "wild" steelhead in July and August in these sub-basins. The "wild" steelhead present in July and August are likely offspring of hatchery summer steelhead, and the timing of this opening would not affect ESA-listed winter steelhead. However, ESA-listed winter steelhead could be caught incidentally by anglers targeting hatchery steelhead in the Santiam Rivers, and this likely causes some level of incidental mortality for ESA-listed fish.

Basinwide Monitoring

Funding for spawning ground surveys above and below federal high-head dams in the four "UWR BiOp populations" has been reduced in recent years. Therefore, since 2018, ODFW has focused its remaining resources on a limited set of spawning ground surveys. As a result, data reported here for the years 2018–2021 have limited comparative value to metrics reported in Sharpe et al. (2017, 2018).

PIT tag readers at WVS projects (and below) are not nearly as common as they are in the federal Columbia River Power System (FCRPS), partially because the FCRPS has fish passage routes that can be easier to access for PIT array installation (adult fish ladders and juvenile bypass systems) and routes designed specifically for volitional fish passage. A PIT tag reader has been installed below the RO outlet at Cougar Dam, though it does not upload to the PTAGIS database automatically. No PIT detectors are currently installed at project dams in RO outlets or spillways where more juveniles are likely to pass under the new Preferred Alternative measures or Injunction measures. The lack of PIT tag arrays has limited the collection of fish passage data through the entire system. Most of the fish passage studies that have been conducted (active tag) have focused on survival through a specific dam at a specific time or operation. The use of rotary screw traps below dam projects has been ongoing for many years, but conditions at many of the locations create fairly low trap collection efficiencies and low sample sizes.

Information about more recent (project and operation-specific) monitoring studies can be found in the sub-basin sections below, the WVS Biological Opinion (NMFS 2024b), and Hanson et al. (2017).

Non-Trust Species that Affect Trust Species

See notes about lamprey in Species Section 4.1.7 above.

5.1.2. North Santiam River Sub-Basin - Detroit and Big Cliff Dams

Streamflow & Water Quality

In the North Santiam River, Big Cliff Dam serves as a re-regulating facility for Detroit Dam, which serves as both a flood control and hydropower facility. High TDG levels are more common at Detroit Dam, but high TDG levels are at times seen all the way through Big Cliff reservoir to Big Cliff Dam. The need to mitigate for both TDG and temperature issues complicates Detroit Dam operations. For example, in the fall, as reservoir elevation is dropping, flow is released through the upper regulating outlets (ROs) to lower stream temperatures, which pull from deeper, cooler parts of the reservoir than the turbine intakes, and then, eventually, the lower ROs are opened, but this results in higher TDG than the use of the turbines. If TDG reaches 120 percent, flow will also be released through the turbines to reduce TDG, but this results in a temperature increase, which is less ideal for incubating Chinook salmon eggs.

Substantial water appropriations and withdrawals from the North Santiam River occur at and below the community of Stayton. During low-flow months (July through October), domestic water use, combined with irrigation withdrawals in the lower elevations of the watershed, may significantly reduce stream flows. In 1990, approximately 55 percent of the population of Marion County received its water supply from the North Santiam River. The communities of Idanha, Gates, Mill City, Stayton, Salem, Turner, and Jefferson all divert their supplies from the lower or middle reach of the river (or in the case of Jefferson, just below the confluence of the North and South Santiam Rivers) (Snyder et al. 2002). Above Stayton, appropriated water in the North Santiam River watershed represents only a small fraction of average flows; therefore, surface water withdrawals are generally believed to have little or no effect on current in-stream habitats in the middle reach (Snyder et al. 2002).

Summer and fall water temperatures have also generally increased as a result of land use practices, primarily from a reduction in riparian forest cover in the tributaries and the mainstem. These increased water temperatures can decrease survival and/or growth of juvenile Chinook salmon and steelhead.

Toxins from agricultural pesticide sources, as well as urban and industrial sources, are a key threat to juvenile Chinook salmon and steelhead.

For more detailed information, see “Stream Flow & Water Quality” under Section 5.1.1, “Current Conditions in Mainstem Willamette and Study Area”.

Adult Passage

Water temperatures in the river below Big Cliff dam have been cooler in the summer compared to pre-project levels (NMFS 2008a, section 4.6.3.3.1), potentially delaying the upstream movement of Chinook salmon adults to the extent that they are not able to cope with other significant sources of stress.

Upper Bennett Dam (RM 31.5) no longer impairs adult salmonid access to habitat upstream of the dams, although passage conditions at Lower Bennet Dam (RM 29) still cause adult passage

delays. Detroit and Big Cliff dams are complete barriers to upstream adult migration. These dams block access to an estimated 71 percent of the historical production area for Chinook salmon and 55–65 percent of historical spawning habitat for winter steelhead. The Minto Adult Fish Facility, located 4 miles downstream of Big Cliff Dam, is also a barrier to adult upstream passage, but this is done deliberately. Non-volitional access to areas upstream of Detroit Dam is partially achieved when (hatchery-origin) fish are trapped at the Minto facility and hauled to areas above Detroit Dam. Fish are at times passed upstream of the Minto facility barrier to spawning habitats between the Minto barrier and Big Cliff dam. If TDG is too high in the Minto to Big Cliff reach, adults collected at the Minto facility are transported to the Mehama area on the mainstem.

A study conducted by O'Malley et al. (2022) with the Oregon State University's State Fisheries Genomics Lab evaluated the success of spring Chinook salmon adult outplants and their contribution to subsequent natural-origin adult salmon recruitment from 2016 to 2020. They found that returning natural-origin adult spring Chinook salmon increased from 2016 to 2019, and most of them assigned genetically (using parentage analysis) to salmon released above Detroit Dam (vs. below Big Cliff Dam). Additionally, mean total life fitness for natural-origin (NOR) salmon was greater than that for hatchery-origin (HOR) salmon, and a more even sex ratio in the outplanted fish (closer to 1:1 male to female ratio, rather than more males) was highly predictive of total life fitness. Of the NOR salmon outplanted below Big Cliff Dam from 2013–2015, the 2015 group of parents was the most successful. This was also the year that the least number of adults were outplanted below Big Cliff, suggesting that the outplanting success is limited by spawning habitat availability. This suggests that outplanting NOR Chinook salmon above Detroit Dam at even sex ratios could be the most successful recovery strategy in terms of increasing the number of returning natural-origin adults (if safe and effective downstream passage is also implemented).

Given the low numbers of returning winter steelhead, and the fact that it is now a 100 percent natural-origin population, winter steelhead adults are not currently passed above Detroit Dam (from the Minto Fish Facility) because of the current status of downstream passage conditions at Detroit, which is very poor. They are only passed to the section above the Minto Fish Facility.

Juvenile Passage

The lack of downstream juvenile passage provisions at the North Santiam dams results in migration delays and direct mortality of juvenile Chinook salmon. Lack of defined and prolonged flows can not only obscure principal passage routes through reservoirs but also influence migration behavior of fish below these projects. Any juveniles produced above these facilities must first find attraction flows at the face of the dams, then pass through available routes (Beeman et al. 2014). More specifically, Detroit Dam has no downstream fish passage facilities and has two sets of ROs (upper at 1,340 feet and lower at 1,265 feet) that can be operated at reservoir levels less than 1,450 feet. The ROs are currently used for temperature management purposes in low water years. Since the turbine intake is located above both sets of ROs (at 1,395 feet) water drawn through the ROs can be cooler than water passed through the turbines. Juvenile spring Chinook salmon that are progeny of the adults outplanted above Detroit can move through Detroit via the spillways when reservoir elevations are 1,541 feet or higher,

through the turbines, or during water temperature control operations in the fall (cooling) when the ROs are opened. However, the turbines at Detroit Dam are often used in combination with the spillway or the ROs (for power production or to reduce / disperse high total dissolved gas (TDG), and none are designed for optimal juvenile fish passage conditions. Big Cliff Dam lacks downstream fish passage facilities, and juveniles must pass through one Kaplan turbine or one of three spillway gates, if they are open. No RO structures exist at Big Cliff Dam.

Beeman and Adams (2015) deployed acoustic telemetry monitoring sites from Detroit Dam to Portland, Oregon, in 2014 and monitored downstream movements of tagged fish. Migration rates and survival of juvenile Chinook salmon and steelhead that passed Detroit Dam were measured and analyzed. Juvenile salmonid migration rates in the reach between Detroit Dam and Big Cliff Dam were notably slower than those observed in other reaches in the Study Area. Survival estimates through this reach (2.8 river miles) were 72 percent for spring-released Chinook salmon, 78 percent for spring-released steelhead, and 62 percent for fall-released Chinook salmon. See Hansen et al. (2017) for a more detailed summary of fish passage and survival studies conducted at the North Santiam basin projects.

Habitat

High erosion and destabilized stream banks in tributaries to the North Santiam from past and current land uses have released excess sediment, causing turbid water and silt deposits that settle in spawning beds and could harm winter steelhead eggs and alevins (ODFW & NMFS 2011). Road crossings and other land-use related passage impediments restrict steelhead access to spawning and rearing habitat in smaller tributaries. Partial barriers include unscreened diversions, Santiam Water Control District power and irrigation canals, road culverts, the Salem ditch, and Sidney Ditch (WRI 2004). Habitat conditions may further exclude winter steelhead from some lower tributaries (McElhany et al. 2004).

The presence of the mainstem dams has eliminated natural sediment delivery from areas above Detroit Dam and made the lower mainstem entirely reliant on a narrow alluvial canyon immediately below Big Cliff Dam, the Little North Santiam River, multiple small tributaries, and mainstem banks as sources of coarse sediment. The consequences of this, despite flow-related reductions in the lower river's transport capacity, have been a loss of finer textured gravel bars below Big Cliff Dam and scouring of some areas near the dam down to bedrock with scattered boulders. This type of channel coarsening reduces the diversity of riverbed substrates and the availability of spawning habitat for anadromous salmonids (NMFS 2008a).

Impaired physical habitat in the North Santiam drainage has significantly degraded rearing potential for Chinook salmon and steelhead during the winter parr life stage. The lower portion of the sub-basin contains only 25 percent of the original extent of floodplain forest, and there has been significant loss of wetland, floodplain, and off-channel habitats and associated habitat complexity.

The Little North Fork Santiam is a winter steelhead stronghold for both juveniles and adults. Adults are also known to spawn successfully in tributaries to the lower North Santiam like Rock

Creek, in areas within the mainstem. Chinook salmon prefer to spawn in mainstem areas below the Minto Fish Facility.

For more detailed information see the “Habitat Degradation” information in Section 5.1.1 “Conditions in Mainstem Willamette and Study Area”.

Predation & Competition

Monitoring of species that predate salmonids have not been conducted in the North Santiam, but ODFW has noted that largemouth bass seems appear abundant in Detroit Reservoir (ODFW Pers. Comm. 2022).

Natural production resulting from hatchery releases of non-native South Santiam stock summer steelhead is a risk to the viability of the North Santiam steelhead population (NMFS 2004). This hatchery stock originated from Skamania stock and is not part of the UWR steelhead DPS. Releases of thousands of hatchery smolts annually likely results in competition with juvenile UWR North Santiam steelhead. A study conducted in the South Santiam sub-basin by Harnish et al. (2014) demonstrated a residualization rate of 12.8 percent for hatchery summer steelhead releases. They also observed a strong overlap with natural-origin steelhead habitat use in space and time resulting in competition impacts that are likely detrimental to natural-original steelhead, and also possibly to Chinook salmon. Another factor that may impact juvenile winter steelhead is the earlier emergence of summer steelhead, which may impart a competitive disadvantage to native fish if choice feeding territories are already occupied by summer steelhead (Kostow and Zhou 2006). Research conducted by Sharpe et al. (2008) demonstrated very low predation of hatchery summer steelhead releases on Chinook salmon fry.

Population Traits

The UWR Recovery plan (ODFW & NMFS 2011), notes a loss of population traits for both Chinook salmon and steelhead in the North Santiam from hatchery fish interbreeding with wild fish on spawning grounds. This represents a key threat to the genetic characteristics of the wild Chinook salmon and steelhead populations. Hatchery operations for Chinook salmon on the North Santiam River began nearly 100 years ago. In the recent Willamette Hatchery Program Opinion, NMFS estimated that the current percent of hatchery fish spawning on natural spawning ground is 100 percent above Detroit (as expected) and 66 percent downstream of the dams, but the future target would be to have less than 10 percent pHOS above Detroit Dam and 21 percent below the dam (NMFS 2019c).

Releases of hatchery-produced winter steelhead in the North Santiam River system ended in 1998, but the legacy of past hatchery releases persists. ODFW continues to release thousands of hatchery-produced South Santiam stock summer steelhead smolts annually. This hatchery stock originated from Skamania stock and is not part of the UWR DPS. The full impact to listed UWR (winter) steelhead from genetic introgression with summer steelhead is unknown. The North Santiam River once had the highest densities of summer steelhead redds observed in any of the steelhead populations in the DPS. Studies in the nearby Clackamas River have shown adverse effects from non-native Skamania summer steelhead on native winter steelhead (Chilcote 2003, Kostow and Zhou 2006).

5.1.3. South Santiam River Sub-Basin - Green Peter and Foster Dams

Streamflow and Water Quality

The South Santiam River Reach that is least influenced by high water temperatures lies below Foster Dam, where temperature increases are buffered by releases of deep cold water from Green Peter Reservoir. In contrast to the North Santiam Basin (highly permeable geology with sustained base flows), the South Santiam Basin is of low permeability, tends to quickly transition precipitation to runoff, and is considered flashy in nature (Tague and Grant 2004).

Water withdrawals for irrigation, domestic, and industrial water uses contribute to low-flow conditions in the South Santiam River and its tributaries, particularly in late summer and early fall. The loss of streamflow affects steelhead productivity by reducing rearing habitat availability and quality for fry and summer parr.

For more detailed information, see "Streamflow & Water Quality" under Section 5.1.1, "Current Conditions in Mainstem Willamette and Study Area".

Adult Passage

Green Peter and Foster dams block or limit volitional access to an estimated 85 percent of the historical production area for Chinook salmon and steelhead (ODFW and NMFS 2011).

The South Santiam Basin contains two major impassable dams, a low-head dam (Foster Dam) that blocks volitional access to the upper South Santiam River, and a high-head dam (Green Peter Dam) that currently blocks access to Quartzville Creek and the Middle Santiam River. The Chinook salmon population in the South Santiam basin currently produces several hundred natural origin adults per year, which constitute approximately 30–40 percent of the total number of spawners in the basin. An adult fish facility is located below Foster Dam, where both natural-origin steelhead and Chinook salmon are collected and transferred to areas in the South Santiam branch of the river above the point where it enters the Foster Reservoir. Chinook salmon adult outplanting efforts above Green Peter began in 2022, using only hatchery-origin fish. Adult outplanting above Green Peter was not conducted in the past because of poor passage survival and high predation. It remains to be seen if these conditions improve through Injunction measures and the new EIS alternative measures.

With the cessation of fish passage over Green Peter Dam in 1988, spawning is currently limited to the mainstem South Santiam, and Thomas, Crabtree, and Wiley Creeks. There is no basinwide time series for South Santiam winter steelhead abundance. Steelhead spawning survey data (index redd counts) are available for a number of tributaries to the South Santiam River; in addition, live counts are available for winter steelhead transported above Foster Dam. Temporal differences in the index reaches, and the conditions under which surveys were undertaken, make the standardization of data among tributaries very difficult. Mapes et al. (2017) provides a comparison of survey methodologies and suggests a current total sub-basin population of around 1,000 spawning adults, except in 2017. For the Foster Dam collection time series, the most recent 10-year geometric mean (2010–2019) has been 141, with a negative trend in the

abundance over those years. On average, 2,600 steelhead passed the Foster Dam site prior to 1966. Wade et al. (1987) reported that, in 1971, the wild winter steelhead count at Foster Dam was 4,254 fish (approximately one-quarter of the Willamette Falls count for that year). Wade et al. (1987) further suggested that prior to the construction of Foster Dam, two-thirds of the steelhead passing the Foster Dam site were destined for the Middle Fork Santiam River (above Green Peter Dam).

The 8-foot high Lebanon Dam at RM 21 is no longer a barrier to adult Chinook salmon passage. The dam is equipped with several new fish ladders that allow passage of adult fish, but the dam may still delay some migration or injure adult fish seeking the entrances.

Small dams, irrigation diversions, road crossings, and other land-use-related passage impediments restrict steelhead access to habitat in smaller tributaries. Numerous partial and complete fish-passage barriers at culverts on tributary streams limit juvenile upstream movement into rearing and refuge habitat.

Juvenile Passage

Mortality of juvenile Chinook salmon and steelhead often occurs during downstream passage through turbines and other outlets at South Santiam dams or because they are not able to locate downstream passage routes. An extensive dam passage survival study was conducted at Foster Dam in 2015, 2016, and 2018 by Liss et al. (2020). Survival rates ranged between 61 percent and 84 percent for yearling Chinook salmon, between 47 percent and 81 percent for winter steelhead smolts, and from 76 to 86 percent for subyearling Chinook salmon in the fall.

A passage study has recently been underway at both Green Peter and Foster dams to evaluate the potential for spring spill operations (Liss et al. 2023). Results thus far indicate that project survival for yearling Chinook salmon at Green Peter ranged from 68 to 71 percent, reach survival through Green Peter all the way to Foster Dam ranged between 42 and 44 percent, and reach survival from Green Peter to the confluence with the Willamette River ranged from 31 to 33 percent. Green Peter Dam passage efficiency estimates ranged between 78 percent (24/7 spill) and 85 percent (nighttime only spill). Yearling Chinook salmon dam passage survival estimates for the Foster Dam project (under low pool conditions) ranged between 83 to 85 percent, and reach survival through Foster Dam all the way to the confluence of the South Santiam with the Willamette was estimated between 42 and 45 percent. The results for the high-pool passage conditions were higher than the low-pool estimates, ranging between 88 and 92 percent for the project (survival) and between 71 and 75 percent for the reach survival from Foster to the Willamette River confluence. Dam passage efficiency estimates for Foster Dam where highest under the high-pool conditions (77 percent overall, day and night passage combined).

A notched spill bay stop log, or fish weir, is used at Foster Dam in the spring to provide downstream fish passage for juvenile Chinook salmon and steelhead, and, possibly, for steelhead kelts. The fish weir was modified in 2018 to improve attraction and entrainment but still offers less favorable hydraulic conditions for fish passage compared to spillways at dam facilities in the Columbia and Snake rivers (Deng et al. 2019).

Kelt Passage

In the past, mortality of steelhead kelts occurred during downstream passage through turbines or because they were not able to locate downstream passage facilities.

Habitat

Past management of riparian areas and stream cleaning practices have led to reduced large wood in streams. Mature riparian forests now make up a very small proportion of the floodplain and riparian vegetation along the river and tributaries in the lower basin, particularly in areas where there is the largest amount of agricultural use. Riparian conditions are better in the upper sub-basin than in the lower, but proportions of mature and old-growth coniferous forests are reduced (WRI 2004).

There is limited natural spawning in the lower South Santiam River, Thomas and Crabtree creeks, and Wiley Creek, with the majority of spawning occurring below Foster Dam. Reproductive success in many of the reaches below Foster Dam is likely limited by habitat degradation, although even historically the majority of the Chinook salmon spawning was above the site of Foster Dam (Mattson 1948, Parkhurst et al. 1950). Presently, only unmarked fish are transported above Foster Dam. However, in 2022, some hatchery-origin Chinook salmon were transported and outplanted above Green Peter Dam.

Conditions in the South Santiam River above Foster Reservoir may be limiting due to high (>20°C) prespawning holding temperatures and poor incubation and rearing habitat conditions (the river is prone to scour during flood episodes). For example, 2010 was a poor year with scouring floods during incubation. Alternatively, historical habitat (Quartzville Creek and the Middle Santiam River) above Green Peter Dam may provide better spawning and rearing habitat than the upper South Santiam River; previous surveys suggest that the Middle Santiam River and its tributary, Quartzville Creek, were historically preferred steelhead spawning habitat (Parkhurst et al. 1950, Wagner et al. 1963).

Similarly, the South Santiam River Basin may not be able to achieve its recovery goal status without access to historical spawning and rearing habitat above Green Peter Dam (Quartzville Creek and the Middle Santiam River) and/or improved juvenile downstream passage at Foster Dam.

For more detailed information, see “Habitat Degradation” under Section 5.1.1, “Current Conditions in Mainstem Willamette and Study Area”.

Predation & Competition

Non-native smallmouth bass are present in Green Peter Reservoir and are thought to prey on juvenile Chinook salmon, though no studies have been done to estimate the magnitude of predation.

The naturally produced progeny of non-native summer steelhead released in the sub-basin are thought to compete with juvenile South Santiam steelhead for habitat and food (NMFS 2004).

This hatchery stock was introduced into the Willamette Basin from Skamania stock and is not part of the UWR steelhead DPS. Not all of the adult summer steelhead are harvested by anglers or removed at the Foster trap, and some summer steelhead have been observed spawning in the mainstem South Santiam River, Wiley, Crabtree, and Thomas Creeks. Studies in the Clackamas River have shown adverse effects from non-native Skamania summer steelhead on native (Chilcote 2003, Kostow and Zhou 2006). One ecological factor that may impact juvenile winter steelhead is the earlier emergence of any naturally produced summer steelhead, which may impart a competitive disadvantage to native fish if choice feeding territories are already occupied by summer steelhead (Kostow and Zhou 2006). Research conducted by Sharpe et al. (2008) demonstrated very low predation of hatchery summer steelhead releases on Chinook salmon fry.

Population Traits

Chinook salmon: In general, the influence of hatchery-origin Chinook salmon on the spawning grounds in the Upper Willamette basins has shown a slight improvement, with the exception of the South Santiam River, where fish collection at the new facility has been poor (Keefer et al. 2018) leaving more hatchery-origin fish to spawn below Foster Dam (Ford 2022). Failure to attract natural-origin adults to the fish collection facility at Foster also reduces the number of fish available for transportation to the upper South Santiam River, resulting in more fish spawning below Foster Dam in less desirable habitat (Ford 2022).

Chinook salmon hatchery fish breeding with natural-origin spawners continues to present a key threat to the genetic characteristics of the wild Chinook salmon and steelhead populations. The number of hatchery fish on spawning grounds as a percent of all Chinook salmon on spawning grounds in the South Santiam has been as high as 80 percent or more (ODFW 2005). The current estimate for the proportion of hatchery-origin Chinook salmon on spawning grounds for the South Santiam River is 65 percent, and the long-term target is 30 percent (NMFS 2019c).

The proportions of Chinook salmon currently exhibiting different life history strategies are different when compared with the historical populations. Most hatchery produced juveniles are released as age-1 smolts in the spring, whereas a more continuous migration of naturally produced smolts through the fall and spring periods was observed in the historical populations (NMFS 2004). Hatchery Chinook salmon return at an earlier age than the historical populations. Most of the returns now are age-4 fish instead of age-5 (NMFS 2004). It is unknown if the return of younger adults is the result of genetic changes resulting from hatchery operations or fisheries or simply the result of releasing larger smolts than occurred naturally.

Steelhead: Winter-run steelhead hatchery programs were fully terminated by the late 1990s. Prior to this, the proportion of hatchery-reared fish that spawned naturally in the South Santiam River was believed to be more than 40 percent (ODFW 2005). Currently, the only steelhead programs in the upper Willamette River release Skamania Hatchery-origin summer-run steelhead. Still, the legacy of previous hatchery-origin releases persists in the upper Willamette River. A recent genetic study by Johnson et al. (2021) evaluated the level of colonization by non-native stocks and introgression between non-native summer-run steelhead and non-native early-winter-run steelhead with native late-winter-run steelhead. Johnson et al. (2021) identified westside tributaries as being largely occupied by non-native early-winter-run steelhead originating from

releases by Big Creek Hatchery (Lower Columbia River, Southwest Washington steelhead DPS) beginning in the 1920s. Below the dams of the South Santiam River, introgression from introduced steelhead was higher than in the North Santiam, with 12 percent of the juveniles identified as summer-run × native winter-run hybrids and 14 percent identified as hybrids of non-native early-winter × native late-winter steelhead.

While the diversity goals are partially achieved through the closure of winter-run steelhead hatchery programs in the upper Willamette River, the legacy of past hatchery operations in combination with the continued release of summer-run steelhead presents risks to the viability of the steelhead population.

5.1.4. McKenzie River Sub-Basin - Cougar and Blue River Dams

Streamflow and Water Quality

Peak flows have been greatly diminished by Cougar and Blue River dams. Average annual peak flows after the dams were completed in 1968 are only 60 percent of the average annual peak flows that occurred before dam construction (Alsea Geospatial et al. 2000).

A temperature control tower has been operational at Cougar Dam since 2005. The tower has improved downstream temperature conditions for adults returning to spawn as well as incubating redds in the reach between the dam and the confluence of the South Fork and mainstem McKenzie rivers.

For more detailed information, see "Streamflow & Water Quality" under Section 5.1.1, "Current Conditions in Mainstem Willamette and Study Area".

Adult Passage

The McKenzie River Chinook salmon population is considered both a core and genetic legacy population in terms of UWR Chinook salmon ESU recovery. The McKenzie River still provides volitional access to a majority of its historical spawning habitat. Impassable dams in the Blue River (Blue River Dam), Upper McKenzie (Trail Bridge Dam), and South Fork McKenzie River (Cougar Dam), block historical spawning habitat for spring-run Chinook salmon. Multiple smaller diversions/canals and some higher dams are located on the McKenzie River including Leaburg Dam (RM 29) and the Carmen-Smith Hydroelectric Project (RM 82), both owned and operated by the Eugene Water and Electric Board (EWEB). Leaburg Dam was outfitted with new ladders and a screened diversion intake in 2002–2003. More recently, exclusion grates and a trap has been added to the Leaburg ladders which allows ODFW to keep hatchery fish off spawning grounds above Leaburg.

Construction of Cougar Dam on the South Fork McKenzie River blocks fish access to a significant amount of historically productive Chinook salmon habitat above the dam. Blue River Dam was built without fish passage facilities, but only 2 miles of Chinook salmon spawning habitat was lost because natural passage barrier (waterfalls) already limited distribution. EWEB's

Trail Bridge Dam blocks access to the uppermost 3 miles of the mainstem McKenzie River and a portion of the Smith River. There are no plans currently to provide access to the upper Blue River, but adult "trap and haul" systems are currently being developed for Trail Bridge Dam (through a multi-agency funding agreement). The Trail Bridge system will be complete by 2030. The Adult Fish Facility below Cougar dam consists of a fish ladder, pre-sort pool, crowder, three post-sort pools, and many other features. Adult Chinook salmon are collected here for broodstock and adult transport purposes. All NOR adults that return to the Cougar Dam trap twice are released above Cougar Dam, and hatchery-origin adults that return to the McKenzie and Leaburg hatcheries are also released above Cougar Dam. The hatchery-origin fish are used to supplement the number of natural-origin fish released above Cougar Dam in order to meet a 600 fish minimum target escapement goal (400 females and 200 males).

Overall, the McKenzie River population has the second largest natural origin population in the UWR Chinook salmon ESU (next to the Clackamas River), with a geometric mean for the 2015–2019 return years of 1,664 (Ford 2022). This population has seen a decline in abundance over the last 10 years, providing further incentive to provide access to the South Fork McKenzie River.

Juvenile Passage

Mortality of juvenile Chinook salmon occurs during downstream passage through turbines or the regulation outlets (ROs) or because they are not able to locate downstream passage routes. Current juvenile passage at Cougar Dam differs from most of the other WVS dams, as it has a water temperature control tower in the forebay through which juveniles must pass prior to being sent through the penstocks (which are the turbine intakes) or one of two ROs (and ultimately RO tunnel/spillway). Water flow through the dam is typically routed through both ROs and turbines. Estimated survival of fish passing through the temperature control tower to 2.4 river miles downstream of the dam was about 40 percent for both routes (Beeman et al. 2012). Zymonas et al. (2011) collected fish in the RO tailrace and powerhouse tailrace and documented post-collection mortality rates. They reported that 18 percent of the fish that passed through the powerhouse died compared to 42 percent of the fish that passed through the RO. Additionally, the authors reported that 27 percent of the fish that were collected at river mile 2.8 did not survive (Zymonas et al. 2011). Mortality of fish held 72 hours after passage was higher in the RO (36 percent) than in the powerhouse (19 percent) and was influenced by a combination of low reservoir elevation, discharge, and fish length for each route (Zymonas et al. 2011).

Flow is rarely routed over the spillway at Cougar Dam, as it is currently reserved only for extreme emergencies. Risk reduction measures are currently being implemented at Cougar Dam to address stability concerns with the spillway tainter gates. See Hansen et al. (2017) for a more detailed summary of fish passage and survival studies conducted at Cougar Dam.

Habitat

Trail Bridge Dam and, to a greater extent, Cougar Dam and Blue River Dam, intercept large wood and sediment from 35 percent of the McKenzie River's headwaters (WRI 2004). The mainstem McKenzie River below Deerhorn Park (RM 32) has lost most of its islands and side channels (WRI 2004).

Altered habitat diversity has affected all of the Chinook salmon life stages in the geographic areas, with larger impacts in lower McKenzie River, lower sub-basin tributaries, and Mohawk watershed (WRI 2004). Impacts have particularly degraded rearing potential for Chinook salmon juveniles during the winter parr life stage.

The river reach from the mouth of the McKenzie River to Leaburg Dam is considered marginal spawning habitat but does account for a number of redds each year. Leaburg Dam to Trail Bridge Dam and the lower portion of the South Fork McKenzie below Cougar Dam is presently considered the most productive portion of the basin given passage obstructions at Cougar Dam and Trail Bridge Dam.

For more detailed information, see "Habitat Degradation" under Section 5.1.1, "Current Conditions in Mainstem Willamette and Study Area".

Predation & Competition

Spotted bass (*Micropterus punctulatus*) and largemouth bass are both present in Cougar Reservoir, and a recovering reintroduced bull trout (*Salvelinus confluentus*) population is present above and below the reservoir. Bull trout are a native, ESA-listed species. Therefore, their predation on juvenile salmonids is viewed as a favorable and natural (deleterious) effect to salmonids in the McKenzie basin, whereas predation by the non-native warmwater species is not.

Though a large number of hatchery steelhead smolts are released each spring into the McKenzie River below Leaburg Dam, predation on listed Chinook salmon is not believed to be an issue (Sharpe et al. 2008). Hatchery rainbow trout released into the McKenzie River below the Blue River confluence are also not believed to predate juvenile salmonids at a significant rate (as mentioned and cited in sections above). Native, wild rainbow trout populations found higher in the McKenzie River would be more likely to prey upon small juvenile Chinook salmon, but few Chinook salmon are present in these reaches at present.

McKenzie River juvenile Chinook salmon may also be impacted by competition with residualized hatchery steelhead or the offspring of any hatchery steelhead (that return and spawn prior to being caught or trapped). These steelhead juveniles would be rearing in the system, similar to any natural-origin Chinook salmon juveniles and competing for similar food resources.

Population Traits

The risk of genetic introgression from interbreeding with hatchery Chinook salmon has been a key threat to the native McKenzie River Chinook salmon population. The McKenzie Hatchery Chinook salmon program once greatly increased the number of spawners below and above Leaburg Dam. From 2001 to 2004, hatchery fish comprised 30 to 34 percent of the natural spawners above Leaburg Dam (Schroeder et al. 2007). In 2003, hatchery fish comprised more than 70 percent of the natural spawners below Leaburg Dam (Firman et al. 2004, cited in NMFS 2004). Though this level of hatchery fish on the spawning grounds may be representative of what occurred over the last few decades, in 2022, ODFW staff found a way to significantly reduce hatchery-origin spawners above Leaburg Dam. As noted above, they installed an exclusion grate in the right bank ladder, forcing salmon to pass through the left bank ladder and then ran a newly

designed sorter table from June to August at the left bank ladder. Using this operation and the sorter table, staff removed 1,193 hatchery Chinook salmon and returned all of the natural-origin Chinook salmon to the river (above the Dam), reducing pHOS above Leaburg to an estimated 3 percent.

5.1.5. Middle Fork Willamette River Dams - Hills Creek, Lookout Point, Dexter and Fall Creek Dams

Streamflow & Water Quality

Fall Creek enters the Middle Fork Willamette River below Dexter Dam, while releases from Hills Creek and Lookout Point are re-regulated and released below Dexter Dam on the Middle Fork Willamette.

For further detailed information, see "Streamflow & Water Quality" under Section 5.1.1, "Current Conditions in Mainstem Willamette and Study Area".

Adult Passage

Dexter, Lookout Point, and Hills Creek dams were built without upstream fish passage facilities and block access by adults to an estimated 70–80 percent of the historical production area for Chinook salmon (WRI 2004) and 95 percent of the historical spawning habitat (ODFW and NMFS 2011). ODFW began trucking adult Chinook salmon trapped at Dexter Dam to areas above Hills Creek Reservoir in 1993 (originally for the purpose of providing recovering bull trout with a natural food source) and later expanded the program to include areas above Lookout Point Reservoir. Currently, predominantly hatchery-origin adult Chinook salmon are transported above Dexter/Lookout and Hills Creek dams. A very few juvenile Chinook salmon successfully migrate downstream over or through these high-head dams. Returns of natural-origin Chinook salmon to the Dexter trap have averaged 109 adults, annually (2015–2021). At present, the Middle Fork population is almost exclusively composed of hatchery fish. Attempts to reintroduce Chinook salmon above Hills Creek and Lookout Point dams have not been successful, primarily because the survival rate for any offspring produced by successful spawners is thought to be very low. This low survival rate is the product of low passage efficiency and low survival through 2 to 3 consecutive USACE dams and reservoirs, each characterized by poor passage conditions and high predator abundance. Additionally, pre-spawn mortality rates are high for adults that reach the Middle Fork Willamette. In 2016, pre-spawn mortality for fish found below Dexter Dam was estimated at 96 percent (Sharpe 2017). In 2015, Sharpe (2016) estimated pre-spawn mortality to be 99 percent below Dexter, 60 percent in Fall Creek, 30 percent for adults that were transported and made it to the North Fork Middle Fork (above Lookout Point Dam), and 89 percent for adults transported above Hills Creek Dam.

Fall Creek Dam is also a barrier to fish movement but has an adult fish facility located just below the dam. However, stream temperatures below Fall Creek Dam can be excessively high for returning adult Chinook, especially as they crowd below the adult trap entrance (see additional information below). There have been some recent strong adult Chinook salmon returns to Fall Creek, but in 2021, pre-spawn mortality was nearly 100 percent. Naturally producing winter steelhead are also passed above Fall Creek Dam at this adult fish facility.

Juvenile Passage

Juvenile Chinook salmon pass via spillways (if in operation) or through turbines at Hills Creek, Lookout Point, and Dexter Dams on the Middle Fork Willamette. Flow can also be routed through regulating outlets at Hills Creek and Lookout Point Dams (there are no regulating outlet structures at Dexter Dam). Fall Creek Dam has been operated to assist with juvenile outmigration in the fall/winter months through an enhanced reservoir draw-down (through the regulating outlets), which has proven successful in some years and has been correlated with an increase in adult returns in some years.

A solid body of literature is available on general patterns of downstream passage in the Middle Fork Willamette River subbasin, but less is known about route-specific passage and survival than in other subbasins (Hansen et al. 2017). One passage study reported a 53 percent total project mortality rate for Hills Creek Dam (through turbines and ROs combined) and a 25 percent total project mortality rate through Lookout Point Dam (Keefer et al. 2012), while others showed much higher (Middle Fork system-wide) morality when including Dexter Dam and reservoir passage survival (Hansen et al. 2017). Fish passage during the Lookout Point Reservoir summer and fall drawdown (Injunction-ordered) operation via use of RO outlets was monitored by USGS in 2023 using acoustic tags and arrays (Hance et al. 2024). Receivers were installed below Lookout Point Dam, above Dexter Dam, near the confluence with the Willamette, and at Willamette Falls. All fish were released in the head of the Lookout Point Reservoir. The tagged fish were not fully representative of either reservoir-rearing fish or fall migrants. Most fish released at the start of the drawdown from mid-August to mid-September did not move, and only 11 percent ultimately made it to Dexter Dam (Hance et al. 2024).

Observations from sampling in 2012 and 2013 found that fish passed in the summer when spill occurred at the Lookout Dam tailrace (Keefer et al. 2012). In years when no spring/summer spill occurred and water primarily passed through the turbines, Chinook salmon passage occurred predominantly in the fall months (Romer et al. 2013).

Few to no studies have been conducted to assess specific survival rates through Dexter Dam or route-specific proportions. Fish passage routes include turbines or the spillway (when in operation), and there are no regulating outlet structures at Dexter Dam.

Since 2011, Fall Creek Reservoir has been drawn down to minimum passage pool elevations in the fall and early winter. In 2012, studies were conducted with radio-tagged juvenile fish. Nesbit et al. (2014) released fish into the reservoir at different reservoir elevations to estimate reservoir survival and passage survival at Fall Creek. More than 95 percent of tagged fish passed within 48 hours of release when the reservoir elevation decreased from 720 to approximately 700 feet and the average RO gate opening was 5–7 feet (Nesbit et al. 2014). Survival during the two treatments was reported as 73.9 percent during the first treatment targeting elevation 728 feet and 97.5 percent for the second treatment targeting elevation 703 feet. This study did not account for reservoir survival between initial reservoir entry and final dam passage dates.

See Hansen et al. (2017) for a more detailed summary of fish passage and survival studies conducted at the Middle Fork Willamette basin projects.

Habitat

The present-day Middle Fork Willamette River population of Chinook salmon bears little resemblance to its historical counterpart in its distribution. Currently, almost all of the historical spawning and rearing habitat is volitionally inaccessible to Chinook salmon. Production by natural-origin adults is restricted to lowland low gradient (and warm) unobstructed reaches and areas above Fall Creek Dam where a trap and haul program currently provides access. The geometric mean for the 2011–2016 period was only 351 (Fall Creek). While the reservoir provides a thermal refuge from summer temperatures, Fall Creek and Winberry Creek, which drain into the reservoir, experience relatively high temperatures during adult pre-spawn holding. Little of the Fall Creek watershed lies in the snow zone (above 1200m), with most of this sub-basin being in the transitional or rain zone.

Dexter and Lookout dams are a high-head dam complex that obstruct passage beyond the lower Middle Fork Willamette River, and farther upstream, beyond the North Fork Middle Fork Willamette River, Hills Creek Dam redundantly blocks access to the uppermost reach. Although current productivity is low, historically, the Middle Fork Willamette River was thought to be the major producer of Chinook salmon (Mattson 1948, Parkhurst et al. 1950). Historical and contemporary information on naturally spawning Chinook salmon in the most productive Middle Fork Willamette River reaches (above Lookout and above Hills Creek Dams) is limited. However, long stretches of salmon spawning and rearing habitat is still present in the North Fork Middle Fork and the mainstem Middle Fork above Hills Creek Reservoir and would be particularly resilient to climate-change-related temperature effects. These upper watershed reaches benefit from the High Cascades geology (permeable basalt that provides ample groundwater) and snow melt (Gregory et al. 2007).

The lower sub-basin contains only a small fraction of the original floodplain forest. Remaining floodplain forests are interspersed with areas of farmland, pastureland, highways, residences, and other development. Roads next to stream channels have increased channel confinement and reduced riparian vegetation and canopy cover. As a result of these land alterations, riparian vegetation within 100 feet of the small tributaries of the lower Middle Fork Willamette is generally in poor condition. Changes in riparian canopy cover have led to increased summer water temperatures on some tributary streams (WRI 2004).

For further detailed information, see “Habitat Degradation” under Section 5.1.1, “Current Conditions in Mainstem Willamette and Study Area”.

Predation & Competition

The Middle Fork Reservoirs are currently a haven for introduced, piscivorous fish species. Dexter Reservoir hosts abundant populations of northern pikeminnow, smallmouth bass, and walleye. Lookout Point Reservoir is also host to a robust population of smallmouth bass, as well as walleye, northern pikeminnow, and white and black crappie. Finally, Hills Creek Reservoir hosts a popular white and black crappie fishery, as well as largemouth bass and a small, native bull trout presence. A recovering and reintroduced bull trout population is present above Hills Creek, similar to Cougar Reservoir. Bull trout are a native, ESA-listed species, hence, their

predation on juvenile salmonids is viewed as a favorable and natural deleterious effect on salmonids, whereas predation by the non-native warmwater species is not.

A large number of hatchery-origin summer steelhead smolts are released into the Middle Fork Willamette River below Dexter Dam. The effects of these releases on juvenile Chinook salmon are not well documented. These hatchery steelhead are believed to migrate downstream relatively quickly. However, there is also evidence for potential residualization of hatchery-origin steelhead and potential resulting predation on competition with juvenile Chinook salmon (Johnson et al. 2021). Hatchery rainbow trout are released into Fall Creek Reservoir, Hills Creek Reservoir, and Salmon Creek (near Lookout Point), and their effect on juvenile Chinook salmon could be significant (Murphy et al. 2021). (For more information see similar *Predation and Competition* sections above, such as under 5.1.4.).

Population Traits

The small number of naturally produced Chinook salmon in the Middle Fork Willamette (the population was considered extirpated by ODFW) coupled with the preponderance of hatchery fish in the naturally spawning population has represented a key concern to the population's viability. In the last decade or so, the proportion of Chinook salmon adult hatchery returns to the Middle Fork Willamette (mainstem) has continued to increase, even to the adult fish facility below Dexter Dam. Presently, nearly all of the returning Chinook salmon are of hatchery-origin, though some natural-origin fish do return to Fall Creek. The Middle Fork Willamette hatchery program is intended to operate as an integrated broodstock program where natural-origin fish are incorporated into the broodstock on a regular basis so that the hatchery broodstock is as similar as possible to the natural-origin population (NMFS 2019c). Because of the low number of natural-origin adult returns, most of those that do return to the Dexter adult fish facility get incorporated into the broodstock, leaving only hatchery-origin adults for adult releases above Lookout Point and Hills Creek dams.

Alternatively, since 1998, all natural-origin spring Chinook salmon (unmarked) returning to the Fall Creek adult collection facility have been released above the dam. At present, no marked hatchery-origin spring Chinook salmon are transported and released above Fall Creek Dam, and therefore, the current Fall Creek population is now sustained by the transport of natural-origin adult Chinook salmon released upstream annually. Although the Fall Creek adult fish facility includes many state-of-the-art designs, it still requires fish handling and transport, and pre-spawn mortality rates for adults transported upstream remain high (Peterson et al. 2022). High summer temperatures observed in Fall Creek are likely a contributing factor, in addition to the effects of trap-and-haul operations.

5.1.6. Coast Fork Willamette River and Long Tom

There is little compelling evidence that the Coast Fork supports an independent, self-sustaining spring Chinook salmon population. There may have been intermittent production in this sub-basin, but Dorena and Cottage Grove dams blocked access to most spawning areas. Hatchery-produced juvenile salmon have been released into the Coast Fork, but downstream survival rates were unknown and there have been limited adult returns. Releases of juvenile Chinook salmon into

the Coast Fork, a westside tributary that does not support a Chinook salmon population, have been made in an effort to maintain a harvestable hatchery return but reduce hatchery / natural adult interaction on natural spawning grounds in eastside tributaries. Some of these returning adults have returned to their hatchery of origin rather than the Coast Fork release site (NWFSC 2022). In recent years, a small number of surplus adult hatchery salmon have been outplanted into a Coast Fork tributary, Mosby Creek. In combination with strays, these outplants have been associated with some limited spring Chinook salmon production (ODFW Pers. Comm. 2022).

There have been anecdotal reports of spring Chinook salmon spawning in other west-side tributaries, but these fish have presumably strayed from other sites. No self-sustaining populations are believed to exist (Keefer and Caudill 2010).

NMFS considers the Long Tom River a low priority in terms of effects on trust resources other than the potential for some Chinook salmon rearing habitat at the Long Tom River's confluence with the mainstem Willamette River.

5.1.7. Study Area Below Willamette Falls

The biggest issues affecting NMFS trust species and their habitats below the Willamette Falls and in the Columbia River mainstem are mostly due to human population increases, urbanization, land use and development issues, and the presence and operation of the Columbia River System in the Columbia River (NMFS 2020). Past and current effects of the WVS on the Lower Willamette River (below Willamette Falls) in terms of flow / hydrograph alterations and ecosystem degradation are stronger than any effects the WVS has had on the mainstem Columbia River. In addition to UWR Chinook salmon and steelhead, there are 11 additional ESA-listed salmon and steelhead groups that migrate through the Lower Columbia River. ESA-listed eulachon and green sturgeon (also NMFS trust species) also inhabit the lower Columbia River.

5.2. PREFERRED ALTERNATIVE - ALTERNATIVE 5

5.2.1. General Effects to Study Area Including the Mainstem Willamette River

The effects that the Preferred Alternatives measures have on flows, temperatures, water quality, habitats, and ecosystems in the mainstem Willamette River will not only affect salmon and steelhead populations in the four primary sub-basins (North Santiam, South Santiam, McKenzie and Middle Fork Willamette), which is the focus of this report, but also on salmon and steelhead populations in the following sub-basins: west-side tributaries to the Willamette, the Molalla River sub-basin, the Calapooia sub-basin, and the Clackamas sub-basin. This includes ESA-listed (UWR) Chinook and steelhead in the Calapooia and Molalla sub-basins and ESA-listed (LCR) Chinook and coho salmon in the Clackamas basin.

Measure 30b - Refined Integrated Temperature and Habitat Flow

Measures 304 and 718 - Augment Instream Flows Using WVS Power Pools and Inactive Pools

Under measure 30b, when the water supply is forecast to be anything less than 80 percent of the 30-year average (which could occur more often in the future under certain climate change

scenarios) the proposed minimum (7-day moving average) flow on the mainstem Willamette River (at Salem) has been set at 80 percent of the required 2008 WVS biological opinion "deficit" flow for the month of April, 67 percent for May, and 73 percent in the first half of June. This measure would reduce flows below the minimum 2008 WVS biological opinion flows during the same months of the year when the majority of juvenile salmon and steelhead in the Willamette basin migrate downstream. The trade-off presented is that minimum flows in October could be 50 percent higher than 2008 biological opinion minimum requirements. Higher flows in October might be beneficial to late Chinook salmon spawners, incubating Chinook salmon eggs, and fall migrants, but less beneficial if temperatures are still too warm. Proposed minimum flows for the months of July, August, or September are equal to 2008 biological opinion "deficit" flow requirements but not the adequate or abundant biological opinion flow requirements, especially in years where the forecast is less than 80 percent of the 30-year average. In these months, river and stream temperatures can increase relatively quickly owing to a combination of low flows and warm atmospheric temperatures.

Even in years where the forecasted water supply is 80–100 percent of the 30-year average, proposed minimum flows under measure 30b would be 87 percent and 91 percent of deficit biological-opinion-required flows in May and the first half of June, respectively. When comparing to biological opinion required "adequate" minimum flows, measure 30b flows will only meet or exceed these in years where the water supply forecast is greater than the 30-year average and only in the months of April, May, June, and October. This means that under alternative 2b/5, even in "better" water supply years, 2008 biological opinion adequate flows would not have to be met in July, August, or September.

Additionally, because future predicted conditions under various climate change scenarios were not factored into the new flow management plan, it is difficult to understand what might happen in years when the water supply forecast is significantly lower than 80 percent. Lowering minimum flow requirements (from those in the 2008 Biological Opinion RPA) is not a viable solution for incorporating future expected climate change effects when it comes to the recovery of ESA-listed salmonids. Instead, other reservoir fill and release strategies might be needed in years of low water supply forecast, low snowpack, or when higher average winter and spring temperatures lead to earlier snow melts and a shift in the natural hydrograph (e.g., forecast informed reservoir operations)

Temperature requirements for ESA-listed Chinook salmon and steelhead in the UWR are not currently being met at all times of the year, and these conditions are unlikely to improve under the preferred alternative measures. Under future climate change projections, air and stream temperatures in the Willamette Basin will likely rise in general and constrain the region's ability to meet various stream temperature criteria, such as EPA TMDLs and fish temperature targets established by the state and federal fish agencies. If temperature reductions are not possible or feasible because of the various and competing requirements of the WVS, potential mitigation strategies should be proposed to improve temperatures in the mainstem Willamette River and, potentially, in the lower reaches of the four most affected tributaries inhabited by ESA-listed fish. Proposed short-term water releases or "pulses" from WVS dams in summer months may provide some release, but these may not always be triggered before heat waves and their effects begin or occur because of the use of a 7 DADM temperature trigger.

It is not clear how flows related to the Willamette Basin Review (WBR) and associated water use allocations will be affected by the new flow and temperature management measures. Under the proposed measures, the 2008 WVS biological opinion tributary minimum flows are not likely to be met in all months of the year, even in some "wet" years. This makes it unlikely that WBR allocations could be fully granted (according to the WBR Biological Opinion RPA [2.9.4] and associated stipulations).

Overall, the effects of these measures on NMFS trust species and ESA-listed Chinook salmon and steelhead in the mainstem Willamette River include a continued lack of habitat complexity from diminished spring flows that reduce floodplain connection and do not support channel-forming processes. Proposed minimum flows may also continue to affect migration timing of adult Chinook salmon (a cue to move upstream) and downstream migrating juveniles (Poff et al. 1997; Scheuerell et al. 2009) and exacerbate rising temperature issues, including greater prevalence of pathogens and increased stress to salmonid species and many other parts of their ecosystem.

Measure 384. Gravel Augmentation Below Dams (Big Cliff, Foster, Blue River and Cougar Dams)

The success of this measure depends on many factors: the gravel added must be of the appropriate size and composition for Chinook salmon and steelhead spawning; the gravel should not be placed in areas where suitable spawning gravels are already present; studies should be implemented to monitor the movement of the gravel; and results should inform future gravel placement as part of an adaptive management strategy. The gravel placement and monitoring should occur at the appropriate time(s) of the year and be based on the most current research or habitat engineering studies related to gravel augmentation methods, monitoring, and success in the Pacific Northwest region.

The reach between Blue River Dam and the Blue River confluence with the McKenzie River needs gravel augmentation, but there is not a large potential for spawning habitat in this reach because it is less than 2 miles long. This reach is also a fairly incised and the banks are heavily armored near the town of Blue River, which increases the power of the river flow through this section. For gravel augmentation to be successful below Blue River Dam, numerous instream habitat structures would likely have to be installed to promote gravel retention. Gravel augmentation below Cougar Dam on the South Fork McKenzie has much greater potential to improve salmon spawning habitat. This reach could also benefit from large wood additions prior to adding the gravel, and these habitat structures could aid in gravel retention.

Measure 719. Adapt Hatchery Program

Cohort replacement rates are not an appropriate measure for evaluating the effectiveness of new passage measures or for making hatchery program adjustments, especially since current adult return abundances are a very small percentage of what they were historically. Adult return rates are the result of a complex combination of factors, many of which occur outside the influence of WVS project presence and operations. In addition to juvenile downstream passage survival through the WVS, cohort replacement rates (CRRs) are influenced by environmental conditions (not dam operation influenced conditions) in the tributaries (where the adults migrate, hold, and

spawn and juveniles rear), and by conditions in the Willamette River mainstem, the lower Columbia River estuary, and the ocean. These factors all influence the size and health of juveniles at ocean entry and whether the timing of juvenile migration synchronizes with favorable ocean conditions.

The most direct way to demonstrate that the new proposed measures are effectively improving fish passage, fish survival, and habitat access issues is through robust monitoring plans and evaluation, and this should occur alongside adult return evaluations. Measure 719 states that the adult return evaluations will begin as soon as any "passage improvement" begins. This language is vague and does not set measurable standards to determine when passage is actually improved or optimized. To optimize juvenile passage survival, a robust monitoring plan should be implemented to immediately track effects of the change in passage. This will help establish a baseline for juvenile passage survival rates through each project under the Preferred Alternative measures and make it possible to determine if operations are not working as planned and can be improved based on monitoring data. The monitoring efforts should be able to demonstrate whether juveniles are passing through the intended routes and allow for a comparison of overall project survival rates among various sets of operations and conditions. Monitoring should also allow for the calculation and comparison of injury and mortality rates among size classes and under different operations and conditions. Monitoring should occur during as many days of the year as possible, especially during operations intended for passage. Similarly, genetic pedigree analyses and pre-spawn mortality surveys should continue in an effort to evaluate adult outplanting methods, and efforts to reduce handling and stress on adult fish being transported above the dams should continue.

The only language about juvenile survival rates in Measure 719 is very vague and does not establish any goals or criteria other than a sentence about comparing juvenile survival to rates estimated to "support the replacement criteria". Ideally, agreed-upon performance criteria could be established and then tested through improved monitoring. Such criteria would include minimum survival rates for each possible passage route at each project and minimum (or maximum) proportion of juveniles passing through each route. Although it may be too costly or difficult to mount PIT tag detectors on turbine outlets and spillways, there are other technologies such as sonar transducers (DIDSONs) that can detect fish presence in an area, signifying whether a passage route has been identified. The installation of PIT-tag detectors may also possible at the downstream end of some regulating outlets or certain types of new locations given the current technology.

Another concern is that once the proposed CRR evaluation begins after juvenile survival rates have been assessed and conditions have been optimized, reaching a CRR of 1.0 or more means very little in terms of recovering these diminished populations of salmon and steelhead. If the starting population size is very small, it is much easier to attain and maintain a 1.0 replacement rate. While that goal could be met, the population may still be thousands of fish below recovery target abundance or below its capacity given available habitat. CRR counts will include returning adults that are the offspring of hatchery fish for some time, as hatchery-origin outplanting assists in establishing natural-origin production until there are major passage survival improvements. A better measure for determining the right time to decrease hatchery production would be

consecutive years of successful returns for natural-origin adults with increasing trends combined with meeting or exceeding population abundance goals.

Hatchery production will need to continue for a period once adult returns begin to improve, as it serves as a safety net and allows for flexibility in addressing downturns. For example, if hatchery outplanting efforts are reduced after some successful natural-origin return years, but then another natural-origin downturn occurs, sustained hatchery production can assist in meeting outplanting goals or in reviving any hatchery outplanting efforts. NMFS recommends waiting 10 years (or five Chinook salmon cohorts with returns above the HGMP minimum number of natural origin fish) post-juvenile passage and adult transport optimization, before evaluating the effectiveness of the Preferred Alternative measures on adult returns and in making decisions related to hatchery Chinook salmon production and management. This will help bridge the gap among potential stochastic events that can cause the runs to be abnormally high or low.

On a separate note, state and federal fisheries management agencies and international decision-making bodies are regarded as the authority on fishery and hatchery management decisions. Willamette Valley hatchery fish were originally produced to mitigate for lost fishing opportunities and still serve a purpose in maintaining mitigation fisheries. These fish contribute to fisheries in the Willamette, the Lower Columbia, and in the ocean from Oregon to Alaska.

Measure 9 - Maintain Revetments Using Nature-Based Engineering or Alter Revetments for Aquatic Ecosystem Restoration

In the Basin, the presence of revetments and levee structures and associated infrastructure along the mainstem Willamette and the riparian zones and wetlands of the Willamette and its tributaries have reduced habitat complexity, led to homogenization of habitats, and decreased overall ecological function (Moyle and Mount 2007; Poff, et al. 1997). Levees and revetments that are Corps authorized or maintained disconnect floodplain, off-channel, riparian, and wetland habitats to the detriment of a wide spectrum of fish species and their habitats.

It is difficult to see any added benefit of this measure as it is written in the current draft of the EIS. It does not include targets such as “conversion of X amount of bank length” per year to nature-based revetments. It only mentions improving sites that need repair if they have been funded, and it includes no mention of levee setbacks. It also lacks any certainty of implementation needed for NMFS to consider the measure as a reasonable form of conservation for offsetting dam operations or floodplain disconnection. The introduction of nature-based engineering alone does not address the need to increase connectivity with other habitats (e.g., off-channel, wetland), encourage natural disturbance processes, and ultimately increase overall ecosystem function. However, nature-based engineering does have some positive potential, such as providing habitat for native riparian vegetation and decreasing hard surface area (e.g., rock) within the system.

The true benefit from this measure would come from projects similar to the Corps Engineering with Nature (EWN) program, which could include construction of setback levees, notching, or other modifications of current levees to increase riverine connectivity and operational flow management. The Corps is currently working with local agencies on a large setback levee project called the “San Francisco District’s Pajaro River Flood Risk Management Project (Pajaro)”,

which could potentially provide a model for similar projects in the UWR. These actions could promote floodplain function, including an increase in open-water riverine connectivity, and in the frequency and duration of disturbance processes necessary to maintain habitat elements.

5.2.2. North Santiam – Big Cliff Dam and Detroit Dam

Injunction Measures - also see page 11 of DEIS Appendix A.

Current Injunction measures in effect for the North Santiam River sub-basin include:

1) Prioritizing flow at Detroit Dam through non-turbine outlets at night (generally with no turbine operation at night) and only operating the turbines during the day during the fall drawdown and winter months (once reservoir elevation is less than 100 feet over the turbines. This measure is aimed at improving juvenile passage for Chinook salmon, but at elevations more than 100 feet above the upper regulating outlet, will be limited. It does provide a source of cooler water to release into downstream spawning and incubation habitat.
2) At the same time of year, once the Detroit Reservoir is drafted to 1,465 feet or less, using the lower regulating outlets for temperature control purposes. This measure is aimed at cooling temperatures below Big Cliff Dam for incubating salmon eggs.
3) Spreading flow across multiple spillways at Big Cliff Dam. This measure is aimed at reducing TDG.
4) Providing various downstream routes of passage for juveniles and water temperature management options in the late spring and summer through the strategic use of the spillway, turbines, and regulating outlets at Detroit Dam.

Measures Affecting Streamflows and Water Quality:

Measure 30b (Refined Integrated Temp and Habitat Flow) and

Measure 304 (Augment Instream Flows by Using PowerPool at Detroit Dam)

Measure 105 (Construct Water Temperature Control Tower at Detroit Dam)

In Appendix D of DEIS (Figure 1-397), the Corps shows simulated monthly mean water temperatures under the No Action Alternative (NAA) and the other Alternatives under three climatological scenarios: year 2011 (cool and wet), year 2015 (hot and dry), and year 2016 (warm with average precipitation). In general, compared to the NAA, the model shows that Alternative 2b/5 would produce warmer average monthly temperatures at Big Cliff in the months of April through August, warmer temperatures in the month of September (except 2015, in which case the 2b/5 measures would have produced cooler temperatures), and similar temperatures by October (except for in 2015 2b/5 is cooler). It is important to note that the NAA model simulation did not capture the actual outflows in 2015 (hot, dry year), as minimum flows were adjusted downward in all seasons, meaning that the actual conditions were worse than the simulated ones. Comparing the predicted temperatures under Alternative 2b/5 with the target temperatures (set by the fisheries and natural resources agencies) is of greater importance in

assessing the effects of Alternative 2b/5 on NMFS trust resources. Model outputs for Alternative 2b/5 (Figure 1-398; USACE 2022a), show estimated highest and lowest 7DADM temperatures would exceed the temperature target range at least once in each month from April through November under the 2015 and 2016 scenarios and also July through November under the 2011 scenario. In the 2015 scenario, the targets would be exceeded by at least 5°F or more (for at least 1 day) in almost all months of the summer and fall season (June through November). Given that years like 2015 may become more prevalent in the future, the Preferred Alternative does not appear to improve conditions for migrating Chinook salmon adults or for incubating Chinook salmon eggs. Additionally, increasing temperatures at Big Cliff in the summer months could lead to increased temperatures downstream and better conditions for warmwater species that predate juvenile salmonids.

In Appendix D of the DEIS, a formula was used to estimate an improved difference (delay) in Chinook salmon egg emergence timing (by basin) relative to the current early timing under the various alternatives. Under 2b, in the North Santiam basin below Big Cliff Dam, this would range from 0 days later (2011) to 27 days later (2015), and including year 2016, an average of 15 days later. However, this assumes that climate change effects (changes in average air temperatures, precipitation, and the hydrograph) do not further increase temperatures during incubation.

Also, these models likely include the assumption that the water temperature control tower is constructed and in operation, with construction scheduled to begin in 2025 and take 5 years. It remains to be seen if a strategic use of spillways, turbines, and regulating outlets (under the Injunction measures) can achieve similar results in the meantime.

Minimum flows in the North Santiam under Measure 30b will not always meet the required flows under the 2008 WVS NMFS Biological Opinion RPA, during years when achieved storage is <90 percent of the rule curve. In years when storage is >90 percent of the rule curve (“wet” years), the minimum flows under Measure 30b do not meet minimum biological opinion flows from March 16 to April 15 or from September 1 to mid-October. This would be detrimental to juveniles that have the ability to find downstream passage and are ready to migrate to the Willamette River. Chinook salmon fry, subyearlings, and yearlings, and steelhead yearlings are ready to move in March and April and Chinook salmon juvenile fall migrants are ready to move in September and October under current hydrology and passage conditions. This could also be detrimental to Chinook salmon and steelhead adults as it could delay important river flow cues to move upstream or spawn. In “dry” years where fill is <90 percent of the rule curve, this situation would be exacerbated; 2008 RPA minimum flow objectives would not be met mid-March through June and August through November. The only benefit this measure may bring to fish would be for spring Chinook salmon adults in the “wet” years, in which case minimum flows would be higher than required biological opinion minimums from mid-May through September 1, which could potentially improve migration conditions, unless the water is much warmer (as noted above). However, most adult Chinook salmon spawning takes place in September, and at that point, lower flows will reduce available spawning habitat.

In some years, measure 304 could be helpful for meeting minimum flow objectives from June 1 to November 30, when Chinook salmon are rearing, migrating, and spawning. However, this

measure and associated operations may affect the capacity of the temperature management operations that use regulating outlets. As the reservoir gets lower, thermal stratification is reduced, thereby affecting the volume of cold water. It is difficult to determine how the various temperature and flow measures in the Preferred Alternative will affect NMFS trust resources (not including the water temperature control tower, which will take many years to construct and become fully operational), especially in dry years.

According to the TDG analysis and applying their SYS-TDG model to the last 84 years, the operations under Alternative 5 would never exceed 120 percent TDG, but TDG would be higher than it is under the NAA most of the time at both Detroit and Big Cliff dams. Under the NAA, it appears to be below 110 percent 75 percent of the time, but under Alternative 5, only 12 percent of the time at Detroit. TDG below Big Cliff Dam under the NAA is below 110 percent at least 60 percent of the time, yet only 20 percent of the time under Alternative 5. TDG is problematic at Detroit Dam and often the higher TDG concentrations make it all the way below Big Cliff Dam. There is an interim measure aimed at mitigating TDG issues through spreading spill flow among multiple spillways at Big Cliff. While structural improvements to reduce TDG were not included in Alternative 5, they are scheduled to be provided by 2027 under the related Injunction Measure.

Measures Affecting Juvenile Passage:
Measure 392 - Construct Structural Downstream Fish Passage at Detroit Dam
Measure 105 from above (not for juvenile passage but affects juvenile passage)

Two of the Injunction Measures for the North Santiam are aimed at improving juvenile "passage availability". The fall drawdown, and limiting use of turbines during nighttime, could provide additional opportunities for fall subyearling Chinook salmon migrants to move past Detroit Dam and avoid over-wintering in the reservoir if the elevations were low enough. However, the minimum conservation pool elevation (1,450 feet) is greater than 100 feet above the elevation of the upper regulating outlets (1,340 feet.). Therefore, this operation may not create flows that attract juveniles to pass through the regulating outlets effectively unless elevation is reduced below the minimum conservation pool. The strategic use of the spillways, turbines, and regulating outlets could provide additional passage opportunities at Detroit Dam in the spring for early fry migrants and yearling Chinook salmon; however, the use and timing of these routes and the survival rates for juveniles passing through these routes (by life stage) would need to be monitored and evaluated in order to confirm actual benefits. The water temperature control tower at Detroit Dam (measure 105) should be designed with juvenile fish passage standards in mind as well.

The construction and operation of a "floating screen structure (FSS)" above Detroit Dam could provide a large benefit to Chinook salmon and steelhead. Once the FSS is constructed and operational, adult steelhead transport above Detroit Dam could begin, especially if the FSS attracts a high proportion of downstream migrating juveniles and provides them with safe passage. If the juvenile fish captured in the FSS are trucked to locations below Big Cliff Dam then that will likely ensure a much higher survival rate than past or current operations at Detroit Dam and Big Cliff Dam support. In addition, this will do so for most of the year, which will increase diversity of life history strategies and spread migration timing. Unfortunately,

construction of the FSS is not scheduled to begin until 2030, with completion scheduled for 2036. Once the FSS is constructed, monitoring studies should be conducted to ensure that the majority of juveniles are being attracted to the FSS under most operations and conditions and not through any of the dam structures with high juvenile injury and mortality rates.

Other North Santiam Measures

Measure 384 - Gravel Augmentation Below Big Cliff Dam

See Section 5.2.1 above ("Measures that Pertain to the Mainstem Willamette and/or Multiple Sub-Basins").

Measure 719 – Adapt Hatchery Program

See Section 5.2.1 above ("Measures that Pertain to the Mainstem Willamette and/or Multiple Sub-Basins").

Overall Effect of Alternative 5 on Viability of Spring Chinook and Steelhead Populations

According to the Northwest Fisheries Science Center's (NWFSC) Life Cycle Modeling (LCM) results (NWFSC 2022), which were based on a great number of assumptions, the total VSP score for the North Santiam River Chinook salmon population under Alternative 2b/5 was above 3.5, which was nearly the highest VSP score among all of the alternatives. Alternative 2b/5 also performed well for the estimated number of natural-origin spawners (compared to the other models) and resulted in a very low probability for quasi-extinction (threshold of 150 adults) over the next 100 years.

According to the NWFSC LCM results (NWFSC 2022), the total VSP score for North Santiam River steelhead population under Alternative 2b was also above 3.5 and nearly the highest VSP score among all of the alternatives. Alternative 2b also performed well for the estimated number of natural-origin spawners (compared to the other models) and resulted in a very low probability for quasi-extinction (threshold of 150 adults) over the next 100 years.

Passage structures (FSS and FSC) provided the highest passage survivals and dam passage efficiencies (DPE) compared to the operational alternatives, as determined by the FBW. Furthermore, DPEs for most of the operational alternatives were much lower than for structures. These differences were largely due to intermediate reservoir elevations during the process of drawing down or refilling a reservoir, processes that can take several weeks or more. When the reservoirs were not at optimal passage elevations, fish attempting to pass (as determined by the FBW) were delayed and subject to reservoir mortality while waiting to attempt passage at another life history passage window.

A VSP score of 3.5 to 4 equates to a low to very low risk of extinction. According to the NWFSC Life Cycle Model results, the North Santiam Chinook population could reach and maintain its recovery goal (a VSP score of 3 or more) under the measures proposed for Alternative 2b/5. The LCM model result for North Santiam steelhead would be slightly lower than the NMFS Recovery Plan goal (VSP of 4) for this critical population of UWR steelhead.

These results are based on the model inputs from the FBW for FSS collection efficiency and assume that the Measures under Alternative 2b/5 are all implemented within a short period of time. The current Preferred Alternative "implementation timeline" for these North Santiam measures is as late as 2036 to complete FSS construction, 13 years away.

Effects to Other Trust Species in North Santiam

Coho salmon in the North Santiam sub-basin are unlikely to be negatively affected by most of these measures because they tend to spawn in the lower reaches, are more tolerant of higher temperatures, and appear to be returning to the basin on a regular basis despite current conditions. Additionally, there is no current plan to transport adult coho salmon above the project dams in the North Santiam for the purpose of improving their population's viability parameters.

It is possible that some kokanee residing in the Detroit or Big Cliff reservoirs (and managed in these reservoirs for recreational fishing opportunities) may pass downstream through either of the dams via new operational measures. Rotary screw traps (RST) are operated below Big Cliff Dam throughout the spring for monitoring purposes (RST catch represents just a proportion of the total number of each species moving downstream). In the spring of 2023, 157 kokanee, 22 bluegill, and 48 pumpkinseed (*Lepomis gibbosus*) were observed in the RST catch. It is difficult to predict the effect this could have on the reservoir kokanee populations, but a reduction in density and competition could lead to faster growth among the kokanee that remain in the reservoir, or potentially, to a depensatory effect (Rieman and Maiolie 1995).

Effects to Species which Directly or Indirectly Affect NMFS Trust Species (in North Santiam).

Pacific lamprey and brook lamprey, which were once historically present throughout the sub-basin, are not likely to benefit from any of the proposed measures for the North Santiam basin. Though they are currently present in the basin up to the Bennett Dams, the presence of the federally managed dams and an absence of passage routes through the dams has limited their ability to re-occupy their historical distribution. There are no measures directed at improving their ability to do so volitionally or non-volitionally. Lacking benefits for lamprey is likely to cause harm to NMFS trust species, as salmonids evolved when lamprey were already present in the ecosystem. Lamprey's role as prey buffer for juveniles benefits salmonid species. Any measures that benefit salmonid species downstream of Big Cliff Dam are likely to benefit lamprey species. Rapid fluctuations in reservoir elevations or in river flows (below dam projects) could negatively affect juvenile lamprey (ammocoetes) by drying out important habitat areas or making them less inhabitable (Ojutkangas et al. 1995).

It appears that neither Detroit or Big Cliff reservoir will be drawn down low enough (for salmon temperature and passage improvements) to help draw out some of the predator populations inhabiting the North Santiam reservoirs and move them into less hospitable habitats, which could thereby reduce predation pressure on listed salmonids and improve reservoir survival. While it is possible that the new operations may continue to move introduced species to areas below the dams (such as bluegill and pumpkinseed noted above), it is difficult to quantify the additional effect this could have on trust species below the projects.

5.2.3. South Santiam River Sub-Basin - Foster Dam and Green Peter Dam

Injunction Measures - also see page 11 of DEIS Appendix A.

Current injunction measures in effect for the South Santiam River sub-basin include:

1) Beginning in spring 2022, once Green Peter Reservoir reaches elevation 971 feet, spill continuously until May 1 or for at least 30 days, whichever is longer. (Injunction Measure 12(a)).
2) Conduct a fall drawdown of Green Peter Reservoir to a target elevation of 780 feet by November 15, and hold at that elevation until December 15. Generally, use the regulating outlets exclusively to pass flow once the reservoir is below minimum power pool (887 feet). (Injunction Measure 12(b)) Note: This operation is anticipated to begin in fall 2023.
3) Draw down Foster Reservoir to elevation 620–625 feet by October 1, and operate the Foster Dam spillway, with limited turbine operation, from 1 hour before sunset to a half hour after sunrise from October 1 through December 15. (Injunction Measure 13(a)).
4) Hold Foster Reservoir at minimum conservation pool (elevation 613 feet) and operate the Foster Dam spillway, with limited turbine operation, from 1 hour before sunset to a half hour after sunrise from February 1 through May 15. Beginning May 16, refill Foster Reservoir, targeting full pool by Memorial Day Weekend, and operate the Foster Dam spillway, with limited turbine operation, from 1 hour before sunset to a half hour after sunrise until June 15. Beginning June 16 through mid- to late-July, operate the Foster fish weir for downstream water temperature management. (Injunction Measure 13(b)).
5) Outplant spring Chinook salmon adults for reintroduction above Green Peter Dam in both the Middle Santiam River and Quartzville Creek. (Injunction Measure 11). Monitor the success of their offspring migrating during subsequent passage operations, beginning in spring 2023.

Measures Affecting Streamflows and Water Quality:

Measure 30b (Refined Integrated Temp and Habitat Flow)

Measure 304 (Augment Instream Flows by Using Active Pool at Green Peter Dam)

Measure 166 (Use RO for Temperature Management at Green Peter Dam)

Measure 721 - Use Green Peter Dam Spillway to Release Warm Surface Water Until August (or Until Dry)

Measure 392 at Foster Dam: Downstream fish passage structure with 500-800 cfs surface spill

Measure 479 Foster Warm-Water Supply pipe (FWWS) to the existing adult fish ladder at the Foster Fish Facility

Plus Passage Measures 40 and 714 Below

In Appendix D of DEIS (Figure 1-397), model predictions for monthly mean water temperatures under the No Action Alternative (NAA) and the other Alternatives are reported for three different climatological scenarios: year 2011 (wet), year 2015 (dry) and year 2016 (average). In general, compared to the NAA, the models predict that (under Alternative 2b/5) average monthly temperatures on the South Santiam will be generally warmer in the months of April, May, and especially June (up to 6 degrees warmer) under all scenarios. Under the wet and average year scenarios, temperatures will continue to be warmer under 2b/5 through August (up to 8 degrees in August for a wet year) and will then come closer to the NAA. Interestingly, under the dry year scenario, average monthly temperatures would be 4 to 12 degrees cooler from the monthly of July to September (compared to the NAA). This demonstrates that at least during an extreme dry year event, temperatures appear better under the new measures than in the NAA simulation; however, it does not mean that the temperatures will be ideal for salmonids.

More important than the difference between the NAA and Alternative 2b/5 is how predicted Alternative 2b/5 average temperatures compare to the temperature targets (set by the fisheries and natural resources agencies), which aim to reflect more natural, pre-dam project temperatures. Keeping the river closer to these temperature ranges is critical to the timing of salmonid migrations and spawning and the overall productivity of their populations. Based off of model outputs for Alternative 2b/5 at the SSFO temperature gauge on the South Santiam (Figure 1-399), for estimated highest and lowest 7DADM temperatures for each month under the dry-year scenario, the 7DADMs would exceed the temperature target range by more than 5°F (at least once) in all months from April to June and from October to December. Under the average year scenario, these temperature target ranges would be exceeded at least once by 5 degrees or more in all months from April to August and in October and December. Even under the wet year scenario, the targets would be exceeded by at least 5°F or more (for at least 1 day) from August through November. Given that years like 2015 are likely to become more prevalent in the future, the Preferred Alternative does not appear to improve conditions for migrating steelhead or Chinook salmon adults or for incubating Chinook salmon eggs. Additionally, increasing

temperatures below Foster Dam in the summer months could lead to increased temperatures downstream and better conditions for warmwater species that predate juvenile salmonids.

Operations under Measure 166 would occur from October 1 to November 15 at Green Peter Dam, primarily as a means of cooling the river for the benefit of Chinook salmon egg incubation below Foster Dam. It is not clear if this operation will cool temperatures significantly because the ROs are located close to the turbines (moving water from similar depths) and the turbines would likely also be running some of the time. Similarly, it is unclear if there would be a benefit or a cost to fish passage for juvenile Chinook salmon migrants via this measure, especially because of the proximity of the ROs to the turbines. If it is a benefit, it would complement the Green Peter Reservoir fall drawdown timing, which is a current injunction measure (November 15th to December 15th) and also part of Measure 40 (below). It would be unfortunate if fall migrants were attracted to the ROs and turbines under measure 166 and many of them passed through Green Peter through the turbine route prior to lower elevation drawdown on November 15, which would allow RO passage more suited toward juvenile downstream passage.

During a large proportion of the year, proposed minimum flows for the South Santiam under Measures 30b and 304 would not meet the required minimum flows under the 2008 WVS Biological Opinion, especially if the reservoir is filled to <90 percent of the rule curve volume, when they are significantly lower. Even when refill is greater than 90 percent of the rule curve volume, the minimum flows under Measure 30b do not meet minimum required biological opinion flows from March 16 to April 15 or from September 1 to mid-October. This would be detrimental to juveniles that have the ability to find downstream passage and are physiologically ready to migrate to the Willamette (both steelhead and Chinook salmon yearlings and Chinook fry ready to move in April, and Chinook fall migrants ready in September). In years where the fill is <90 percent, this situation would be exacerbated and minimum required flows would not be met for even longer periods of time (early February through mid-June and September through mid-October). The only benefit these measures might produce would be for spring Chinook salmon adults, particularly in years where the fill is >90 percent, in which case minimum flows would be slightly higher than required biological opinion minimums from mid-May through June 30 (40 cfs) and higher July 1–September 1, which could potentially encourage adults to migrate upstream earlier and reduce pre-spawn mortalities (before they reach the ladder at Foster or their spawning grounds). As adults return to spawn through the end of September, the tail end of the return could run into lower flows (and higher temperatures) during a time when the RPA minimum flow objectives increase significantly.

Compared to an alternative that does not include measure 304, the increased volumes from the power pool could be helpful from June 1 to November 30 when Chinook salmon are returning and spawning.

Under Measure 721, up to 60 percent of flow would be released from the spillway at Green Peter Dam in the spring and summer to improve attraction temperatures for upstream migrating adult Chinook salmon. While this could certainly improve adult Chinook salmon delays, like measure 479, it might also provide a route of passage for yearling Chinook salmon juveniles being produced above Green Peter that have not yet passed (if conditions are not harmful). That said, one of the current Injunction measures requires spill operations at Green Peter for at least 30

days until May 1st, and there is another measure (714, see below) requiring downstream spillway passage from May 1 to July 1. The benefit of this measure and the early spring spill Injunction Measure for Chinook salmon juveniles will depend on the success of adults being outplanted above Green Peter Da, and also the passage conditions through the Green Peter Dam spillway.

There are no TDG measures within Alternative 5 for Green Peter and Foster dams. According to the TDG analysis in the DEIS, which applies the SYS-TDG model to the last 84 water years, the model predicts TDG levels exceeding 110 percent at Green Peter Dam for an average of 151 days per year and for 126 days per year at Foster Dam. Under Alternative 5, Green Peter Dam results in an increase of 139 days of TDG exceedances, and Foster Dam is increased by 94 days as compared to the NAA. The average number of days of spill per year at Green Peter Dam would be 190 days and 284 days at Foster Dam.

Passage-Related Measures

Measure 479 - Foster Fish Ladder Temperature Improvement

This measure would benefit adult migration delays (to the Foster Dam adult fish facility at least) and reduce the risk of pre-spawn mortality as it would encourage spring Chinook salmon and steelhead to pass into the facility sooner and be transported to upstream spawning areas. There is a plan to screen the intake with a juvenile fish screen so there should be no harm to juvenile fish.

Measure 40 - Deep Fall Reservoir Drawdown at Green Peter Reservoir via RO (like injunction measure above)

Unlike Measure 166 above, this measure is aimed at aiding juvenile passage by providing a high degree of attraction flow to the ROs at Green Peter Dam by November 15 (drawdown actually begins July 1 to achieve ideal attraction elevation of 25 feet above the ROs by November 15). If the passage conditions through the ROs do not cause high levels of mortality or injury, this measure could provide a great benefit to juvenile Chinook salmon subyearlings, assuming they have not already passed through the dam or been predated by pikeminnow and smallmouth bass in Green Peter reservoir. Monitoring for effectiveness and passage conditions / survival is highly recommended for studying the effectiveness of this measure. Turbine operations will be limited to 8 hours in daytime from November 15 to December 15.

Measure 392 - Construct Structural Downstream Juvenile Passage at Foster Dam (in meantime will operate the spillway in fall and spring at night)

Providing downstream fish passage using a floating screen structure (including gravity-fed flow and pumps) at Foster Dam could be a very beneficial measure for both Chinook salmon and steelhead juveniles in the South Santiam, assuming the structure is effective at attracting juveniles given the other operations occurring at Foster dam at the same time. Under this measure, the direction would be to prioritize turbine operations at night time hours and to minimize power peaking. The main issue with this measure is that it is not scheduled to begin until 2031, at the earliest. Until then, juveniles that survive passage through Green Peter Dam and juveniles produced in the South Santiam River above Foster Dam will hopefully benefit from the Injunction measure for spill in the spring and fall during nighttime hours (see above).

Measure 714 - Downstream Spring Spillway Passage at Green Peter Dam (like injunction measure above)

This measure differs in timing (May 1 to July 1) compared to the current Injunction measure (see above) to spill until May 1 for a minimum of 30 days. The earlier injunction operation would be of greater benefit to Chinook salmon yearling migrants, whereas this measure could benefit fry migrants but possibly not yearling migrants. Although according to the Chinook salmon periodicity table in the South Santiam 2022 Fish Operations Plan, subyearlings in this basin do migrate in April through July (Corps 2022c). Steelhead juvenile migrants are not currently present above Green Peter Dam, unless you include rainbow trout offspring that choose to migrate. It is unclear how turbine operations would be prioritized under this operation at Green Peter Dam.

Measure 52 - Provide Pacific Lamprey Passage and Infrastructure at Green Peter

Pacific lamprey are commonly observed at the South Santiam Fish Facility where lamprey-friendly passage has been included. Construction of the Green Peter Adult Fish Facility, including lamprey passage improvements, is scheduled to be completed by 2032. Any efforts to reintroduce Pacific and brook lamprey and improve lamprey production above these facilities in the South Santiam basin are likely to benefit Chinook salmon and steelhead juveniles that may be produced above Foster Dam and Green Peter Dam.

Measure 722 - Construct Adult Fish Facility at Green Peter Dam

There is general support for passing fish above Green Peter, which began this year with outplanting hatchery-origin Chinook salmon. If these adults are producing viable offspring and a few survive and return as adults, it will not be possible to distinguish between these fish and the offspring of the adults being released in the South Santiam branch (above Foster) when they arrive at the Foster Adult Fish Facility. This necessitates an additional adult fish facility below Green Peter for adults that are ideally homing back to their natal spawning areas above Green Peter Dam. However, this proposed solution requires double the amount of trapping, handling, and transport stress for Chinook salmon adults headed to areas above Green Peter, which is less than ideal. Construction of the Green Peter Adult Fish Facility, included lamprey passage improvements, is scheduled to be completed by 2032.

Other South Santiam Measures:

Measure 384 - Gravel Augmentation Below Foster Dam

See Section 5.2.1 above (“Measures that Pertain to the Mainstem Willamette and/or Multiple Sub-Basins”).

Measure 719 – Adapt Hatchery Program

See Section 5.2.1 above (“Measures that Pertain to the Mainstem Willamette and/or Multiple Sub-Basins”).

Overall Effect of Alternative 5 on Viability of Spring Chinook and Steelhead Populations

According to the Northwest Fisheries Science Center's (NWFSC) Life Cycle Modeling (LCM) results (NWFSC 2022), which were based on a great number of assumptions, the total VSP score for the South Santiam River Chinook salmon population under Alternative 2b was less than 1 and not much different than the predicted viability score under the NAA scenario. Despite the large number of measures aimed to improve flow, water quality, and passage conditions for South Santiam Chinook salmon under Alternative 2b (and many others), all alternatives resulted in poor results for this population other than Alternative 1, which included both structural downstream passage at Green Peter and a modified fish weir at Foster Dam including juvenile collection. Alternative 2b did not perform well for the estimated number of natural-origin spawners or spawners in above-dam reaches (only a little higher than the NAA) and resulted in nearly 100 percent certainty of quasi-extinction (threshold of 250 adults) over the next 100 years (similar to the NAA). The pHOS (percent hatchery fish on spawning grounds) estimate also remained relatively high under Alternative 2b (not much lower than the NAA), and the abundance of different life history stages (juveniles) also improved.

According to the NWFSC LCM results (NWFSC 2022), the total VSP score for South Santiam River steelhead population under alternative 2b was above 2.0, the second-highest VSP score among all of the alternatives (lower than Alternative 1). Alternative 2b performed better than the NAA for estimated number of natural-origin spawners (though half as good as Alternative 1), especially for natural-origin spawners above the dams and resulted in a very low probability for quasi-extinction (threshold of 200 adults) over the next 100 years.

A VSP score between 0 and 1 equates to a high to very high risk of extinction, and 2.0 is a moderate risk of extinction. The NMFS Recovery Plan goal for the South Santiam Chinook salmon population is a VSP score of 2 and a score of 4 for the basin's steelhead population. Based on the LCM model results, the South Santiam Chinook salmon population would not reach its recovery goal, and the steelhead population would remain very far from recovery under the measures proposed for Alternative 2b/5. The model suggests that measures under Alternative 1 (structural passage at Green Peter Dam) would help both populations exceed or come close to achieving VSP recovery goals (Chinook salmon would come close to 3/2, and steelhead close to 3.5/4).

Effects to Other Trust Species in South Santiam

Coho salmon in the South Santiam sub-basin are unlikely to be negatively affected by most of these measures because they tend to spawn in the lower reaches, are more tolerant of higher temperatures, and appear to be returning to the basin on a regular basis despite current conditions. Additionally, there is no current plan to transport adult coho salmon above the project dams in the South Santiam for the purpose of improving their population's viability parameters.

While it is possible that some kokanee or rainbow trout residing the Green Peter or Foster reservoirs may pass downstream through either of the dams through the new measures, they are mainly resident forms and may not be attracted to these passage routes. If any kokanee or rainbow trout have passed through the dams' current operations, it has not been an observable

number. RST data from mid-June of 2023 for "non-target species" collected in Foster Reservoir mostly include dace, largescale sucker, one sculpin (*Cottus* sp.), and one cutthroat trout (*Oncorhynchus clarki*).

Effects to Species which Directly or Indirectly Affect NMFS Trust Species (in South Santiam)

Pacific lamprey and brook lamprey were once historically present throughout the sub-basin. Pacific lamprey may benefit from the proposed measure to provide lamprey passage at the new Adult Fish Facility at Green Peter Dam, if there is a plan to begin transporting adult lamprey from the South Santiam Fish Facility to areas above Foster and/or Green Peter Dam. Though lamprey are currently present in the basin up to Foster Dam, the presence of the federal dams, and an absence of passage routes through the dams, has limited their ability to re-occupy their historical distribution. Measures that are beneficial to lamprey are generally beneficial to NMFS trust species (see Species section information). However, it is important to ensure that lamprey passage structures do not accidentally attract salmonids to areas where they could get trapped. It is possible that the Green Peter fall drawdown measure could affect juvenile lamprey if they inhabit shorelines of the reservoir and reservoir elevations decrease rapidly during drawdown.

Any measures that benefit salmonid species downstream of Big Cliff Dam are also likely to benefit lamprey species. Rapid fluctuations in flows and river depth are likely to negatively affect lamprey, especially ammocoetes.

5.2.4. McKenzie River Sub-Basin - Cougar Dam and Blue River Dam

Injunction Measures - also see page 11 of DEIS Appendix A.

Current injunction measures in effect for the South Santiam River sub-basin include:

1) Conduct a fall drawdown of Cougar Reservoir to a target elevation of 1,505 feet by November 15 until December 15, and generally use the regulating outlets exclusively during that time to pass flow. (Injunction Measure 14).
2) On December 16, initiate the refill of Cougar Reservoir to minimum conservation pool (elevation 1,532 feet) and hold until March 1. On March 1, begin drafting Cougar Reservoir to reach elevation 1,520 feet by April 1. Using adaptive management to determine the refill starting date, delay the refill of Cougar Reservoir from elevation 1,520 feet as long as possible while maintaining a high likelihood of reaching elevation 1,571 feet by July 1 to enable use of the water temperature control tower in late summer and fall. From December 16 through June 1, prioritize the regulating outlets at night to pass flows. In September, transition to the fall drawdown operation. (Injunction Measure 15).

Measures Affecting Streamflows and Water Quality:

Measure 30b (Refined Integrated Temperature and Habitat Flow)

Measure 718 (Augment Instream Flows Using Inactive Pool at Blue River Dam)

and Measures Below (For Passage)

In Appendix D of the DEIS (Figure 1-397), model predictions for monthly mean water temperatures under the NAA and under the other Alternatives are compared for three different climatological scenarios: year 2011 (wet), year 2015 (dry), and year 2016 (average). In general, the models predict that under Alternative 2b/5 and the 2011 scenario (wet), average monthly temperatures on the South Fork McKenzie (below Cougar Dam) will be warmer in the months of October and November (up to 6°F) but cooler in other months compared to the NAA. Under the dry scenario, temperatures will be similar to the NAA in the spring months and cooler (by 5°F) from July through December under 2b/5. Under the average year scenario, temperatures would be cooler from June through most of August and slightly cooler through most other months (compared to the NAA). This demonstrates that at least during an extreme dry year event, temperatures could be better under the new measures than in the NAA; however, it does not mean that the temperatures will be ideal for salmonids.

More important than the difference between the NAA and Alternative 2b/5, is how predicted average temperatures under Alternative 2b/5 compare to the temperature targets (set by the fisheries and natural resources agencies), which aim to reflect more natural, pre-dam project temperatures. Keeping the river closer to these temperature ranges is critical to maintaining Chinook salmon migration timing, spawning, and the overall productivity of their population. Model outputs for Alternative 2b/5 (Figure 1-400) under a wet-year scenario show that 7DADM temperatures on the South Fork McKenzie below Cougar Dam would exceed the temperature target range by more than 5°F (at least once) in October and November, which could continue to cause premature fry emergence. Under the dry year scenario these temperature target ranges would be exceeded at least once by 2 to 4°F in April, May, and June. In the average year scenario, the targets would be exceeded by 2–3°F or more in the early spring and late fall. Predicted temperatures under the Preferred Alternative at this location were closer to meeting the sub-basin fish target temperatures than any other sub-basin affected by the DEIS. However, during a wet year, it is possible that the river may be too warm in October and November to prevent pre-spawn mortalities and rapid egg development.

In years that the Cougar Reservoir is filled to <90 percent of the rule curve, proposed minimum flows for the McKenzie River would not meet the required minimum flows under the 2008 WVS Biological Opinion from February through June (other than the second half of May). This could be detrimental to Chinook salmon juveniles that have the ability to find downstream passage at that time and are physiologically ready to migrate to the Willamette River. This period of lower than minimum required flows covers most of the entire period of time that Chinook salmon juveniles (regardless of life stage) migrate downstream in the spring. The only benefit the new proposed minimum flows might have would be for spring Chinook salmon adults, particularly in years where the fill is >90 percent, in which case minimum flows would be higher than required

biological opinion minimums from April through November, which could potentially increase spawning opportunities and success if stream temperatures are also beneficial. However, if and when the deep drawdown to the diversion tunnel can also maintain outflow equal to inflow, juveniles will benefit from more riverine-like conditions and a clearly identifiable passage route through the dam.

In some respects, and compared to an alternative that does not include it, measure 304 could be helpful from June 1 to November 30 for adult Chinook salmon that are returning and spawning in the mainstem McKenzie River below the Blue River confluence.

There are no TDG measures for Alternative 2b/5 for Cougar (or Blue River) Dam. Under Alternative 2b, the average number of days per year above 110 percent TDG levels at Cougar is 27 days. The annual difference in number of days above 110 percent TDG decreases by 30 days under Alternative 2b/5, as compared to the NAA. The average number of spill days per year at Cougar under Alternative 2b/5 is 46 days.

Passage-Related Measures

Measure 40 - Deeper Fall Reservoir Drawdown at Cougar for Downstream Fish Passage

Measure 720 - Spring Reservoir Drawdown at Cougar for Downstream Fish Passage

This measure differs from the Injunction measure for fall drawdown because it specifies bringing the reservoir down to 25 feet over the Cougar Diversion Tunnel for downstream passage, as opposed to drawing down for passage via the ROs, which requires passage through the water temperature control tower first. This could be very beneficial to juvenile Chinook salmon passage if the passage conditions through the tunnel via this operation do not kill or injure a large proportion of the passing juveniles. Before this operation could begin, investigations are needed to determine how well the tunnel structure and operation conditions meet downstream juvenile fish passage requirements and necessary modifications, including the likely need to modify structures in the middle of the tunnel like the rock traps and the transition to the control gate chambers in the middle of the tunnel. The tunnel is 2,000 feet long and was the original diversion channel used during Cougar Dam construction. Even after juvenile passage modifications are completed, studies should be conducted to determine survival and injury rates, passage efficiency, and passage timing. The proposed timing for this operation would be from November 15 to December 15. This covers a portion of the window for fall subyearling Chinook salmon migration but does not cover the ideal times for other life history strategies (or for juvenile steelhead migration).

Measure 720 is similar to the Injunction measure above, as the objectives for both are to let more spring flow through the regulating outlets or diversion tunnel by delaying spring refill as a means to improve passage opportunities for Chinook salmon (and steelhead) yearlings and fry. In the Injunction Measure, they reach the low elevation by April 1, and under this Measure, the goal is to reach the target elevation by May 1 (and hold until June 15). Also, turbine operations would be limited to 8 hours in the daytime from when the drawdown begins through when refill begins (May 1 to June 15).

If the passage conditions through the tunnel, and through the ROs during drawdown, are safer for juvenile fish than current operations (which, appear quite rocky and rugged, especially through temperature control tower and ROs or penstocks and turbines), then this could add to the benefits provided by the fall drawdown, though the timing is on the back end of peak spring Chinook salmon yearling migration. This operation could also provide an outlet or passage route that has better attraction flow and is easier for juveniles to find, which could improve passage efficiency. The safety of the tunnel for passage will be very dependent on the head or reservoir elevation compared to the tunnel elevation. If the tunnel is opened when the reservoir elevation is still too high (for the purposes of being able to meet refill targets), this operation may not provide better passage. One concern with diverting the flow through the tunnel would be that it might also provide attraction flow at the downstream end for upstream migrating adults, especially steelhead based on the timing of the operations. However, since the current RO and RO spillway passage route has very poor survival, this new measure should be an improvement. Assuming this is true, steps needed to begin testing these tunnel operation measures should be prioritized and fast-tracked as much as possible.

Measure 384 - Gravel Augmentation Below Cougar Dam and Blue River Dam

See Section 5.2.1 above ("Measures that Pertain to the Mainstem Willamette and/or Multiple Sub-Basins").

Measure 719 – Adapt Hatchery Program

See Section 5.2.1 above ("Measures that Pertain to the Mainstem Willamette and/or Multiple Sub-Basins").

Overall Effect of Alternative 5 on Viability of McKenzie Spring Chinook Population

According to the Northwest Fisheries Science Center's (NWFSC) Life Cycle Modeling (LCM) results (NWFSC 2022), which were based on a great number of assumptions, the total VSP score for the McKenzie River Chinook salmon population under Alternative 2b was nearly 3.5 and the third-highest overall VSP score among all of the alternatives. Alternatives 2a and 4 scored higher and included the use of a FSS to pass juveniles downstream (at high collection efficiencies and with minimum mortality). Alternative 2b was an improvement over the NAA. The Preferred Alternative performed marginally for the estimated number of natural-origin spawners in the basin and above the dam but still resulted in a very low probability (~10%) for quasi-extinction (threshold of 250 adults) over the next 100 years.

While a VSP score of 3 or greater does equate to a low risk of extinction, the VSP recovery goal for the genetic-legacy McKenzie River Chinook salmon population is a score of 4, which would not be achieved under the measures proposed for Alternative 2b/5, though it is an improvement over the no-action alternative. However, it is also true that the Fish Benefit Workbook survival score for tunnel passage is the same as the survival rate assigned to the RO passage route, which is quite low. If the tunnel operation can provide juveniles with better passage conditions and better survival than the current RO and turbine routes, then the LCM prediction for McKenzie River spring-run Chinook salmon viability in the long-term would improve.

Limited Discussion of Effects to Other Trust Species in the McKenzie River

Since very few coho salmon have ever been observed in the McKenzie River, the measure is unlikely to affect coho salmon.

Limited Discussion of Effects to Species Which Directly or Indirectly Affect NMFS Trust Species

The tunnel drawdown operations could potentially help draw introduced non-native and native predator species out of the reservoir, and ideally, into less hospitable habitats. Drawdowns could potentially increase their abundances in the lower McKenzie or Willamette river mainstems but could also help reduce their numbers in the reservoir and improve survival for juvenile salmonids migrating downstream from the upper South Fork McKenzie (through Cougar reservoir and dam). Recent RST data from below Cougar reservoir from mid-June 2023 shows that most of the "non-target" species catch consisted of dace (*Rhinichthys* spp.) (507), *O. mykiss* (i.e. rainbow trout or steelhead) (38), sculpin (30), mountain whitefish (*Prosopium williamsoni*) (10), and 2 bull trout.

Any of the measures that are beneficial to salmonids downstream of Cougar Dam may also benefit lamprey species, such as temperature or flow improvements, but there are no measures that are targeted toward lamprey recovery or passage in the McKenzie River Basin. Rapid fluctuations in flows and river depth downstream of Blue River and Cougar dams are likely to negatively affect lamprey, especially ammocoetes.

5.2.5. Middle Fork Willamette River Sub-Basin - Fall Creek Dam, Hills Creek Dam, Dexter Dam, Lookout Point Dam

Injunction Measures - also see page 11 of DEIS Appendix A.

1. Implement regulating outlet spill operations daily from 6-10 p.m. at Hills Creek Dam once the reservoir elevation is 50 feet or less above the regulating outlets in the fall through March 1 (Injunction Measure 8/Corps Interim Measure 20).
2. Use storage from Hills Creek Reservoir to begin refilling Lookout Point Reservoir in early March. Once Lookout Point Reservoir reaches elevation 890 feet, spill water over the spillways 24/7 for at least 30 days at both Lookout Point and Dexter dams while maintaining the elevation of Lookout Point Reservoir between 890–893 feet. During that time, generally do not operate the turbines at both projects, with limited exceptions. After that initial 30-day period, spill at night at both projects, with generation during the day, for as long as water is available and downstream conditions allow. Then manage Lookout Point Reservoir to achieve elevation 887.5 feet by July 15, 2022, and operate the regulating outlets as needed to reduce downstream water temperatures when water temperatures downstream of Dexter Dam near 60°F (Injunction Measure 17).
3. Conduct deep drawdown of Lookout Point Reservoir and prioritized use of the ROs to improve downstream fish passage and survival. The Corps will conduct a deep drawdown in 2023 and 2024 according to this implementation plan unless unfeasible due to landslide, public safety or dam safety concerns (Injunction Measure 16). The initiation of

drawdown (to achieve 750 feet elevation) is expected to occur in June or July and once the spring spill operation has ended.

4. Conduct the annual Fall Creek Reservoir deep drawdown operation similar to prior years but extend the dates from December 1 through January 15 (Injunction Measure 19).
5. On January 16, begin the refill of Fall Creek Reservoir to elevation 700 feet, and hold at that elevation through March 15. On March 16, initiate the refill to reach elevation 728 feet by April 15, and maintain that elevation through May 15, unless additional refill is necessary to ensure operation of the Fall Creek Adult Fish Collection Facility through September 30. After May 15, refill the reservoir to the extent possible (Injunction Measure 20).

Measures Affecting Streamflows and Water Quality:

Measure 30b (Refined Integrated Temperature and Habitat Flow)

Measure 718 (Augment Instream Flows Using Inactive Pool at Fall Creek Dam)

Plus, Injunction Measures

In Appendix D of the DEIS (Figure 1-397), model predictions for monthly mean water temperatures under the NAA and the other Alternatives are reported for three different climatological scenarios: year 2011 (wet), year 2015 (dry) and year 2016 (average). In general, compared to the NAA, the models predict that (under Alternative 2b/5) temperatures on the Middle Fork Willamette River (below Dexter Dam) will be fairly similar in wet and regular years. Under the dry scenario, temperatures under 2b/5 will be similar to the NAA in October through December, but slightly warmer in April and May and 1 to 5 degrees cooler June through September. This demonstrates that at least during an extreme dry year event, temperatures could be better under the new measures than in the NAA; however, it does not mean that the temperatures will be ideal for salmonids.

More important than the difference between the NAA and Alternative 2b/5, is how predicted average temperatures under Alternative 2b/5 compare to the temperature targets (set by the fisheries and natural resources agencies), which aim to reflect more natural, pre-project temperatures. Keeping the river closer to these temperature ranges is critical to the timing of Chinook salmon migration, spawning, and the overall productivity of their populations. Based off of model outputs for Alternative 2b/5 (Figure 1-401; USACE 2022a) at the Dexter Dam (DEX) temperature gauge on the Middle Fork Willamette, the estimated highest and lowest 7DADM temperatures for each month, under the wet-year scenario, would exceed the temperature target range by more than 5°F (at least once) from September through December and by at least 10 degrees or more in October. This wet-year scenario is the best-case scenario for temperatures in the Middle Fork Willamette under Alternative 2b/5. Under both dry and normal year scenarios, the temperature targets will be exceeded in every month analyzed (April to December) including by 10 degrees or more in every month except December under the dry-year scenario. This does not bode well for Chinook salmon in the Middle Fork Willamette River, unless temperatures in the reservoirs above Dexter Dam are much cooler than the Dexter gauge

and adult migration and transport conditions can get them into these cooler parts of the sub-basin before temperatures heat up below Dexter Reservoir.

In years that the Lookout Point and Dexter Reservoirs are only filled to <90 percent of the rule curve, proposed minimum flows for the Middle Fork Willamette would not meet the required minimum flows under the 2008 WVS Biological Opinion from February through mid-May. This could be detrimental to Chinook salmon juveniles that have the ability to find downstream passage at that time and are physiologically ready to migrate to the Willamette River. This period of lower than minimum required flows covers a large portion of time that Chinook salmon juveniles migrate downstream in the spring. The only benefit the proposed minimum flows might have in <90 percent fill year would be for adults migrating upstream in the summer months (June through mid-August) when minimum flows would be higher than required under the biological opinion. Also, in years where the fill is >90 percent, minimum flows would be higher than required biological opinion minimums from April through November and significantly higher from mid-April through August, which could potentially increase spawning opportunities and success, if stream temperatures are not too high to do cause stress, disease, and pre-spawn mortality.

In some respects, and compared to an alternative that does not include the measure, measure 304 could be helpful from June 1 to November 30 for adult Chinook salmon that are returning to Fall Creek or returning to the Middle Fork Willamette in particularly low flow years or periods of time.

There are no TDG management measures for Hills Creek, Lookout Point, and Dexter Dams, although model analysis has determined effects to the sub-basin. Under Alternative 2b, Lookout Point would have zero days of TDG exceedance for the year, Dexter Dam would exceed 110 percent TDG 20 days per year, and Hills Creek would exceed the requirement 18 days annually (on average). The average number of spill days per year would be 129 days at Hills Creek, 50 days at Lookout Point, and 88 days at Dexter Dam. Because some Chinook salmon adults are outplanted above Hills Creek Dam and in Middle Fork Willamette tributaries with confluences located in the Lookout Point reservoir, downstream migrating juvenile Chinook salmon could be negatively affected by these TDG exceedances, especially if they are disoriented or injured after passing the dams and cannot swim away from the tailrace conditions quickly.

Passage-Related Measures

Measure 392 - Construct Structural Downstream Fish Passage at Lookout Point Dam and Injunction Measures for Downstream Passage

High quality Chinook salmon spawning habitat is present in some of the tributaries (Salmon Creek, North Fork Middle Fork and Salt Creek) to Lookout Point Reservoir, and adult outplanting efforts are ongoing in these areas. The structure proposed under this measure could be very useful toward improving downstream juvenile passage survival once it is constructed; however, construction is not scheduled to be completed until the year 2044, at the earliest. There is some concern that adult Chinook salmon returns to the Middle Fork Willamette may decline further in the next 20 years, especially if interim injunction measures aimed at passage do not prove successful. Two Interim Injunction Measures are aimed at improving juvenile fish passage

through Lookout Point Dam and Dexter Dam. These include 24/7 spring spillway operations at both projects for at least 30 days without turbine use, followed by nighttime spill with generation occurring during the daytime. Though the current spillway passage conditions at these projects are thought to be harmful (likely to cause injuries and mortalities), it is possible that these spring spill operations will provide a benefit to Chinook salmon. The other Injunction Measure for the Middle Fork Willamette that will likely provide some benefit is a deep drawdown at Lookout Point dam in the fall of 2023 and 2024. Current deep drawdown fall operations at Fall Creek Dam have already demonstrated some success at improving downstream passage conditions for Chinook salmon and will also help support the conservation of diverse life history strategies in terms of migration timing.

The river reach above Hills Creek is likely to be the most resilient to climate change effects, and therefore, has some of the greatest future production potential, but there are no proposed measures for improving downstream juvenile passage at Hill Creek Dam. A long-term solution to improving juvenile passage conditions through all three consecutive reservoir and dam reaches on the Middle Fork has not been proposed or considered as part of the alternatives evaluation process. A set of operational measures aimed at moving juvenile Chinook salmon through the entire system of reservoirs in the Middle Fork, in both the spring and the fall, and also aimed at improving passage route conditions, would likely provide a greater benefit to Chinook salmon.

Measure 719 – Adapt Hatchery Program

See Section 5.2.1 above ("Measures that Pertain to the Mainstem Willamette and/or Multiple Sub-Basins").

Overall Effect of Alternative 5 on Viability of Middle Fork Willamette Spring Chinook Population

According to the Northwest Fisheries Science Center (NWFSC) Life Cycle Modeling (LCM) results (NWFSC 2022), which were based on a great number of assumptions, the total VSP score for the Middle Fork Willamette River Chinook salmon population under Alternative 2b/5 was nearly 2.5, the fourth-highest overall VSP score among all of the alternatives. Alternative 4 scored the highest (VSP > 3) because of its inclusion of structural passage and juvenile collection at both Lookout Point and Hills Creek Dam. However, alternative 2b/5 was an improvement over the NAA (VSP = 0.5). The Preferred Alternative provided for some improvements in the estimated number of natural-origin spawners in the basin and above the dams and resulted in a moderate-to-low risk for quasi-extinction (threshold of 250 adults) over the next 100 years.

While a VSP score of 2.5 relates to a moderate risk of extinction, the ESU recovery goal for the Middle Fork Willamette Chinook salmon population is a VSP score of 3, which would not be achieved under the measures proposed for Alternative 2b/5, though it is an improvement over the no-action alternative. Given the temperatures predicted under Alternative 2b/5, for Dexter Dam, it is surprising to see that the (LCM) model outcome for this Alternative resulted in such a high VSP score. The studies conducted on pre-spawn mortality rates as a function of temperature in the NWFSC's Life Cycle Model Analysis Report show that pre-spawn mortality levels could range around 50 percent even at an average (daily) water temperature of 60°F from July to September. Under the 2015 (dry year scenario) and Alternative 2b, the DEIS models had 7DADM temperatures below Dexter Dam ranging between 66 and 72°F. Granted, those are

average daily *maximums*, so it is not equally comparable data. Actual data on pre-spawn mortality demonstrated agreement with the predicted levels in a study by Keefer et al. (2010). For adult spring Chinook salmon outplanted above dams in the Middle Fork, they observed an average of 48 percent pre-spawn mortality and rates ranged between 0 and 90 percent.

Another observation for the Middle Fork Willamette measures is about whether the fall drawdowns at Fall Creek will continue under the new operations. The Fall Creek drawdown has been successful in some years, but the Fall Creek watershed is not very resilient in terms of climate change. Focusing on improving passage and access to areas above Hills Creek would make more sense.

With or without improving access to areas above Hills Creek, evaluation and monitoring of the proposed measures for improving juvenile passage out of the Lookout Point / Dexter complex is critical. Keefer et al. (2012) conducted a study of juvenile passage and survival through the Middle Fork dam complex over 7 years, which indicated that these reservoirs seasonally entrap many salmon, and some sea-ready smolts residualize because they are unable to find passage through the dams until late fall and winter drawdown operations allow them to do so. For those that did pass, the dam passage mortality estimates were 8 to 59 percent. The authors also called for studies that allow for route-specific and operation-specific injury and mortality rates by size class and time of year, and for each individual dam, as there appeared to be among-route difference in passage hazards and fish size-related effects that are dam or route specific (larger fish often had higher injury and mortality rates) (Keefer et al. 2012).

Effects to Other Trust Species in the Middle Fork Willamette River Sub-Basin

Since very few unlisted Chinook salmon or coho salmon have ever been observed in the Middle Fork, the measure is unlikely to affect these groups. RST data for the trap located below Fall Creek Dam from mid-June 2023 showed 82 *O. mykiss* were collected throughout the spring season, which indicates that new operational measures could move more rainbow trout out of the reservoir and downstream. RST data for the trap located below Dexter Dam from mid-June 2023 showed only 4 *O. mykiss* individuals had been collected through the spring season.

Limited Discussion of Effects to Species Which Directly or Indirectly Affect NMFS Trust Species

The Fall Creek drawdown operations could potentially help draw introduced predator species out of the reservoir and improve juvenile Chinook salmon and steelhead survival through the reservoir. RST data for the trap located below Fall Creek Dam from mid-June 2023 showed 33 brown bullhead catfish (*Ameiurus nebulosus*) were collected throughout the spring season, which indicates that new operational measures could move more salmonid predator species out of the reservoir and downstream.

Measures that potentially increase warmwater species abundances in the lower Middle Fork mainstem could also help reduce their numbers in Fall Creek reservoir and improve survival of juvenile salmonids produced above Fall Creek Dam. It is not clear if passing more flow through the spillways and ROs (under the Injunction and Preferred Alternative measures) will attract and reduce the highly problematic predator populations (smallmouth bass, walleye, crappie, and

northern pikeminnow) in Dexter, Lookout Point, and Hills Creek reservoirs. However, RST data for the trap located below Dexter Dam from mid-June 2023 showed that 312 crappie, one smallmouth bass, and two bluegill had been collected throughout the spring season. If these predator populations could be reduced in the reservoirs, it may improve juvenile survival through the reservoirs and make reintroduction efforts more successful.

Any of the measures that are beneficial to salmonids downstream of the dams may also benefit lamprey species, such as temperature or flow improvements, but there are no measures that are targeted toward lamprey recovery or passage in the Middle Fork basin. Rapid fluctuations in flows and river depth downstream of the dams are likely to negatively affect lamprey, especially the ammocoete life stage.

5.2.6. Lower Willamette River and Lower Columbia River

The effect of the WVS DEIS Preferred Alternative between the Willamette River confluence and the mouth of the Columbia River is minimal because the average annual Willamette River flow is only 12 percent of average annual Columbia River flow. However, any additional warming of the Willamette River, or changes to Willamette River flows and the hydrograph, does have an effect on Columbia River temperatures where the temperature TMDLs are often exceeded in the summer and fall months. For further details about effects of the WVS on the Lower Willamette River, refer to sections 5.1.1 and 5.2.1 above.

5.2.7. CUMULATIVE IMPACTS of PREFERRED ALTERNATIVE

According to the NWFSC's Life Cycle Model (LCM) results, which are based on a great number of assumptions, if all Preferred Alternative (2b/5) passage measures were implemented in the near future, it could potentially decrease the extinction risk level for ESA-listed UWR Chinook salmon (natural-origin) populations in the North Santiam, McKenzie, and Middle Fork Willamette basins, but it would not fully recover (natural-origin) Chinook salmon to their desired status or abundances. This is the result from the model's comparisons with the no-action alternative scenario playing out over the next 100 years (Table 5-1). While the recovery goals for the South Santiam Chinook salmon population are not high (improve to a moderate risk of extinction, VSP score= 2), there are numerous measures under the Preferred Alternative aimed at improving fish passage and temperature concerns at Green Peter and Foster dams. And despite all of the South Santiam measures under Alternative 2b/5, the model did not show it would produce an appreciable improvement over the no-action alternative. Reasons for this are linked to the lack of any structural downstream fish passage improvements in the South Santiam under the Preferred Alternative. While the Preferred Alternative measures are likely to assist in moving juveniles out of the reservoir and during more periods of the year, in comparison to the no-action alternative, the future effectiveness of the non-structural juvenile passage measures is in question. In the LCM, when the reservoirs were not at optimal passage elevations, fish attempting to pass (as determined by the FBW) were delayed and subject to reservoir mortality while waiting to attempt passage at the next window (and possibly, at a new life history stage). Also, neither the regulating outlets nor the spillways at the projects in the WVS were designed (or modified) for juvenile salmonid passage needs. There is a risk of being unable to attract the juveniles to these outlets and also a risk of them being injured or killed while passing, and, up until recently, very few comprehensive passage studies have been conducted to understand the

true passage efficiencies or survival and injury rates for juvenile salmonids under most of the proposed operations. Some of the operations are only now being implemented under the Injunction measures, and the primary methods being used to monitor their success (screw traps) are not nearly as rigorous or comprehensive as the methods used to study new passage structures and operations for juvenile passage. However, the active tag studies that have been implemented in the South Santiam and Middle Fork basins have yielded some information regarding the effectiveness of the fall reservoir drawdown operations (see Hance et al. 2024 and Larson et al. 2024).

Table 5-1. VSP (viability) scores needed to attain ESU recovery for both UWR Chinook salmon and steelhead (ESUs) compared side-by-side with the NWFSC's VSP score estimates (using their life-cycle model, LCM) for each population under various EIS alternative measures.
Grey-filled cells indicate that predicted outcome meets recovery goal. Recovery-level VSP goals were originally determined by the WLC-TRT (Willamette - Lower Columbia Technical Recovery Team) and NMFS Recovery Guidelines (McElhany et al. 2000).

UWR Chinook Salmon Population	**VSP Score**				
	Goal	**LCM Model Output**			
		NAA	**Alt. 2b/5**	**Alt. 1**	**Alt. 4**
North Santiam *	3	1	**3.7**	**3.5**	**3.7**
South Santiam	2	< 1	< 1	**3**	<1
McKenzie *#	4	2.4	3.5	2.5	3.8
Middle Fork Will. *	3	0.6	2.4	2.5	**3.3**

UWR Steelhead Population	**VSP Score**				
	Goal	**LCM Model Output**			
		NAA	**Alt. 2b/5**	**Alt. 1**	**Alt. 4**
North Santiam *#	4	1.7	3.75	3.75	3.75
South Santiam *#	4	1	2.1	3.4	1.7

* = Core population (productivity is most critical to ESU recovery)
# = Genetic legacy population (represent historical genetic diversity of ESU)

Also predicted by the LCM under the Preferred Alternative (2b/5) measures, Chinook salmon (natural-origin) populations in the North Santiam could achieve VSP goals, but the South Santiam population would still fall short and would actually reach a high risk of extinction over the next 100 years (for reasons noted above). The McKenzie River and Middle Fork Willamette River populations get close to their VSP score goals of 4 and 3, respectively, with model output showing scores of 3.5 and 2.4, respectively. However, this assumes that the measures are implemented in the near term, which is not likely the case. According to the implementation timeline in the DEIS, construction completion (at the earliest) of the FSS at Detroit Dam is scheduled for year 2036, the tunnel modifications at Cougar Dam for year 2041, and the passage structure at Lookout Point Dam by 2044. The model also assumes "Structural passage options, floating screen structures (FSS) or floating surface collectors (FSC), were predicted in the FBWs to have both high collection efficiencies and high passage survival." While these structures have

been incredibly successful at improving juvenile passage survival rates and adult returns in the Clackamas River and at Upper and Lower Baker Lake in Washington, some of the WVS reservoirs are deeper and wider in size. One recent study has shown that collection efficiencies are negatively correlated with forebay areas (Kock et al. 2019) but may be optimized in larger forebays by increasing the collector entrance size and inflow enough for effective "discovery" or attraction.

Under the Preferred Alternative, spill passage is proposed in the near term for Detroit, Foster, and Lookout Point dams and in the long term at Green Peter and Hills Creek dams in the spring. In each case, the availability will be limited to when dam elevations are higher than spillway crest levels and will be dependent, in part, on modifying minimum flows below the dams to refill to these elevations. The refill can reduce dam passage efficiency if juveniles do not find the dam face. These tradeoffs should be considered as part of the overall benefits of spill. In addition, the spill (or drawdown) operations at an upstream dam should be coordinated with the timing of passage operations in dams below, such as the Big Cliff and Foster dams in the Santiam Rivers. For the Middle Fork dams, the timing of spill (or drawdown) from Hills Creek should align with Lookout Point and Dexter and similarly Lookout Point with Dexter. This will allow juveniles a better chance to begin their downstream migration to the Willamette River and the ocean closer to the times at which they are physiologically prepared and could also improve survival through a reduction in predator encounters and copepod infestation. Drawdown operations might also reduce the highly abundant predator populations in the reservoirs and route them to less hospitable conditions in the tributaries or mainstem. Where necessary, the design and optimization of spillway deflectors could both reduce the harmful effects of TDG downstream and increase survival for juvenile fish.

The results of the LCM for North Santiam and South Santiam steelhead populations under the Preferred Alternative were somewhat similar to the outcomes for the Chinook salmon populations. The predicted viability outcome for the North Santiam steelhead population under the Preferred Alternative measures was a 3.5 (low to very low risk of extinction), which was much higher than the outcome under the NAA (1.5 - moderate to high risk of extinction), but it did not quite reach the viability goal for the population (4 - very low risk) (Table 5-1). In the South Santiam, the Preferred Alternative outcome was not a great improvement over the NAA (2 vs. 1 - moderate risk vs. relatively high risk) and did not come close to the VSP score goal for this steelhead population (Table 5-1). The explanations for these outcomes were very similar to the ones noted above for the Chinook salmon populations.

Both positive and negative effects to unlisted NMFS trust species are likely to be more minimal. The unlisted coho salmon and fall Chinook salmon in the Willamette River Basin tend to spawn in the lower reaches of the tributaries and are not necessarily affected by the many passage-related measures. Unlisted Chinook salmon may also spawn in the mainstem Willamette River. October flow increases in both the tributaries and mainstem (under measure 30b), may actually be a benefit to coho salmon and fall Chinook salmon adults, as long as water temperatures do not exceed tolerable thresholds. Any improvements to floodplain reconnection in the mainstem or lower tributaries could improve rearing conditions for both species.

In addition to the uncertainties noted above, the Preferred Alternative measures and operations end up producing unintended or unpredictable consequences under certain conditions. For example, NMFS has concerns about how the fall drawdown measures could affect the hydrograph. Because of the proposed minimum flows under measure 30b, if reservoirs are not refilled (partially due to drawdown measures), then water will not be available in the spring months to mimic the spring freshets. The deep drawdowns could also result in additional flattening of the river hydrographs, which will lead to more geomorphic changes downstream that contribute to the loss of ecosystem functions, floodplain connections, and further degradation of critical fish habitat. Also, the LCM models and the basis for many of the fish passage related measures, are based on dam passage efficiency and survival estimates from the Fish Benefit Workbook (FBW), which may not reflect various changing conditions.

Given future climate variability, and the uncertainties about the actual effects of the measures, NMFS calls for improved monitoring of the effectiveness of each operation, with studies to improve FBW estimates. NMFS also supports continuing hatchery production as outlined under the approved HGMPs, which will act as a safety net for the affected populations until the effectiveness of the new operations can be observed and measured. These measures should also be evaluated under a variety of conditions, including less favorable conditions for river and ocean ecosystems and salmon survival including more severe drought years, higher average temperatures, more persistent heat waves, and poor ocean conditions, which are likely to become more frequent and severe into the future.

6. CONSERVATION RECOMMENDATIONS

The conservation recommendations below address the impacts of the NAA, as well as the measures associated with the Preferred Alternative (#5). The following conservation recommendations will benefit species likely to be affected by the WVS and support more coordinated, systemic, and adaptive management and conservation of NMFS trust resources. Recommendations are not prioritized and are not expected to occur concurrently but are expected to support species and their habitats during ongoing and adaptive management of the system. Conservation recommendations have been grouped into two categories, General Conservation Recommendations and Basin-Specific Recommendations.

General

1) In the near-term, continue meeting the minimum flows required by the Reasonable and Prudent Alternative of the 2008 Jeopardy Biological Opinion for the proposed operation of the Willamette Valley System. Work with NMFS, the NWRFC (Northwest River Forecast Center) and with the Flow Management and Water Quality (FMWQT) Team process to analyze options to conserve the ability to provide for mainstem and tributary flows that benefit ESA-listed fish.
2) Add more details about how measures related to downstream temperature management will be monitored and adaptively managed, including how the flow pulses will be provided and the decision framework used to decide which tributaries will provide the flow pulses.
3) Provide stream temperature mitigation through stream habitat restoration and floodplain reconnection downstream of WVS projects (in lower tributaries and the mainstem Willamette River). The USACE Preferred Alternative will not be able to meet monthly

fish temperature targets in areas downstream of WVS projects in several of the affected basins under various conditions. This is an unaddressed impact in the draft EIS which calls for mitigation.

4) Apply flow and temperature models for each affected tributary and for the mainstem Willamette River to the Preferred Alternative (or all alternatives) using conditions that mimic predicted future climate conditions (in 50+ years) for precipitation, snowpack, timing of snowmelt, and temperature. Consider additional adjustments to reservoir and flow management measures (or fish management measures) that could be employed in extreme years (hot, dry) to mitigate for poor, or potentially lethal, conditions.
5) Create a list of studies that need to be completed to improve or verify current estimates and assumptions about passage in the Fish Benefit Workbook, beginning with improved estimates for Detroit, Hills Creek, and Lookout Point dams. Conducting the studies will allow for the establishment of a more complete and accurate baseline and help in the prioritization of future passage improvements.
6) Revise Measure 719 "Adapt Hatchery Program" to ensure that once fish passage measures are implemented, data on adult returns and juvenile survival studies will be collected for a minimum of 10 years before a complete evaluation can be conducted on measure effectiveness and any related changes to the hatchery program can be proposed.
7) Add a measure to the Preferred Alternative to evaluate the feasibility and costs/benefits of deauthorizing each WVS project or set of projects, beginning with Cougar Dam. This sub-basin should be prioritized and the study completed before any larger, system-wide deauthorization evaluation included in the Draft WRDA language.
8) Create and fund a full Research, Monitoring, and Evaluation Plan for monitoring the effectiveness of the proposed and baseline temperature, flow, and fish passage measures. Fish passage monitoring should include more than the use of screw traps, which are mainly useful for determining timing of juvenile passage (for the fish that do pass and survive). Other monitoring methods should include the use of hydroacoustics, radiofrequency, and PIT tag detectors (combined with sufficient PIT tagging) wherever possible, so that it is possible to determine the number or relative percentage of juveniles that are attempting to and then passing each potential route through the dams and when proposed passage routes are effectively attracting juveniles (time of day, time following new operations). Include monitoring to identify any conditions under which spill operations could negatively affect juvenile or adult passage, such as affecting adult fish "discovery" of adult ladder attraction spill or effects to juvenile egress after passage via spill. These issues have been observed at Snake River dams during times of high spill and lower river levels because of the creation of a whirlpool effect.
9) Prioritize FSS structure construction in proposed action timeline, and move up the deadline for all FSS structures (at Detroit, Foster, and Lookout Point) so that they are all completed within 10 years of the signature date for the Record of Decision (ROD) on the Final WVS Environmental Impact Statement (EIS).

Specific to the North Santiam River Sub-basin

1) Monitor injunction measures related to passage. For steelhead and Chinook salmon in the spring, monitor above dam numbers, and count those passing during spring/summer spill. For Chinook salmon in the fall, determine if any fish pass through RO when the elevation is 100 feet or higher above (normal rule curve lowest elevation). If fewer fish are passing

(i.e. less than the weekly, monthly seasonal average that have been counted below Fall Creek Dam during fall drawdown), implement a deeper drawdown in November. If fish passage efficiency is low, consider changing timing and duration.

2) Conduct a cost-benefit analysis for the proposed water temperature control tower, including how significantly it may improve temperatures below the dam, especially under more extreme future conditions, and if the benefit outweighs the cost or delay in providing more optimal downstream juvenile passage. Under the current implementation plan, the time required to design and construct the water temperature control tower is equal to the delay in constructing and implementing the floating surface collector for Detroit reservoir, which could dramatically improve downstream juvenile passage survival.

Specific to the South Santiam River Sub-basin

1) Add total TDG abatement structure(s) where needed at Foster Dam.

2) Monitor measures that affect juvenile passage, beginning with the use of the RO for temperature cooling starting October 1 into use of the RO for downstream passage from mid-November to mid-December. Monitor timing of juvenile passage, route of juvenile passage (RO vs. turbine) and survival rates per route (ideally by species and life stage).

3) Monitor use of the spillway at Green Peter Dam for spring temperature operation (spring through July 1) and juvenile passage (spring thru July 1) to determine its effectiveness at improving the timing of Chinook salmon adult upstream migration at Foster Dam and the passage and survival of juveniles.

Specific to the McKenzie River Sub-basin

1) Move timeline for completion of juvenile passage and operation modifications for the tunnel diversion structure at Cougar Dam to an earlier date.

2) Prior to full tunnel operation, conduct juvenile passage efficiency and survival / injury rate studies and compare to the current estimates for survival and injury through other passage routes at Cougar Dam, as well as to acceptable survival and injury rates. If survival and injury rates through the tunnel do not meet standard NMFS fish passage performance measures, re-evaluate passage conditions through the tunnel to determine if further improvements or adjustments are necessary.

3) Deauthorize Cougar Dam for power production, and mimic the natural run-of-the river flow through the tunnel once passage conditions are optimized (conservation recommendation #2 for the McKenzie sub-basin). Draw Cougar Reservoir down to the level that provides the most optimal fish passage conditions through the tunnel, and only close the tunnel for flood control purposes when necessary. If flood risk reduction requires shutting the tunnel gate, reopen the gate to bring the reservoir back to the optimal fish passage level as soon as possible.

4) Add TDG abatement structure to the Cougar Dam regulating outlet spillway.

Specific to the Middle Fork Willamette River Sub-basin

1) Make juvenile passage optimization through Hills Creek, Lookout Point, and Dexter Dams a part of the Preferred Alternative, including measures to improve all project spillway structures for optimal juvenile passage conditions and a feasibility study to determine how frequently the reservoirs could be drawn down within a year to move juveniles through this reservoir complex quickly through the use of providing optimal attraction flow to the spillways. Because of the quality and quantity of spawning habitat for Chinook salmon above Lookout Point and Hills Creek, and the fact that the Middle Fork Willamette Chinook salmon population is a core population for recovery under the NMFS Upper Willamette ESA Recovery Plan, addressing poor passage survival through this complex should be a top priority. The focus on juvenile passage in the Middle Fork Willamette should move to these projects vs. Fall Creek Dam, as the Fall Creek watershed will be less resilient to climate change over time.

2) Until recommendation #1 for the Middle Fork Willamette projects can be implemented, work to conduct spill operations during drawdown operations and to delay refill, both for optimization of juvenile spillway attraction. If these operations can be achieved, increase adult outplanting efforts in tributaries to Lookout Point Reservoir or above Hills Creek Reservoir.

3) Confirm timing of Fall Creek Reservoir drawdown operations. At present, the Preferred Alternative states that the Fall Creek Reservoir drawdown operation will occur on December 1.

4) Match the timing of injunction spill measures and Preferred Alternative spill measures with ideal timing for juvenile Chinook salmon migration, while also minimizing impacts to USFWS trust species.

5) Add TDG abatement structure(s) to Dexter Dam, where needed.

7. APPENDICES

Appendix A - Timeline that illustrates key milestones in our engagement with the Corps, and interested parties for FWCAR development.

September 12, 2022 – Author's first day on the job with NOAA in FWCA position.

October 4 and 5, 2022 - Author (NOAA) joins tours of facilities at Cougar Dam and Fall Creek Dam.

October 12, 2022 - FWCA Coordination Kick-Off Meeting between (USACE) and Author.

October 25, 2022 – Virtual Partner Coordination Meeting between NOAA staff and ODFW, ODEQ and CTGR staff representatives (see Appendix B).

October 26, 2022 – FWCA Coordination Meeting between USACE and Author.

November 9, 2022 – FWCA Coordination Meeting between USACE and Author.

November 9 and 21, 2022 – Brief discussions with ODFW staff (and Author) about species presence in the Study Area and species interactions.

Appendix B - Virtual Partner Coordination Meeting Agenda

MEETING AGENDA
for
NOAA's Partner Coordination Meeting for the
Fish and Wildlife Coordination Act Report on
Willamette Valley System NEPA EIS

Date: 10/25/2022
Time: 1:00 to 3:00 p.m.

I. Introductions (All)
II. Summary of NOAA's Approach to the FWCA Report (NOAA)
III. Proposed Species List / NOAA Trust Resources
    a. Questions from Partners (ODEQ, CTGR, ODFW)
IV. Current Draft Outline
    a. Questions from Partners (ODEQ, CTGR, ODFW)
V. Proposed NEPA Alternatives – Opportunity to Share Top Priorities
    a. Grand Ronde's Priority Issues (CTGR)
    b. ODEQ's Priority Issues (ODEQ)
    c. ODFW's Priority Issues (ODFW)
VI. Input / Resources that NOAA May Need from Partners – (NOAA)
    a. Current known species distribution resources from ODFW
    b. Current hatchery management or monitoring information from ODFW
    c. Grand Ronde Tribe's Fishery Management Goals in the Region
    d. Any analyses/guidance on TDG, Temperature, Pollutants from ODEQ

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