US Army Corps
of Engineers®
Portland District

# WILLAMETTE VALLEY SYSTEM OPERATIONS AND MAINTENANCE

## FINAL 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 1 8 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.

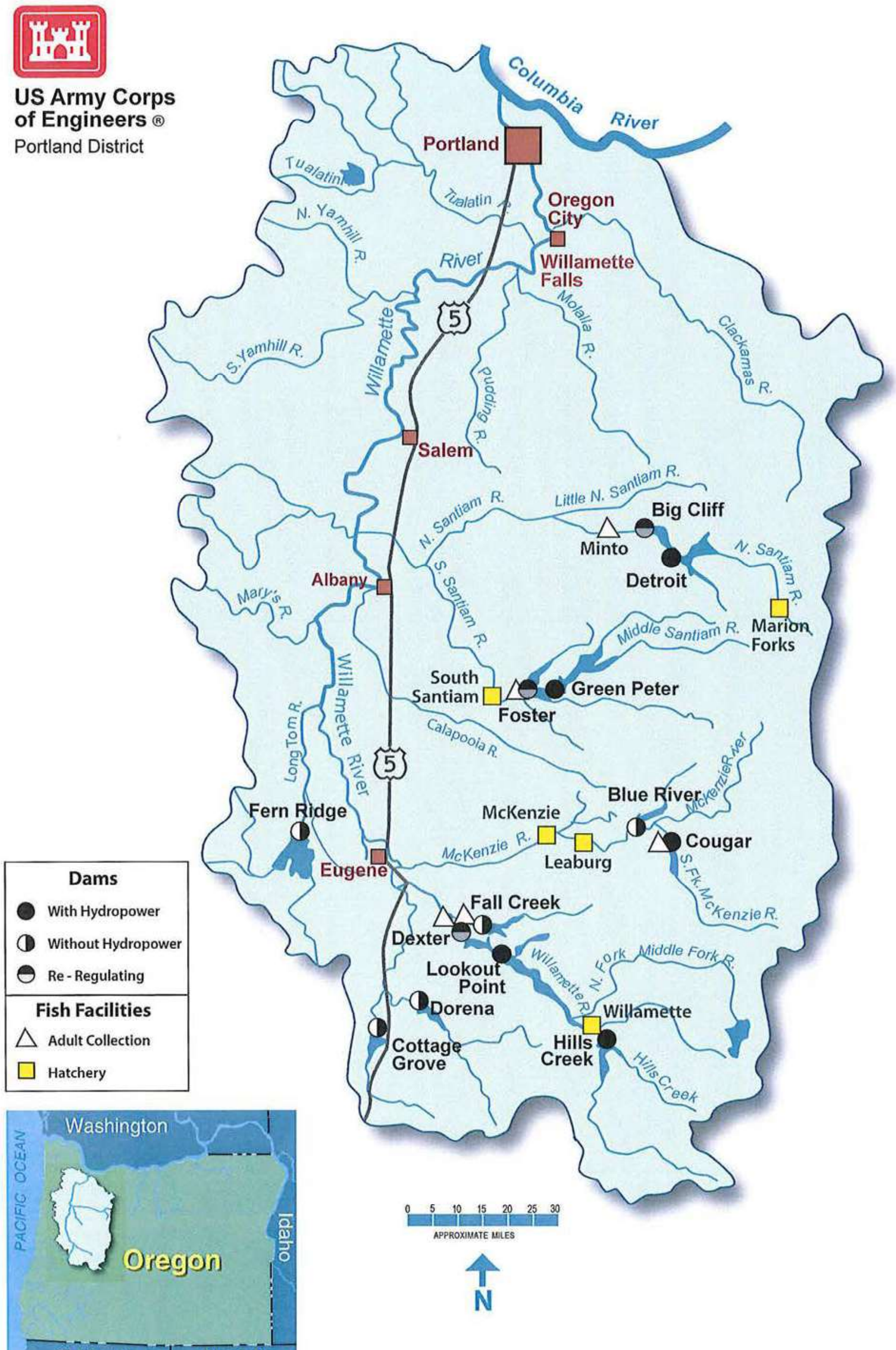
Sincerely,

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.

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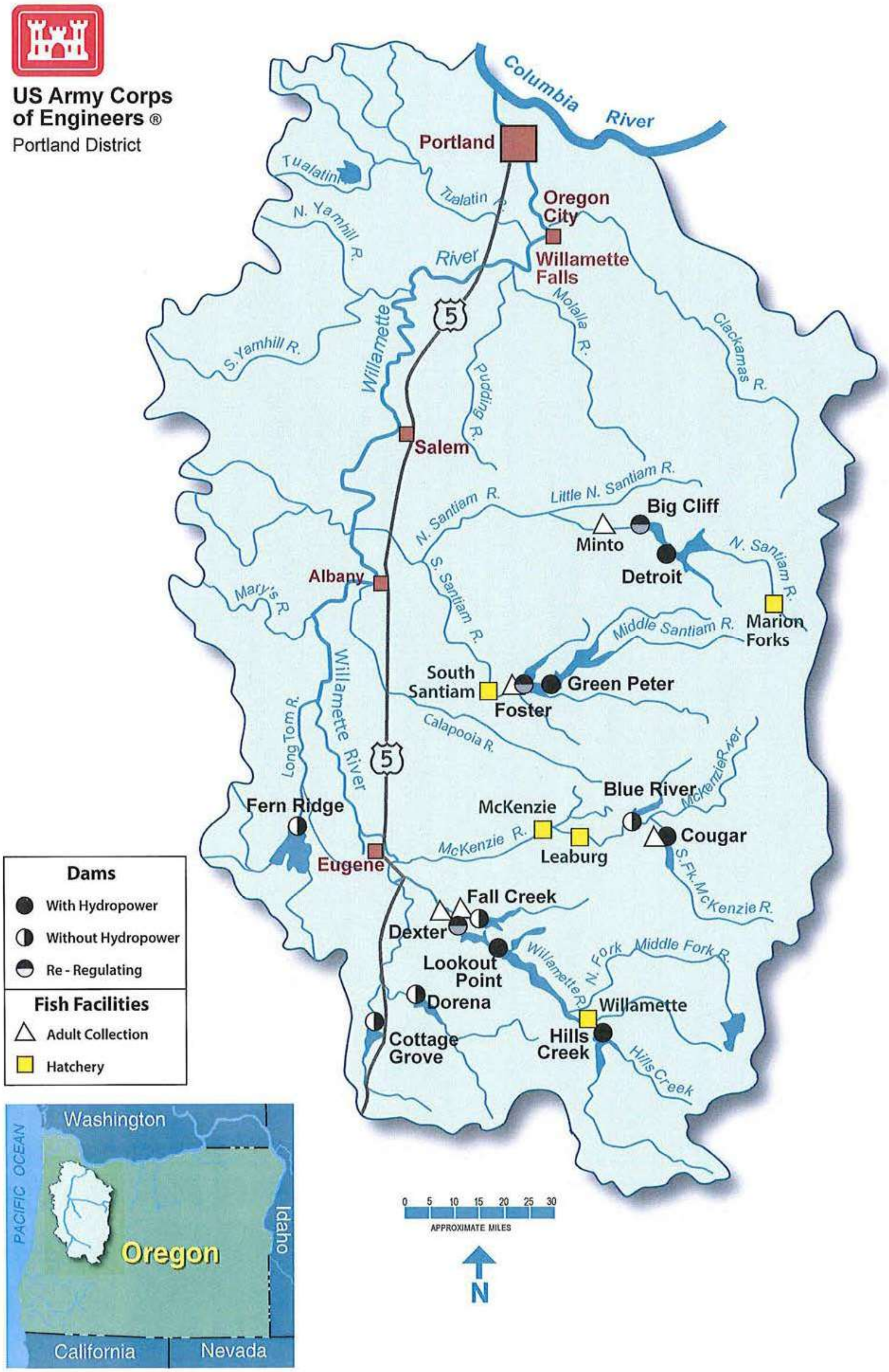
Sincerely,

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 1 8 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.

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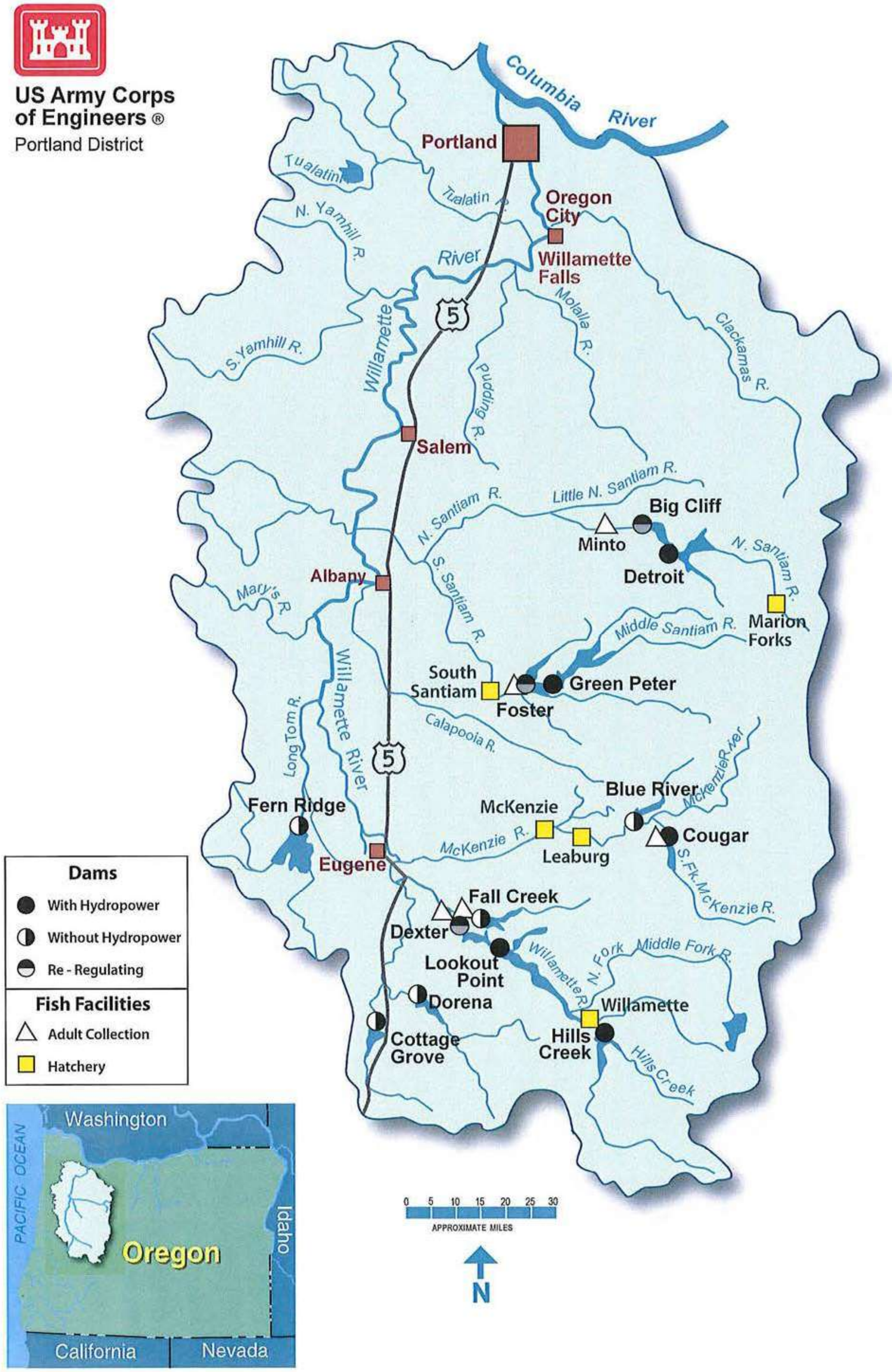
Sincerely,

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 1 8 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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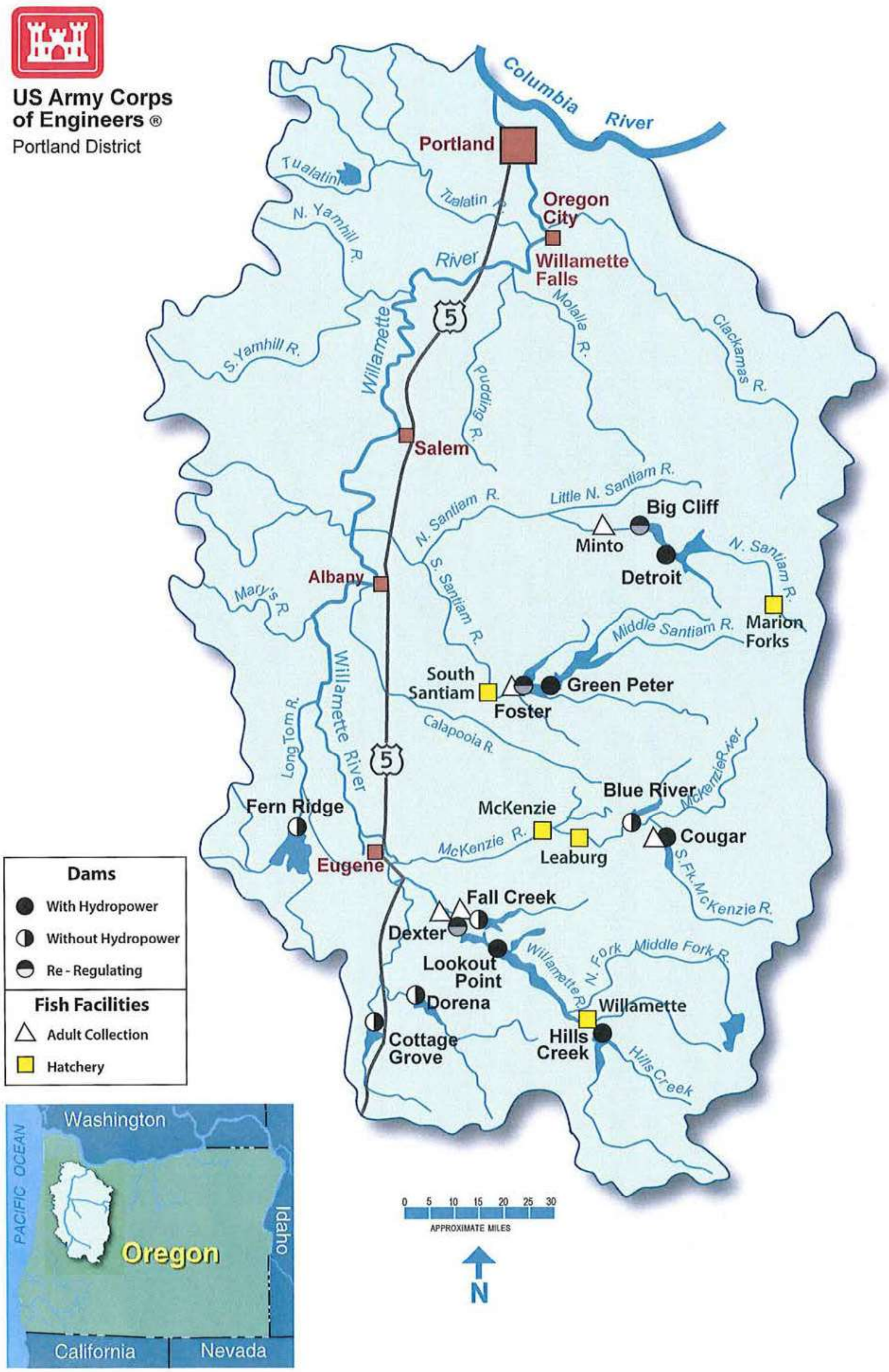
Sincerely,

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 1 8 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.

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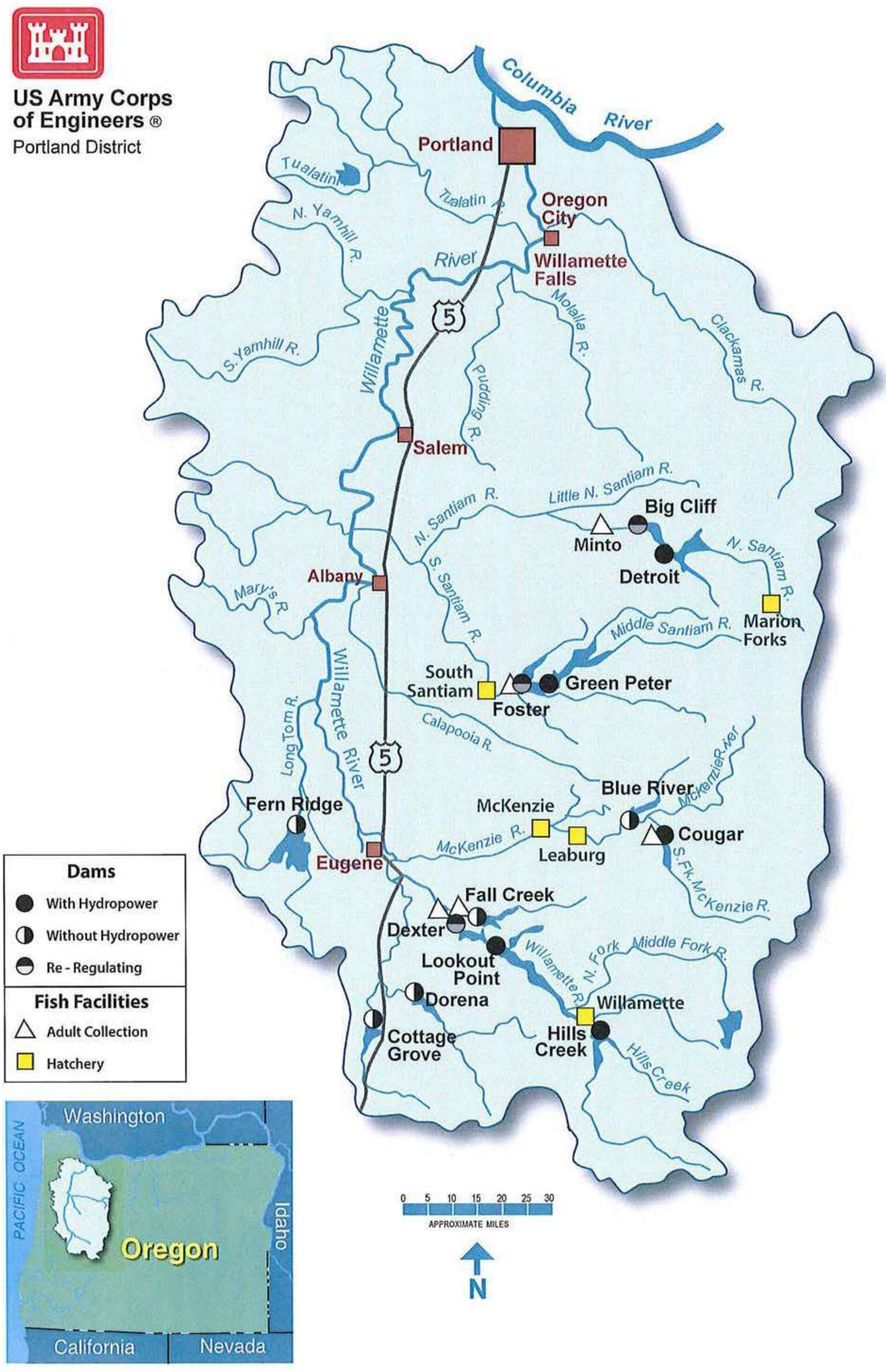
Sincerely,

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 1 8 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.

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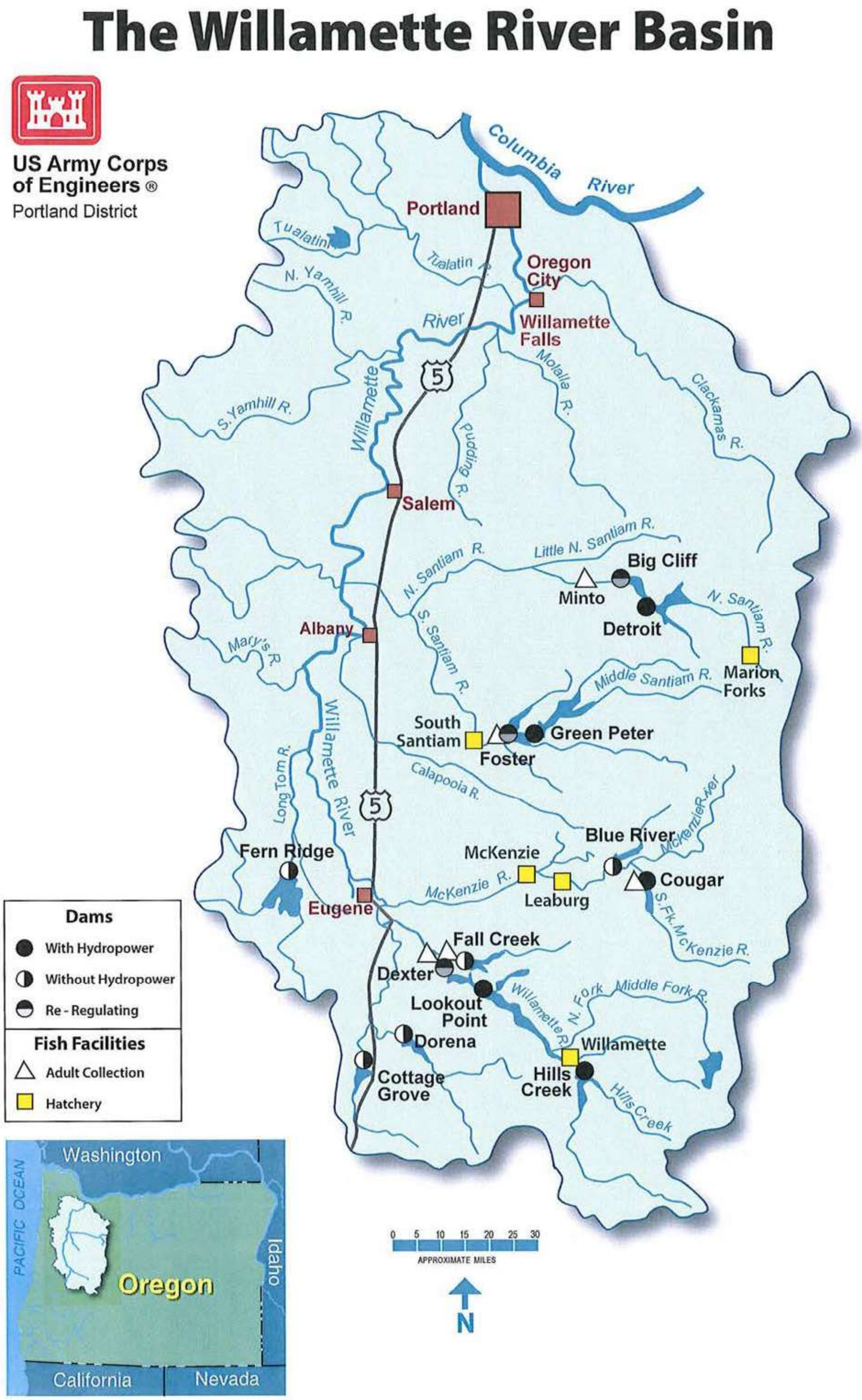
Sincerely,

Amy C. Gibbons
Chief, Environmental Resources Branch

Enclosure

CC: Marc Liverman, Willamette Branch Chief


The Willamette River Basin
US Army Corps of Engineers ®
Portland District
Columbia River
Portland
Tualatin
Tualatin R.
Oregon City
N. Yamhill R.
River
Willamette Falls
Molalla R.
Clackamas R.
S. Yamhill R.
Willamette
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Pudding R.
Salem
Little N. Santiam R.
N. Santiam R.
Big Cliff
Minto
Detroit
N. Santiam R.
Albany
S. Santiam R.
Mary's R.
Marion Forks
Middle Santiam R.
South Santiam
Foster
Green Peter
Willamette River
Long Tom R.
Calapooia R.
5
Blue River
McKenzie River
Fern Ridge
McKenzie
McKenzie R.
Leaburg
Cougar
S.Fk.McKenzie R.
Eugene
Fall Creek
Dexter
Lookout Point
Willamette R.
N. Fork
Middle Fork R.
Dorena
Willamette
Cottage Grove
Hills Creek
Hills Creek
Dams
With Hydropower
Without Hydropower
Re - Regulating
Fish Facilities
Adult Collection
Hatchery
Washington
PACIFIC OCEAN
Oregon
Idaho
California
Nevada
0 5 10 15 20 25 30
APPROXIMATE MILES
N

**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.

-2-

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 1 8 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.

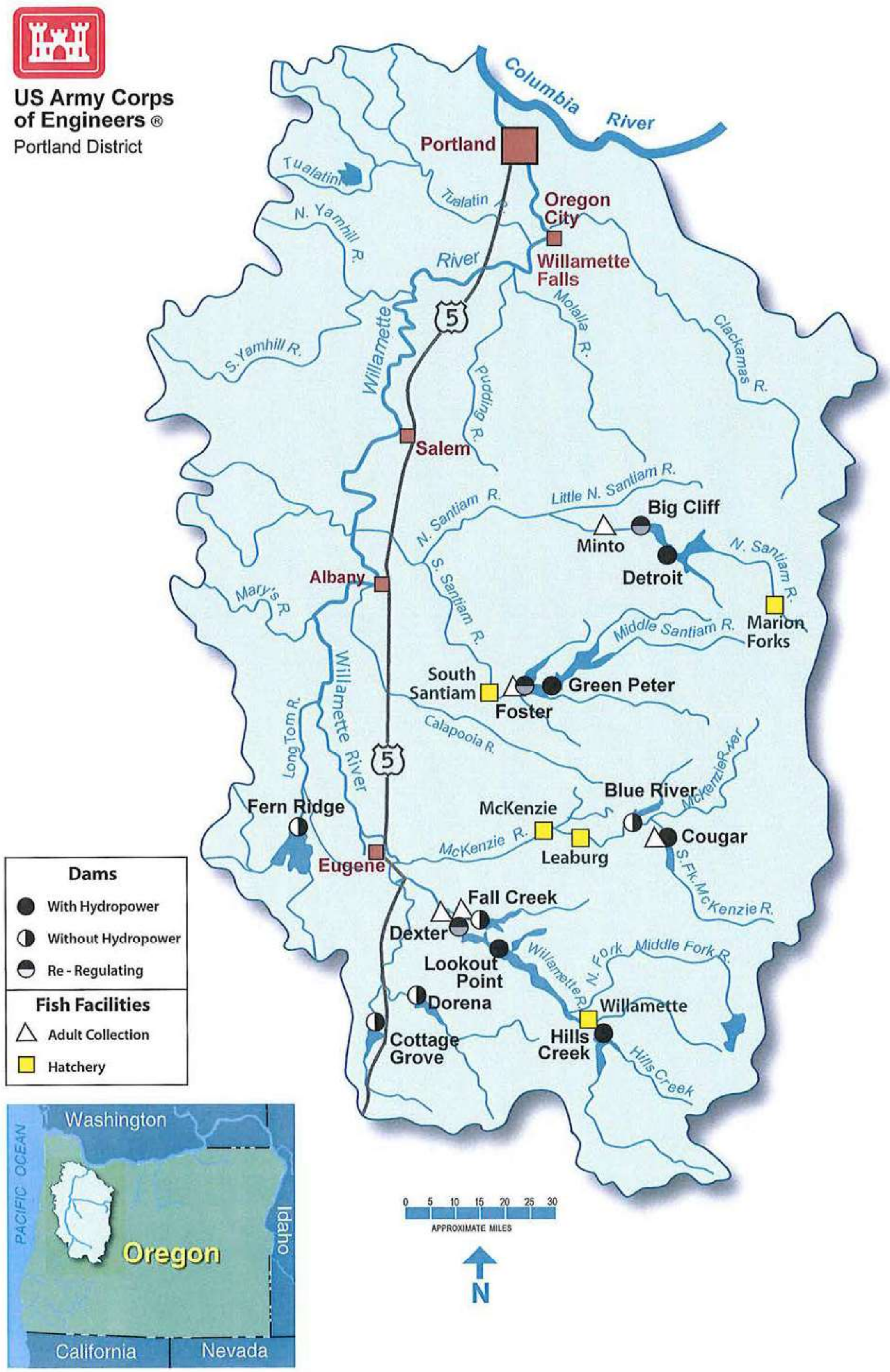
Sincerely,

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 1 8 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.

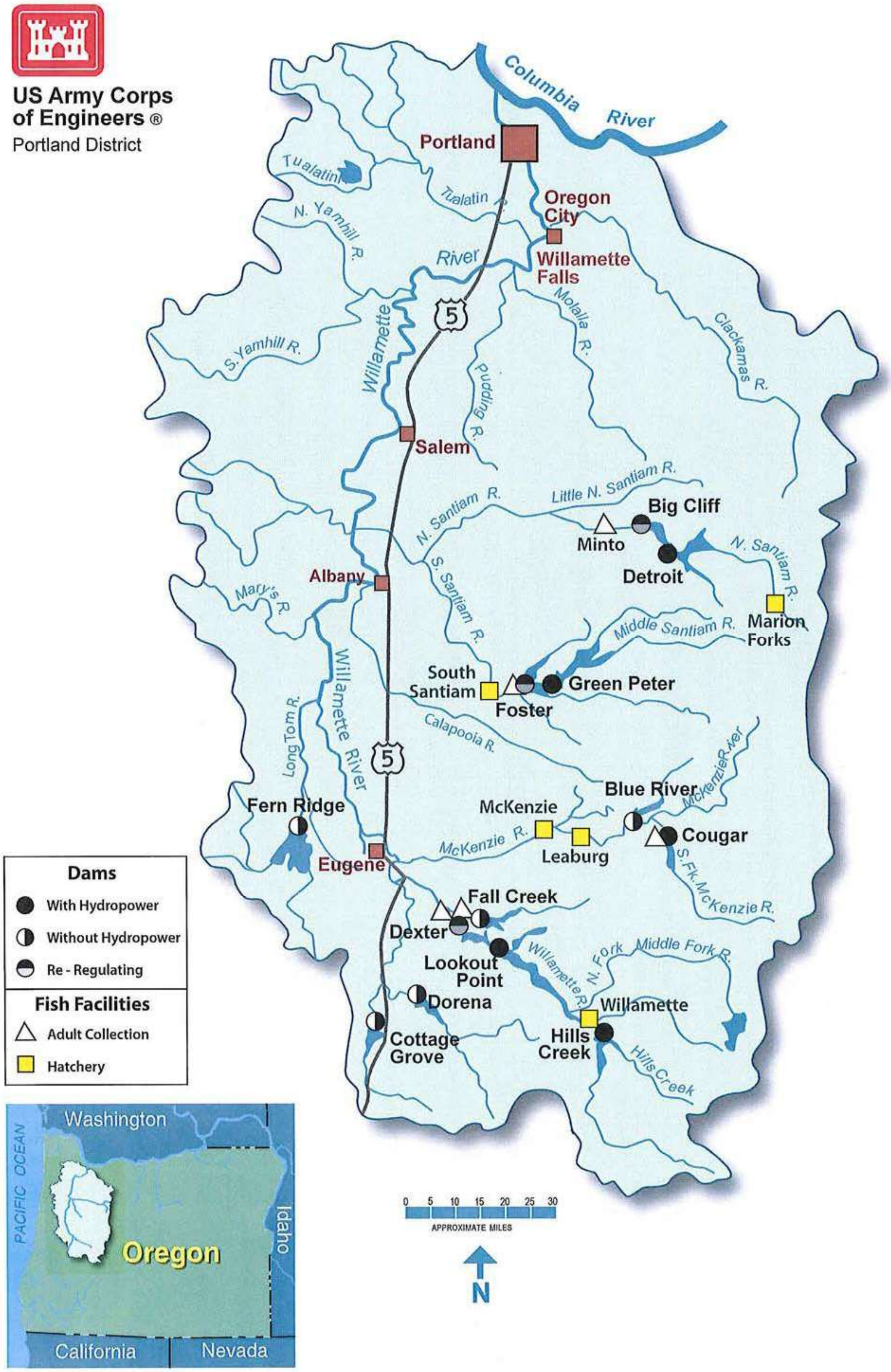
Sincerely,

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.

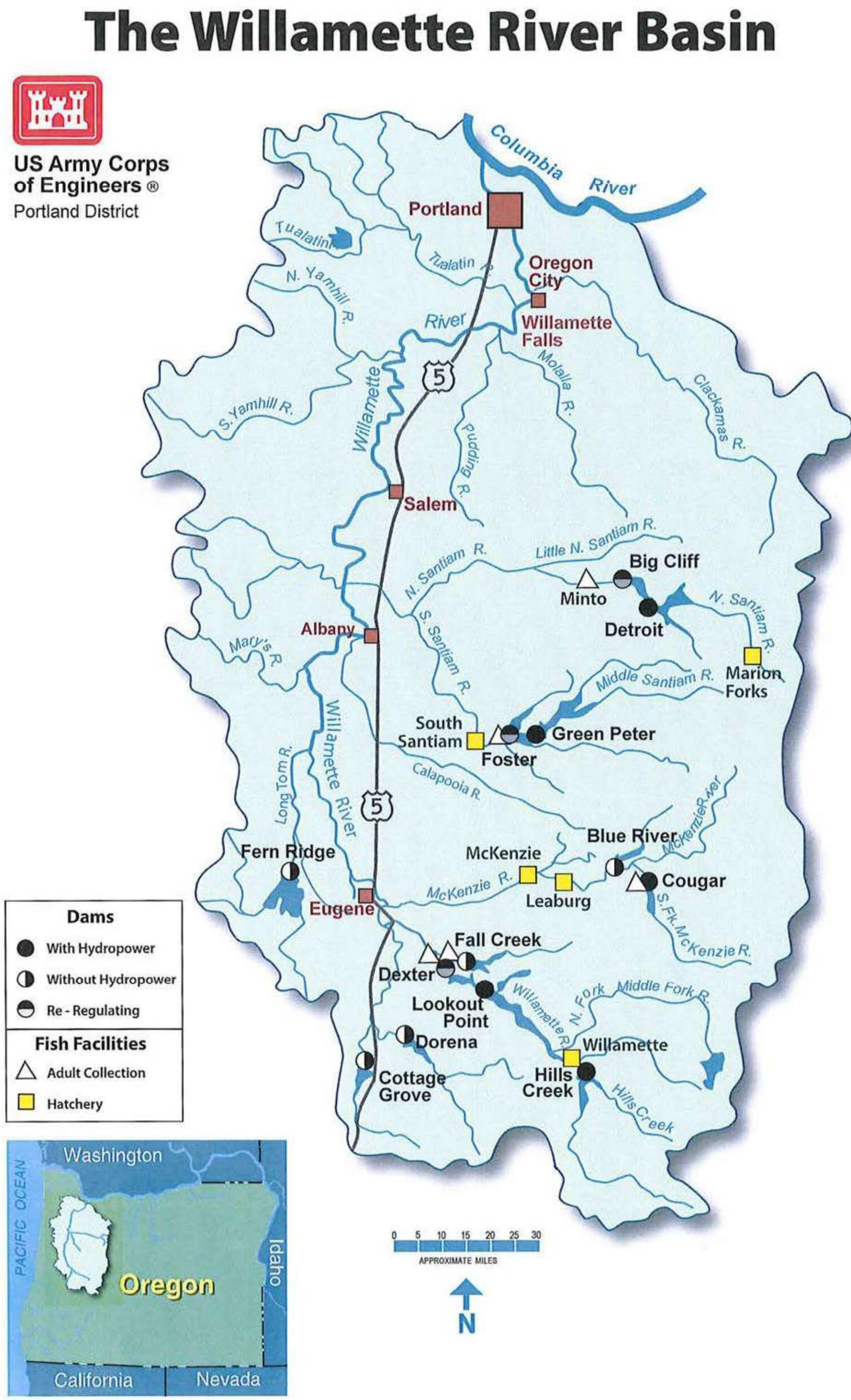
In accordance with 40 C.F.R. § 1501.6(c), we are requesting a reply to this request. Please provide the reply by February 11, 2019. Should your agency decide to not participate as a cooperating agency, please indicate in your reply the reasons for declining the invitation. If your agency elects to not 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
US Army Corps of Engineers ®
Portland District
Columbia River
Portland
Tualatin
Tualatin R.
Oregon City
N. Yamhill R.
River
Willamette Falls
Molalla R.
Clackamas R.
S. Yamhill R.
Willamette
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Pudding R.
Salem
Little N. Santiam R.
N. Santiam R.
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Minto
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N. Santiam R.
Albany
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Mary's R.
Marion Forks
Middle Santiam R.
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Cougar
S.Fk.McKenzie R.
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Lookout Point
Willamette R.
N. Fork
Middle Fork R.
Dorena
Willamette
Cottage Grove
Hills Creek
Hills Creek
Dams
With Hydropower
Without Hydropower
Re - Regulating
Fish Facilities
Adult Collection
Hatchery
Washington
PACIFIC OCEAN
Oregon
Idaho
California
Nevada
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APPROXIMATE MILES
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## 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 1 8 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.

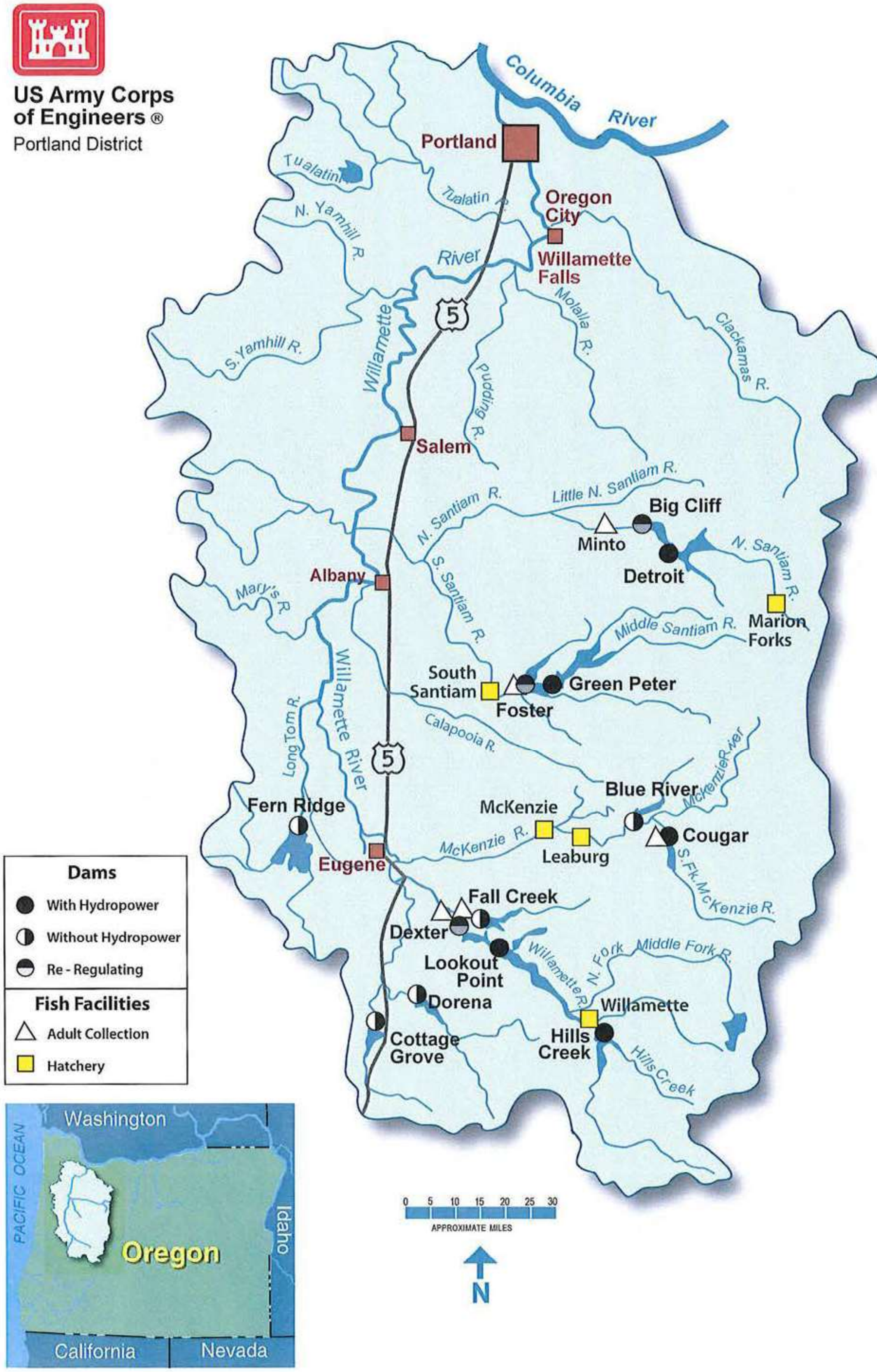
Sincerely,

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

REGIONAL
ADMINISTRATOR'S
DIVISON

JUL 1 0 2019

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 1 8 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.

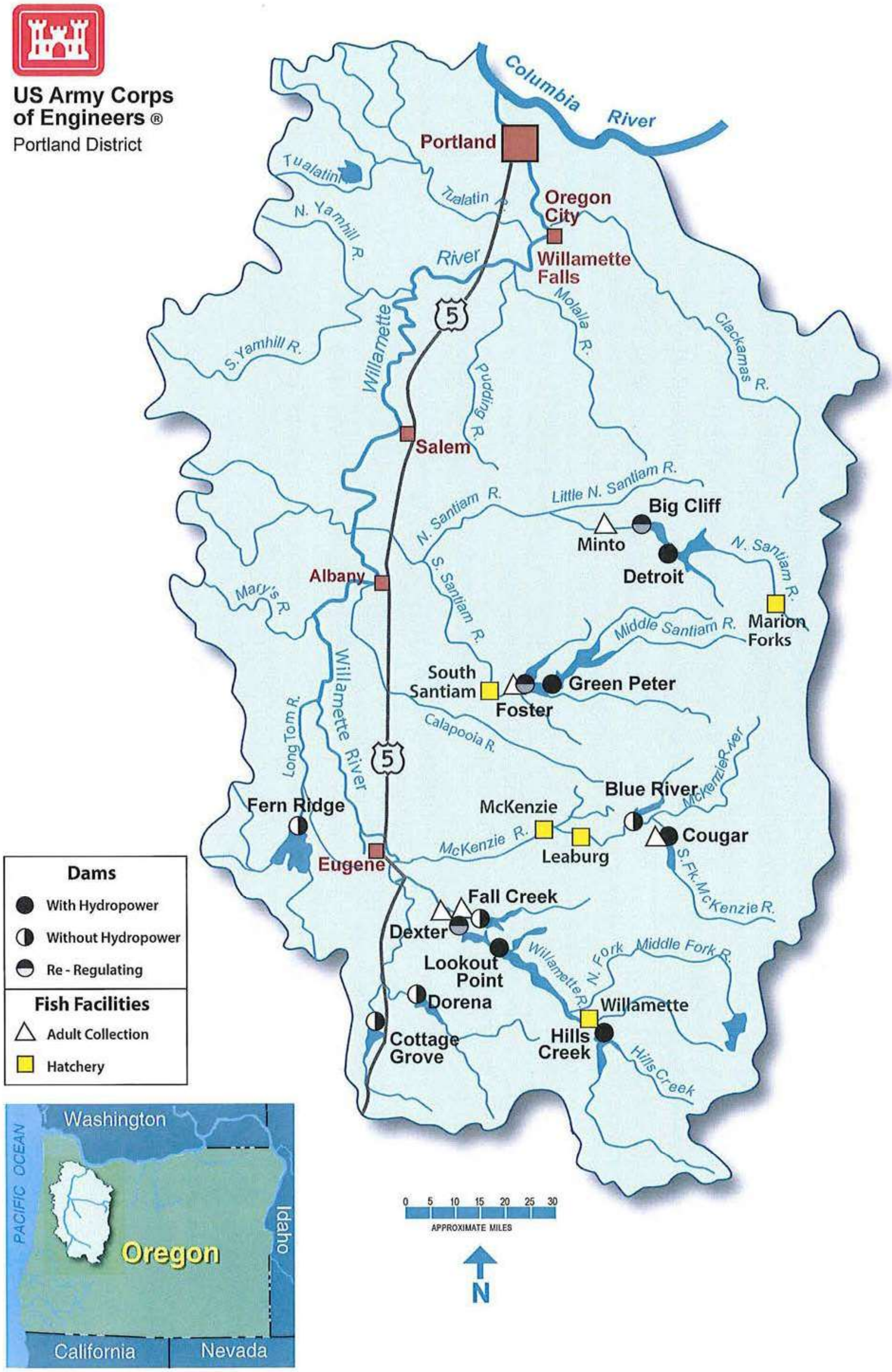
Sincerely,

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

# 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.

1

# 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<br>Overview of the Willamette Valley EIS and charge to the PDT. | Mike Turaski, Project Manager, Portland District<br>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 |

2

## Willamette Valley Charette Agenda

**Day 2: 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<br>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<br>Mike Turaski, Project Manager |

# WILLAMETTE VALLEY SYSTEM OVERVIEW


CENWP-ENC-HR
Mary Karen Scullion

December 5, 2018

1

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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**

2

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## 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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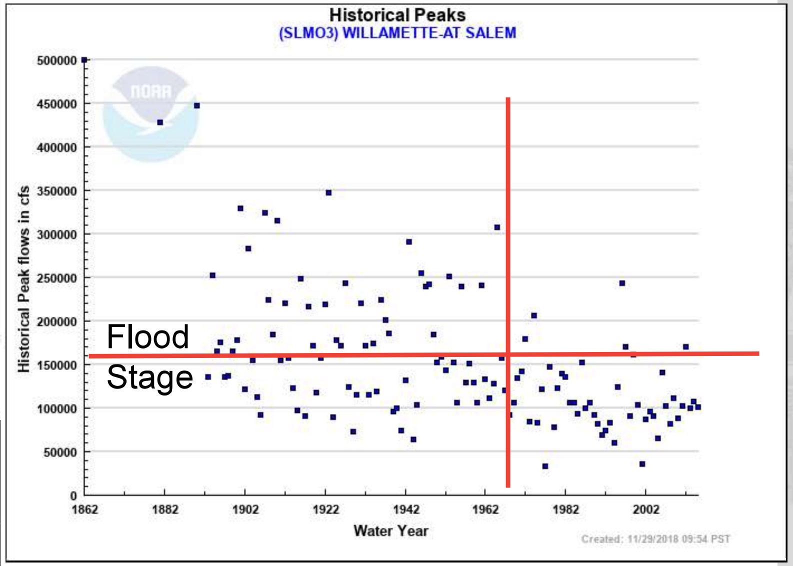
# HISTORIC PEAKS AT SALEM – REDUCED AFTER COMPLETION OF WVP

| 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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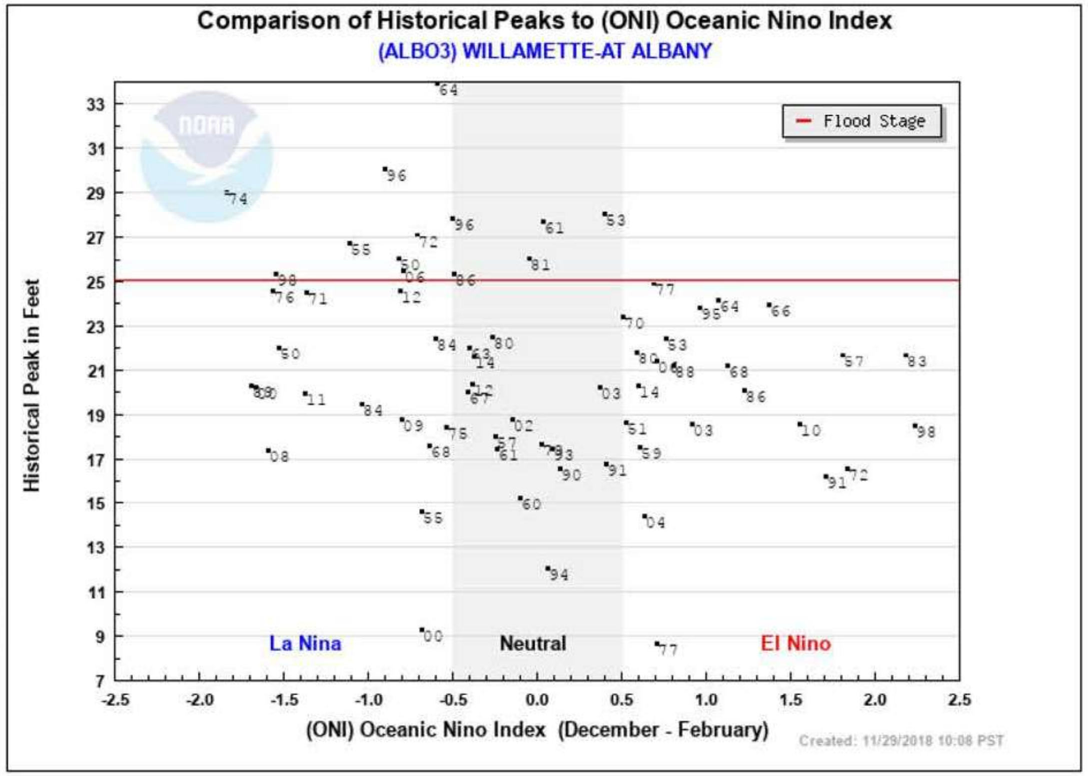
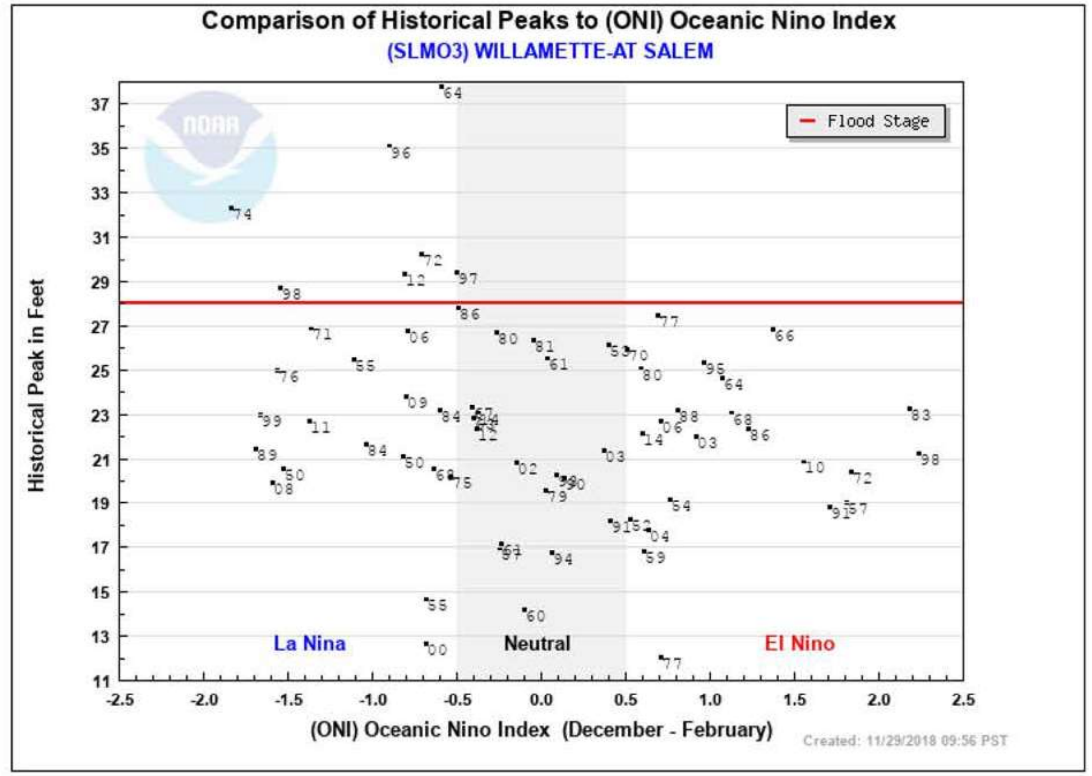
# COMPARISON OF PEAKS TO OCEANIC NINO INDEX




## 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 Forecas
**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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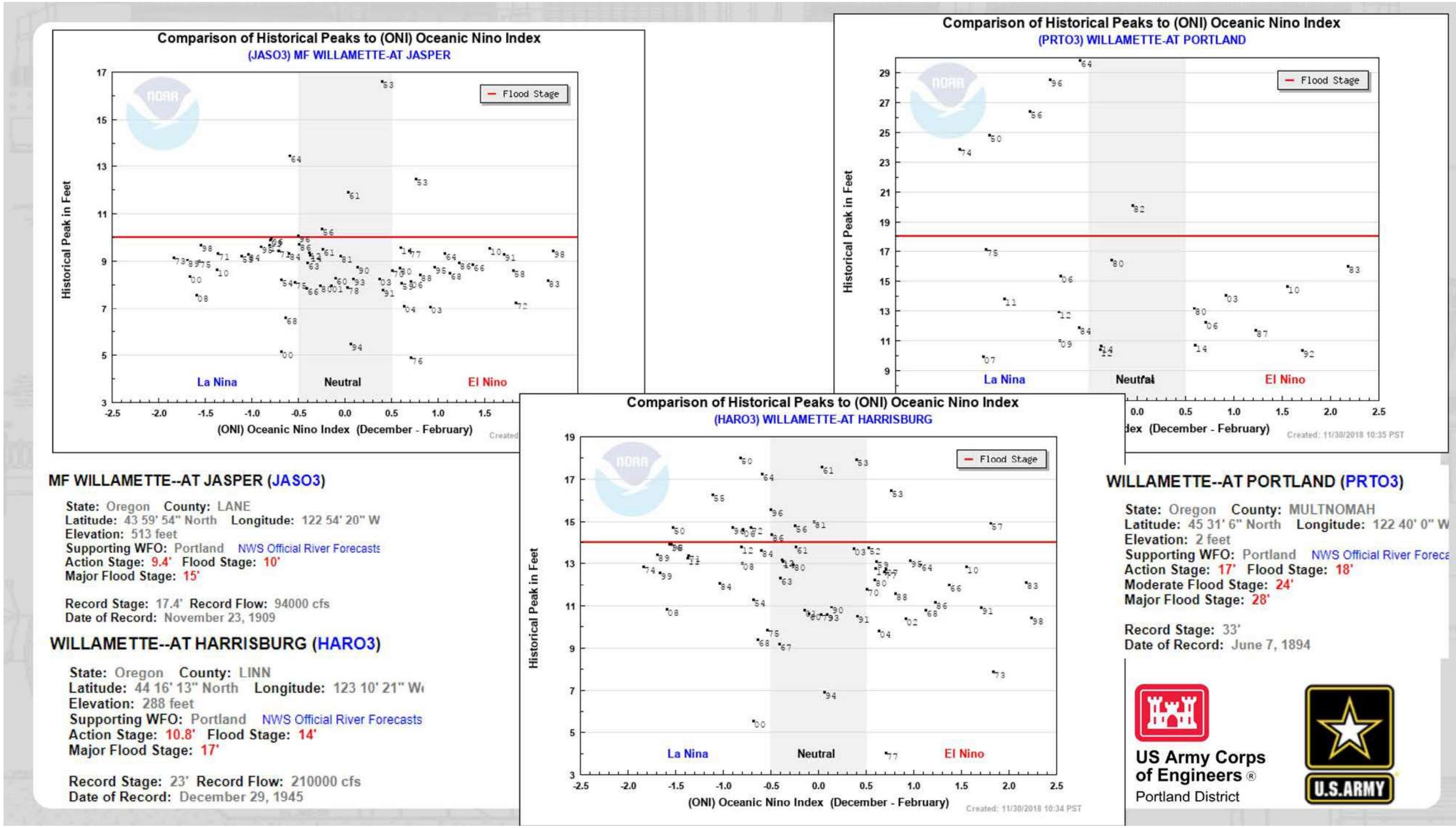
Comparison of Historical Peaks to (ONI) Oceanic Nino Index
(JASO3) MF WILLAMETTE-AT JASPER
Flood Stage
Historical Peak in Feet
La Nina
Neutral
El Nino
(ONI) Oceanic Nino Index (December - February)
Comparison of Historical Peaks to (ONI) Oceanic Nino Index
(PRTO3) WILLAMETTE-AT PORTLAND
Flood Stage
Historical Peak in Feet
La Nina
Neutral
El Nino
Created: 11/30/2018 10:35 PST
Comparison of Historical Peaks to (ONI) Oceanic Nino Index
(HARO3) WILLAMETTE-AT HARRISBURG
Flood Stage
Historical Peak in Feet
La Nina
Neutral
El Nino
(ONI) Oceanic Nino Index (December - February)
Created: 11/30/2018 10:34 PST
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 Forecasts
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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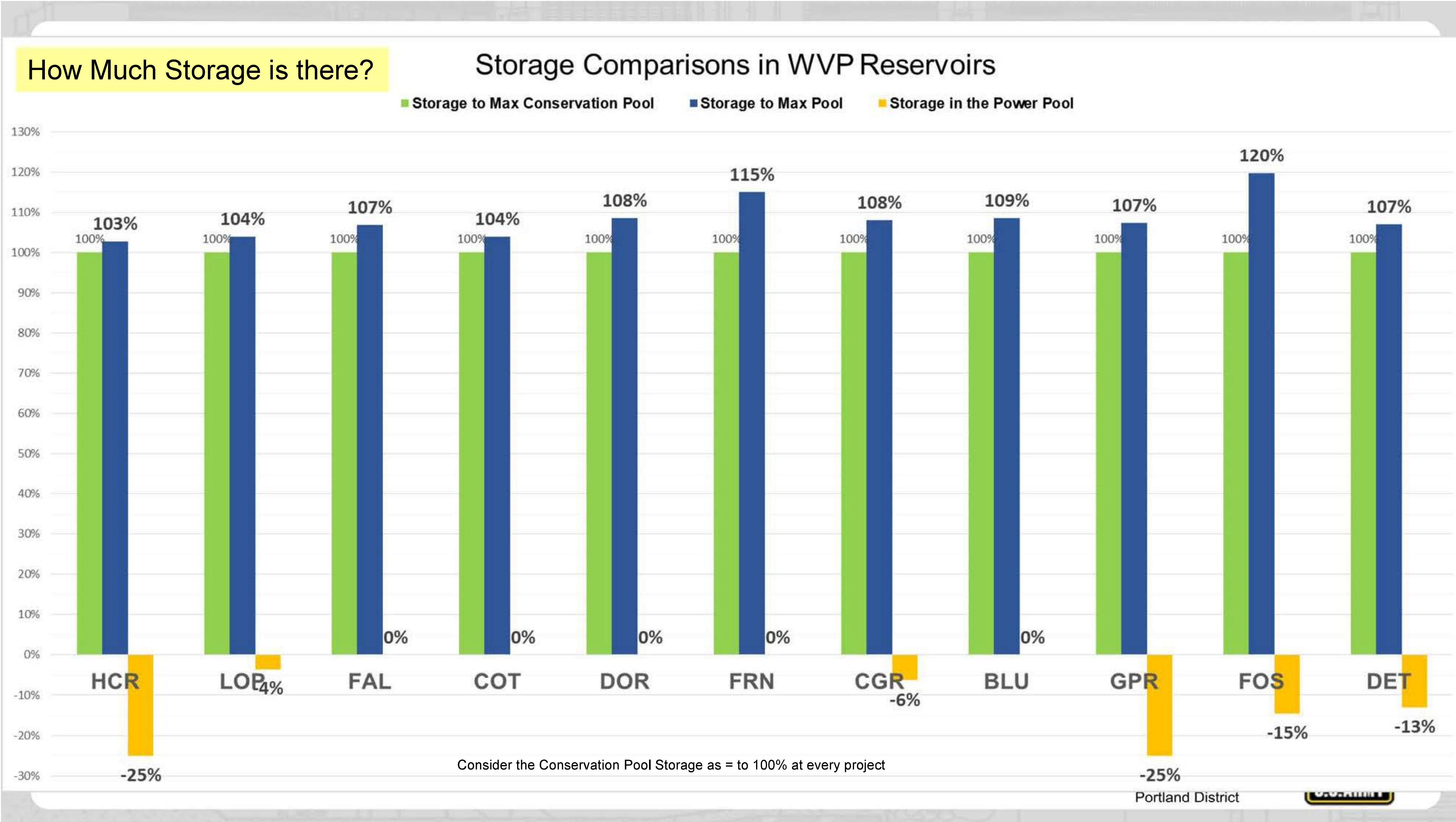

How Much Storage is there?
Storage Comparisons in WVP Reservoirs
Storage to Max Conservation Pool
Storage to Max Pool
Storage in the Power Pool
130%
120%
110%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
HCR
LOP
FAL
COT
DOR
FRN
CGR
BLU
GPR
FOS
DET
100%
103%
104%
107%
104%
108%
115%
108%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

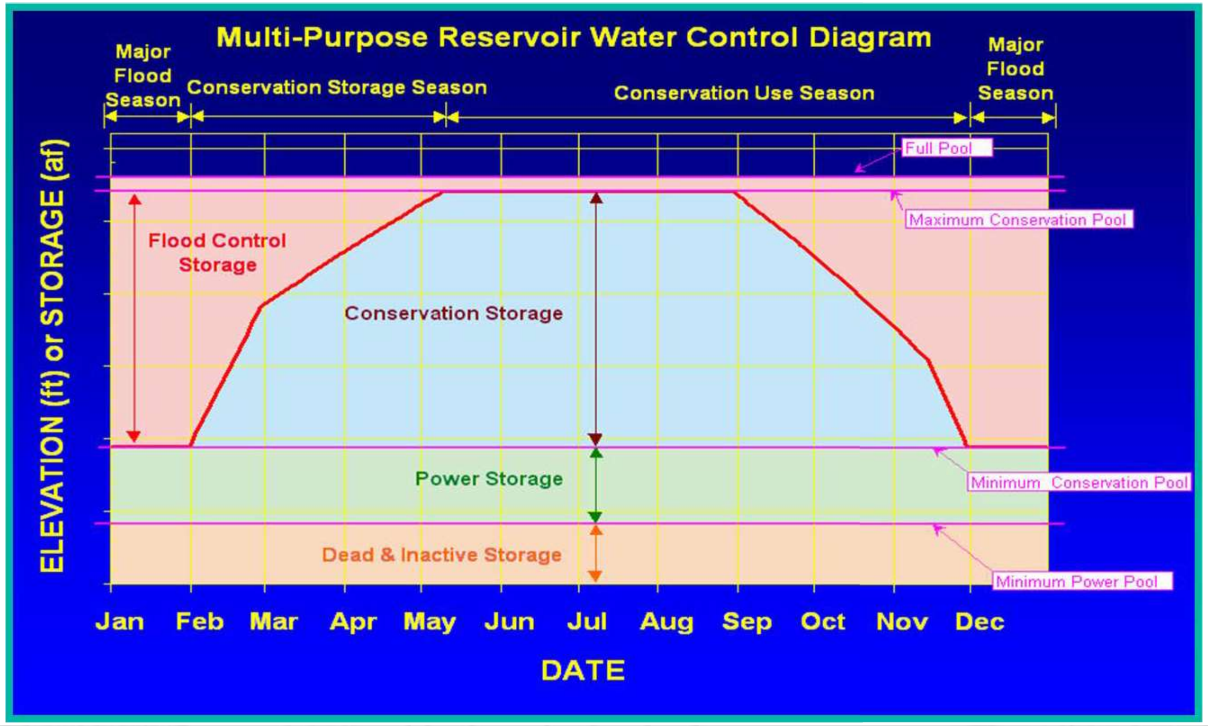
ER 1110-2-8156

CECW-CE

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**

Oregon

TABLE OF CONTENTS


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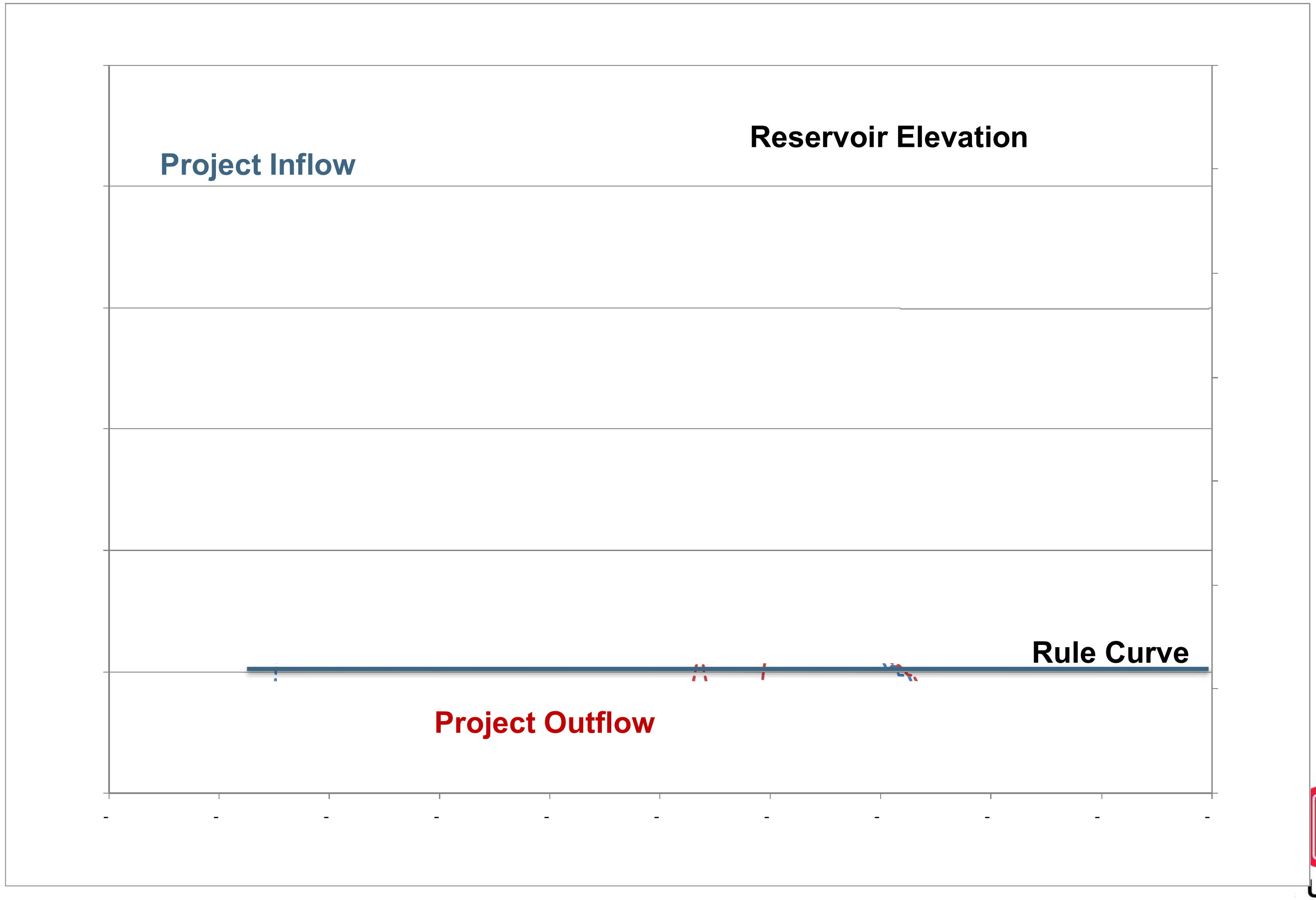
# HOW WE "DO" FLOOD RISK MANAGEMENT AT THE DAM

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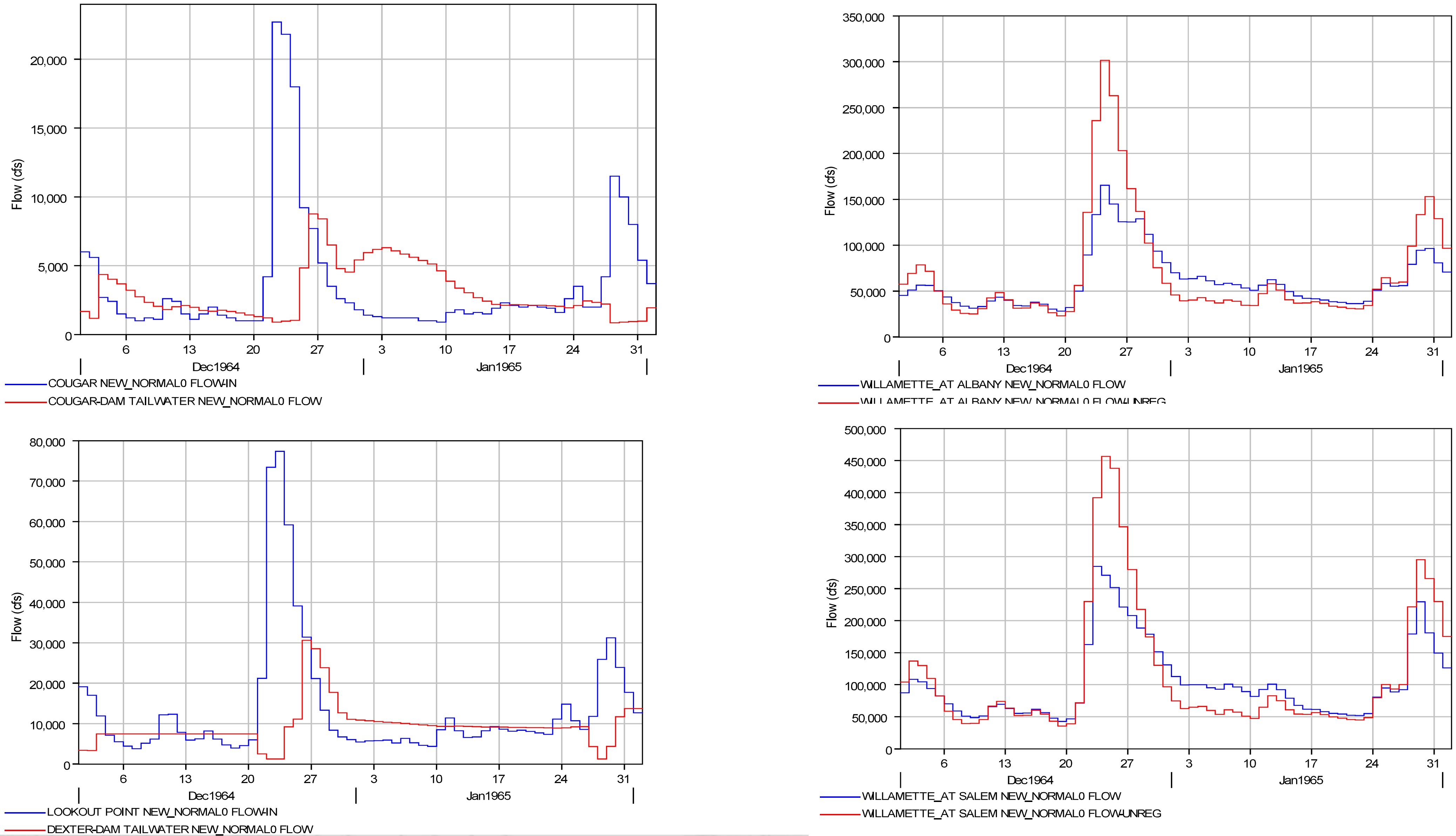
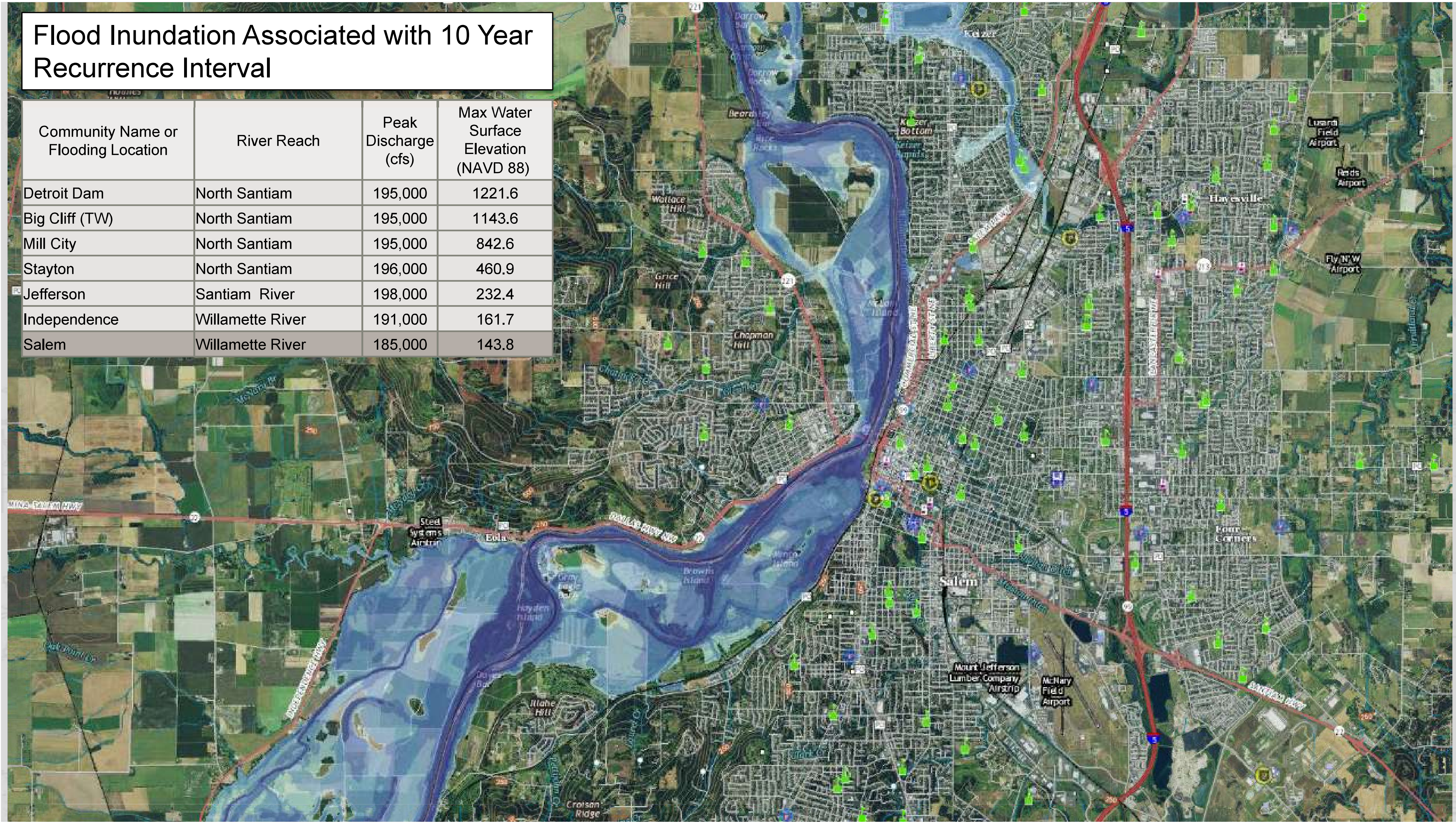
# HOW FLOOD RISK MANAGEMENT LOOKS DOWNSTREAM



## 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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## ANY QUESTIONS ABOUT WINTER SYSTEM OPERATIONS?

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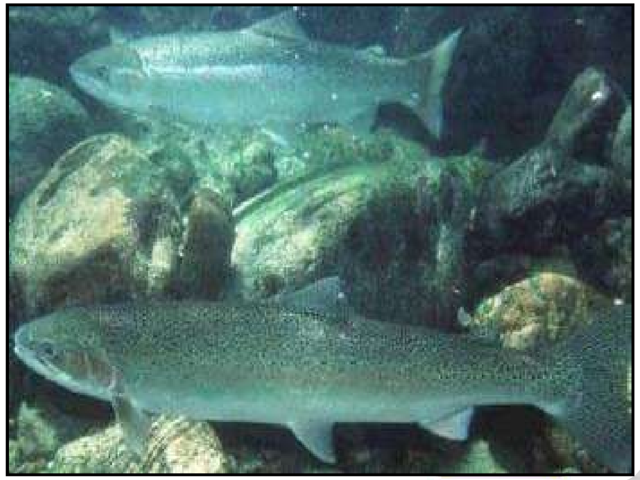
## CONSERVATION SEASON SYSTEM OPERATIONS

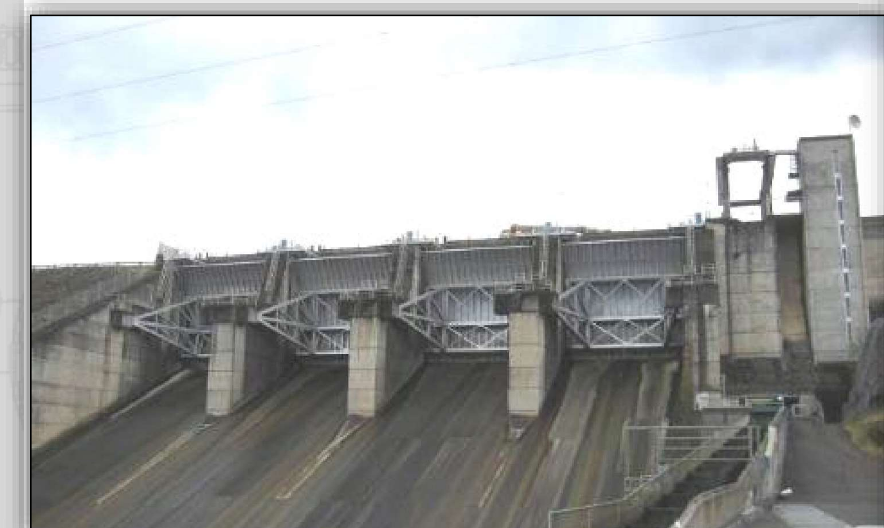
- Refill in Spring so there is sufficient water to meet authorized purposes.
- Operate to facilitate maintenance and project improvements at the dams
- Fisheries Specific Goals
  - Meet Biological Opinion requirements
  - Minimize stranding and dewatering of eggs
    - » Daily and hourly ramping release 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

USDA United States Department of Agriculture
NRCS Natural Resources Conservation Service

**Oregon**
**Basin Outlook Report**
**April 1, 2017**

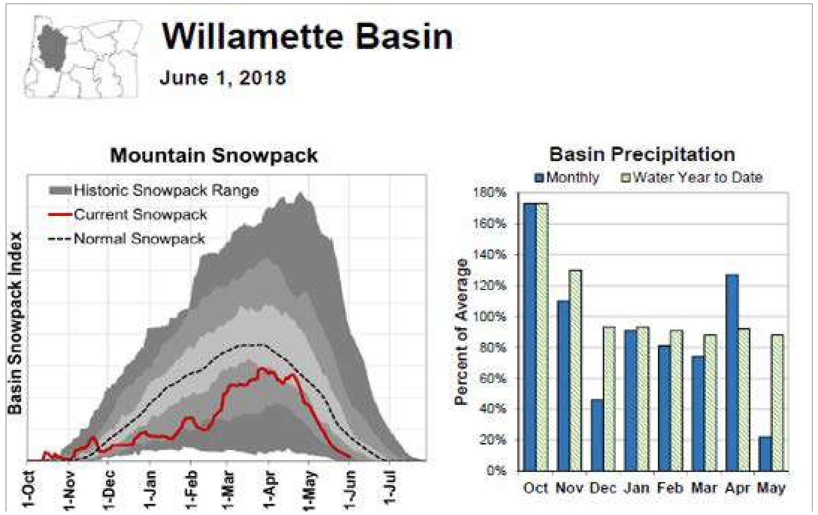
Landslide blocking road & preventing field staff from reaching and conducting snow surveys at Bigelow Camp SNOTEL site in the Siskiyou Mountains
*Photo courtesy of Bill Overman (OR NRCS Snow Surveys)*

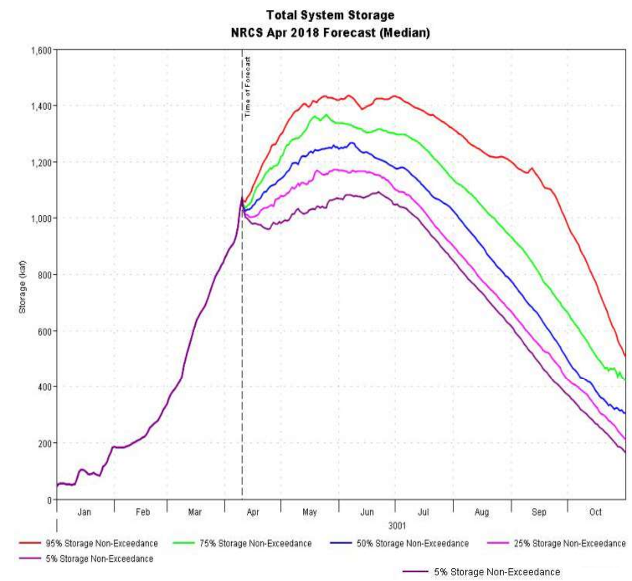
- Water year type determined by mid-May NRCS Water Supply Forecast
- Prescribes mainstem Willamette at Salem & Albany and tributary minimum flow targets

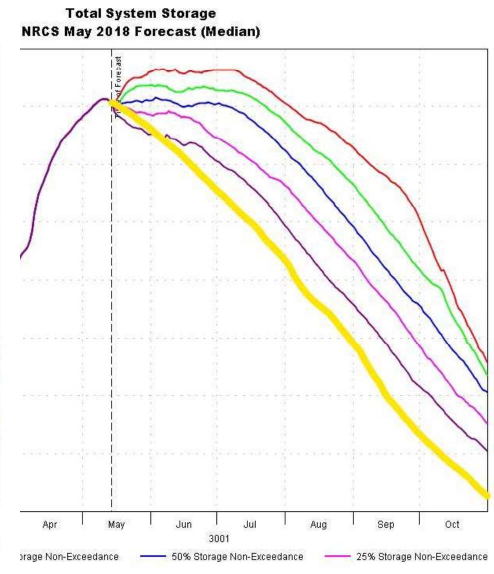
| Characteristics of Water Year Types | Abundant | Adequate | Insufficient | Deficit |
|---|---|---|---|---|
| Mid-May storage (MAF)[1] | ≥ 1.48 | 1.20 to 1.47 | 0.90 to 1.19 | < 0.90 |
| Frequency | 58% | 17% | 9% | 16% |
| Meet all mainstem flow objectives? | Yes | Yes | No | No |
| Alternative flow 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<br>April - Aug: 80 cfs<br>Sep 1-Oct 15: 200 cfs<br>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<br>Jul-Oct: 50 cfs<br>Nov-Jan: Inflow | | 100 cfs per hour 300 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: 100 cfs<br>Jul-Oct: 100 cfs<br>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<br>Jul-Nov: 30cfs<br>(at MNRO)<br>Dec-Jan: Inflow | | 200 cfs | From 30 to 300 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: 300 cfs<br>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<br>100-500cfs : 100 cfs<br>500-1000cfs : 200 cfs<br>1000-2000cfs : 400 cfs<br>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<br>Mar 16-May 15: 1500 cfs<br>May 16-Jun 30: 1100 cfs<br>Jul 1-Aug 31: 800 cfs<br>Sep 1-Oct 15: 1500 cfs<br>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<br>Mar 16-May 31: 1500 cfs<br>Jun 1-Jul 15: 1200 cfs<br>Jul 16 - Aug - 31: 1000 cfs<br>Sep 1-Oct 15: 1500 cfs<br>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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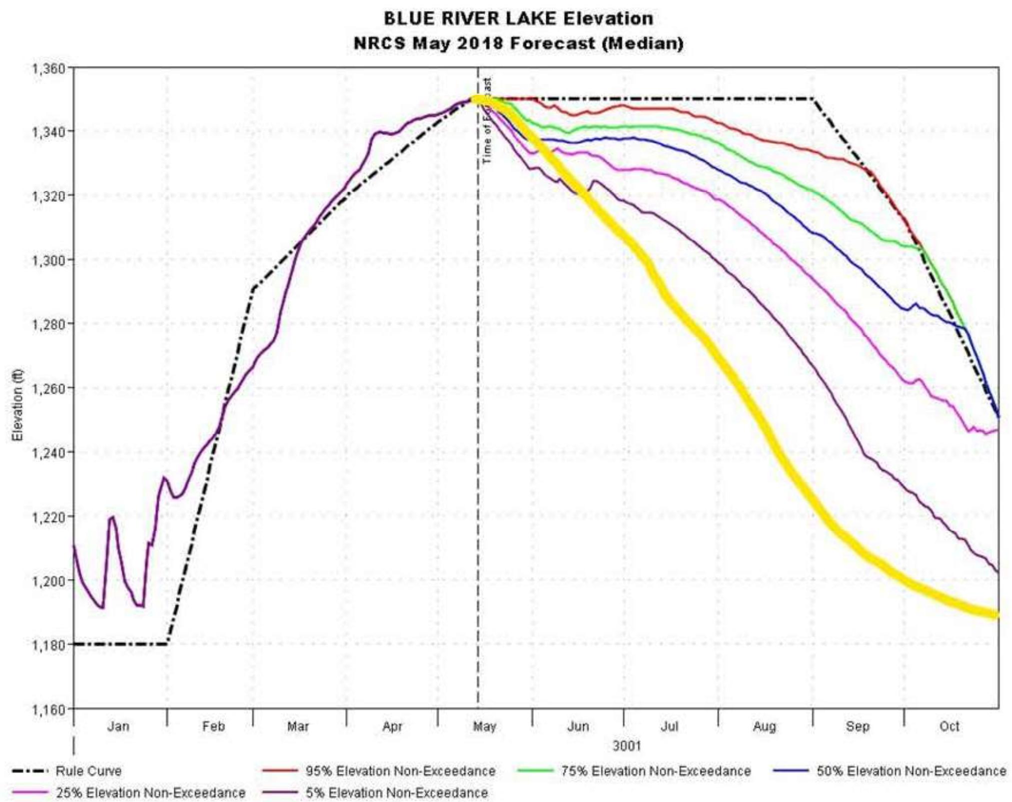
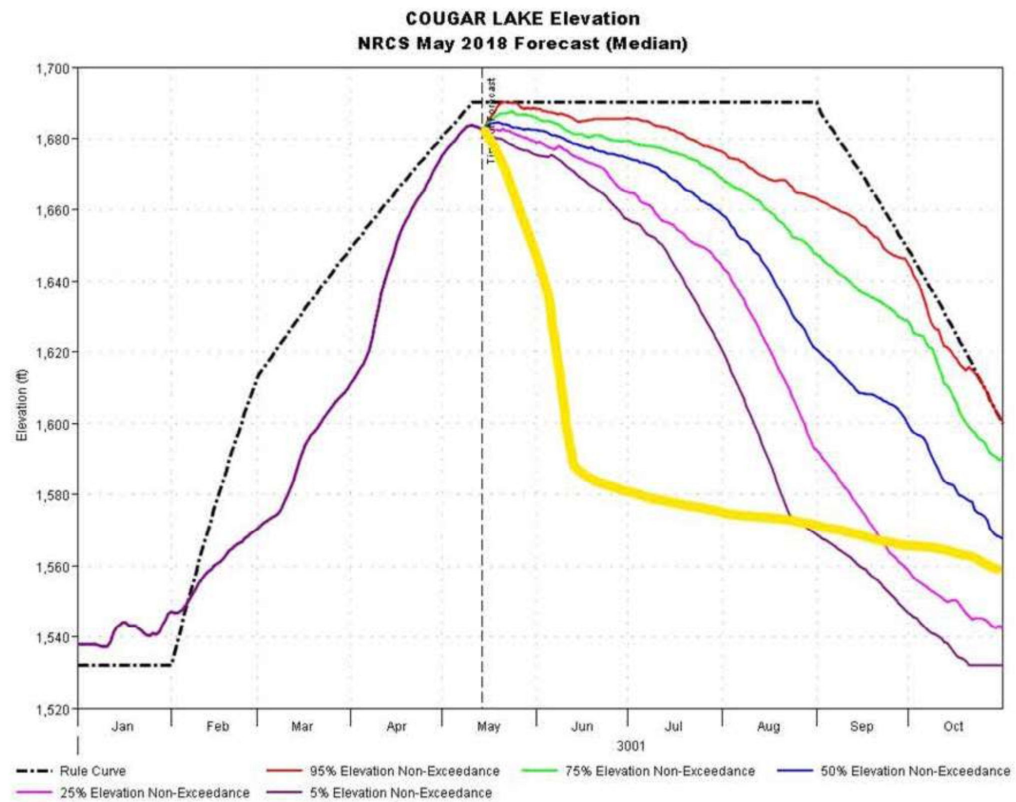
2018 Conservation Season – End Game vs May Forecast

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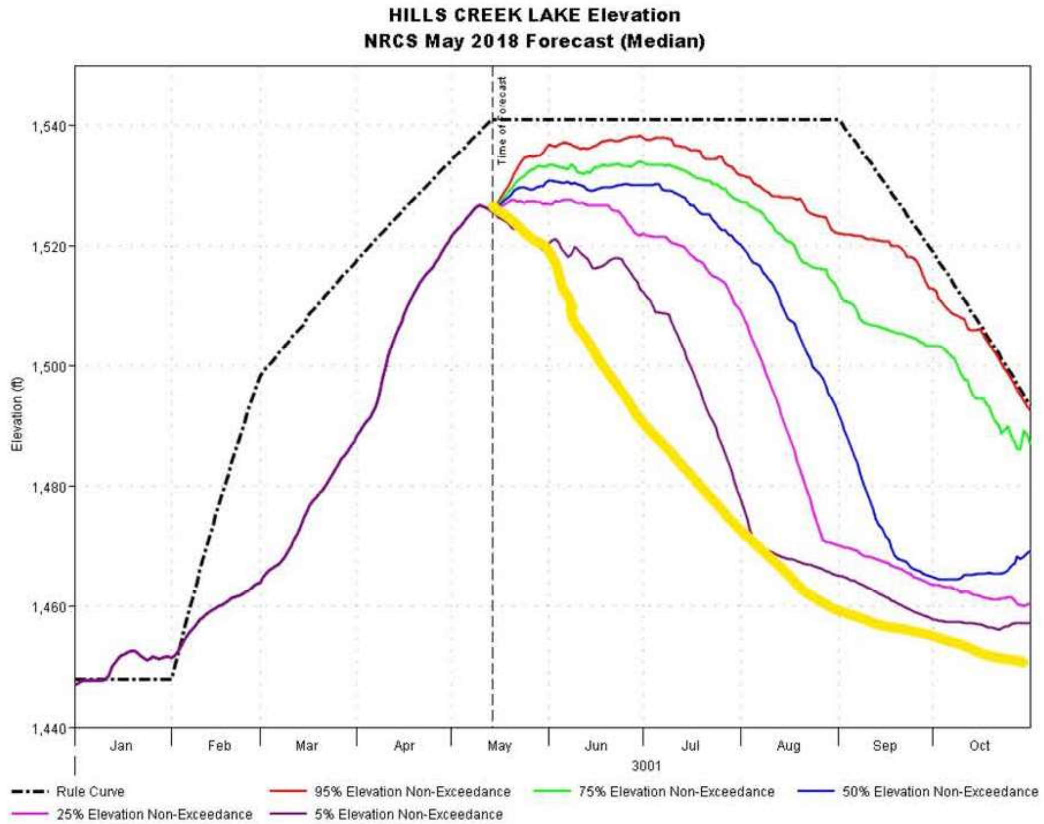
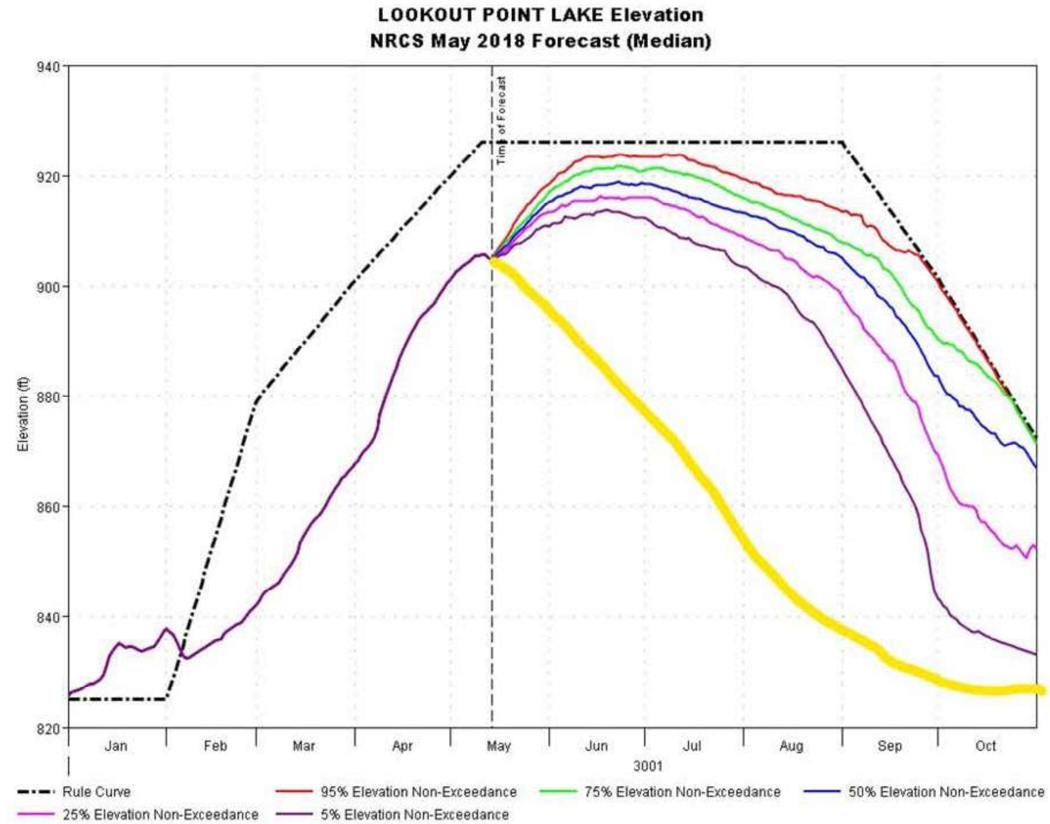
## 2018 Conservation season – Results from April Forecast

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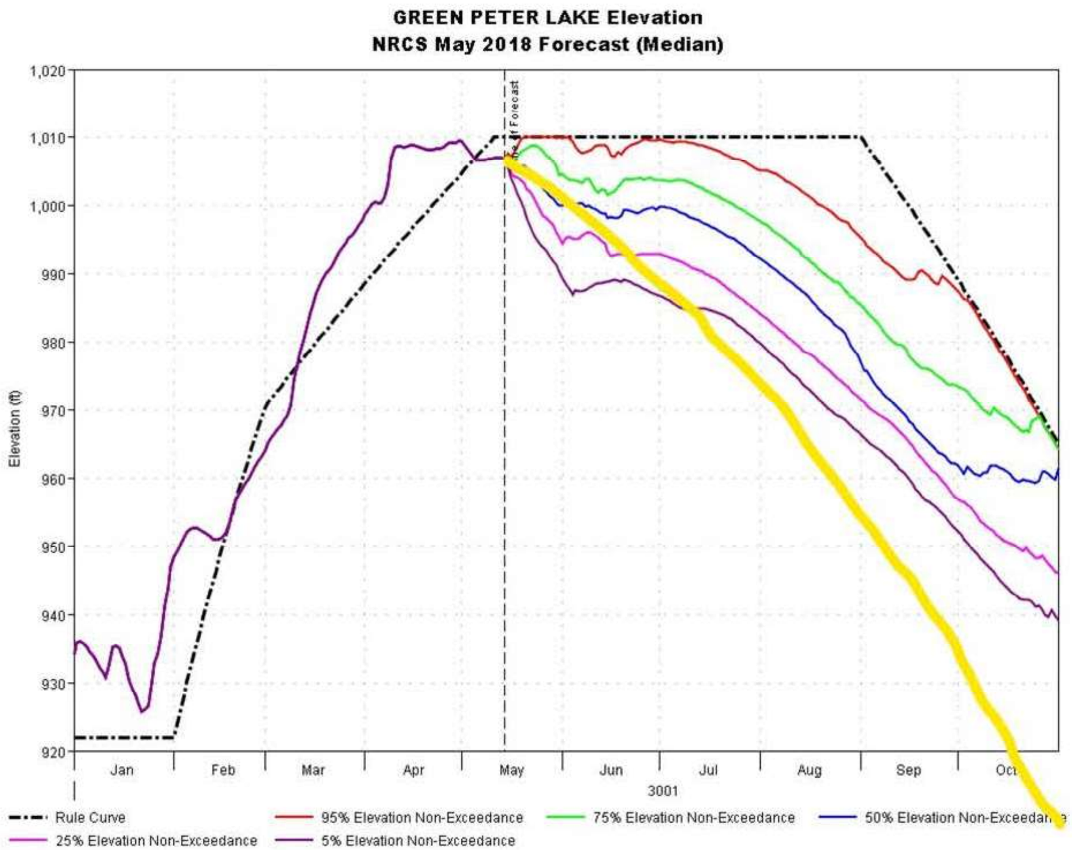
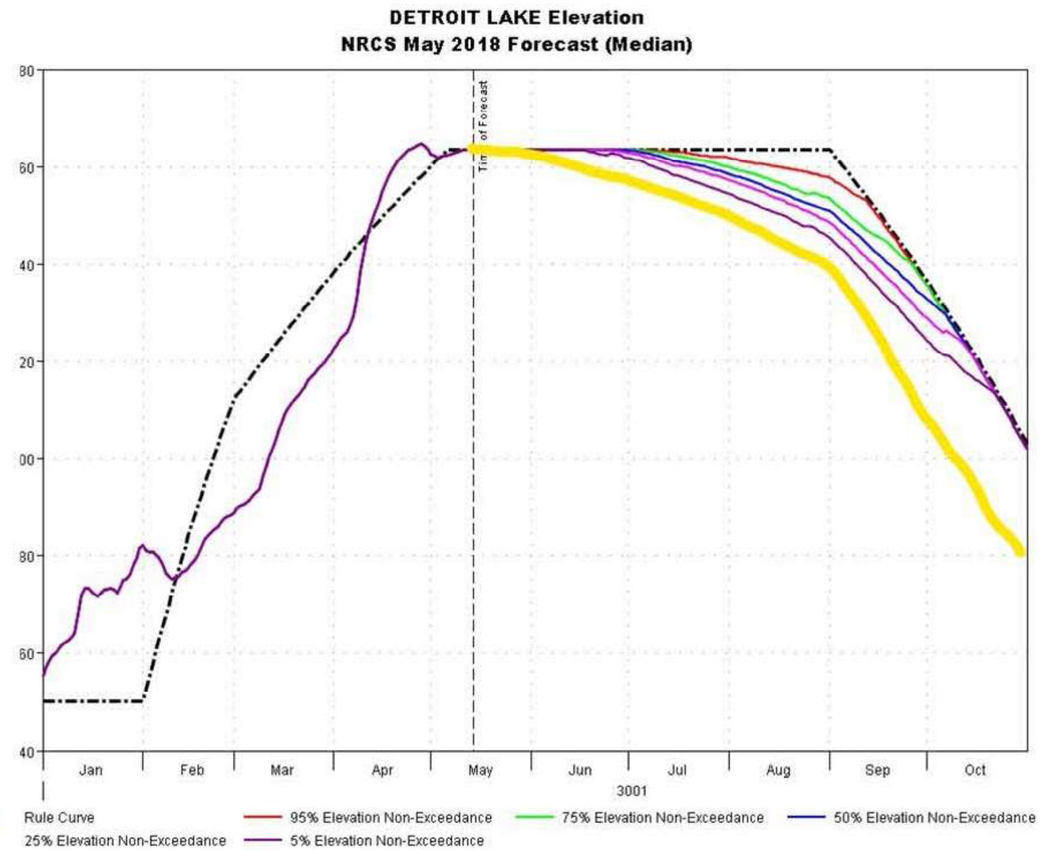
## 2018 Conservation season – Results from April Forecast

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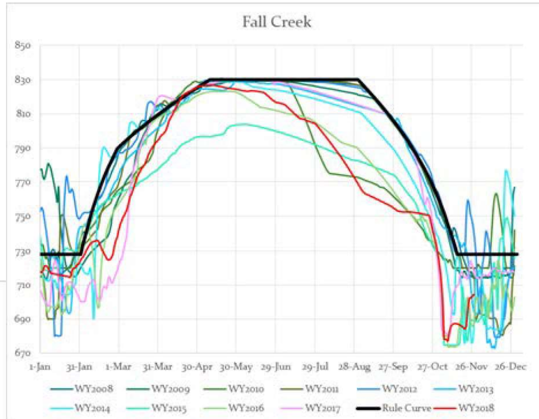
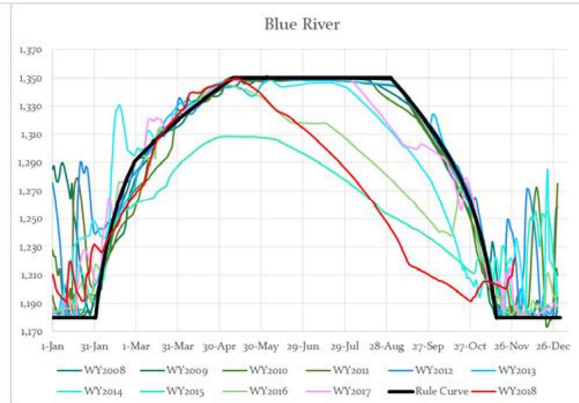
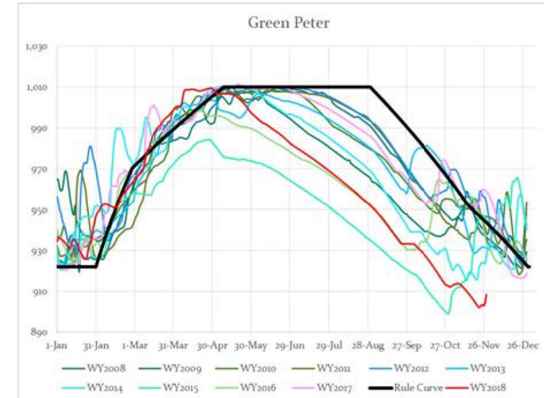
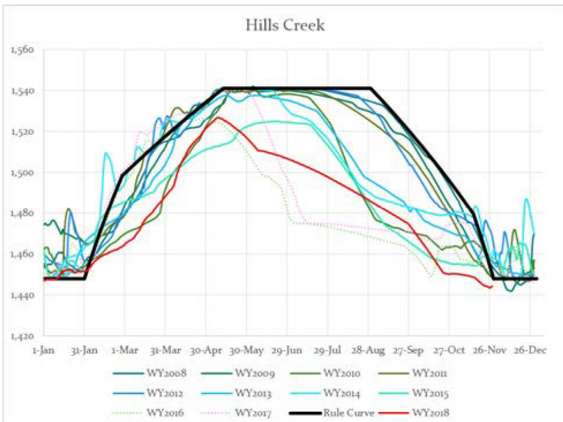
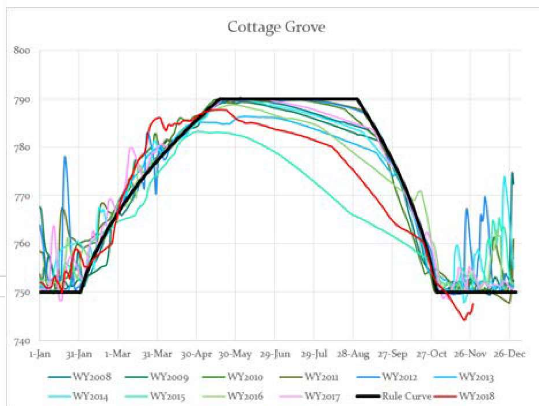
Annual Variability
2008-2018
Biop Implementation Years
(red is current year)

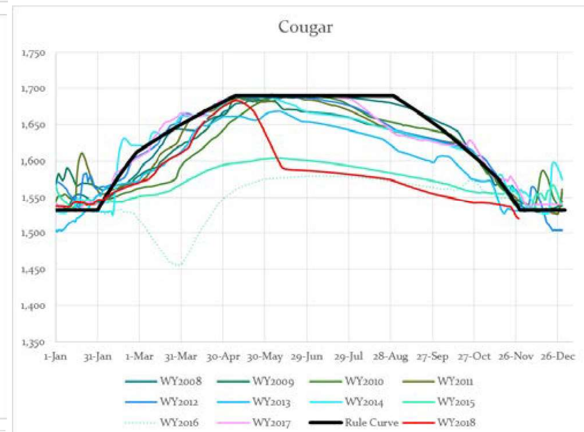


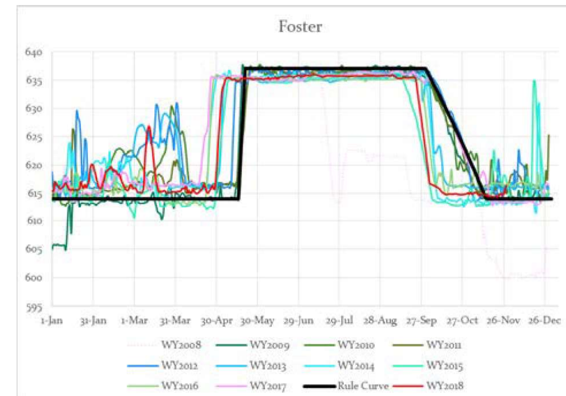



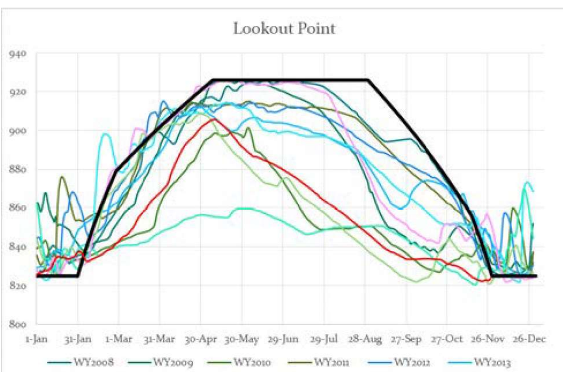



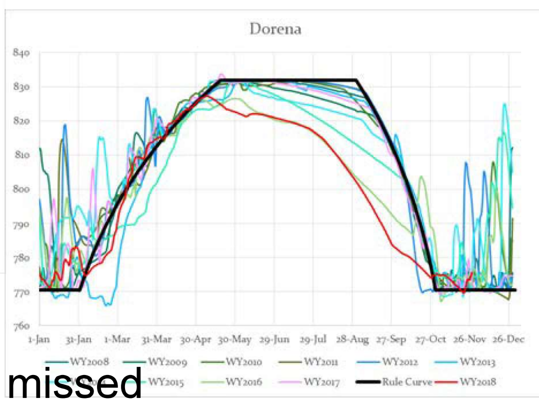



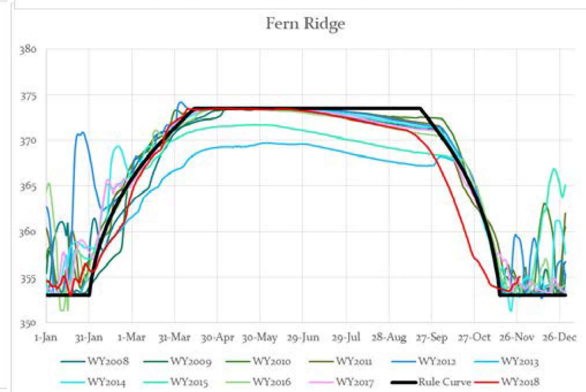



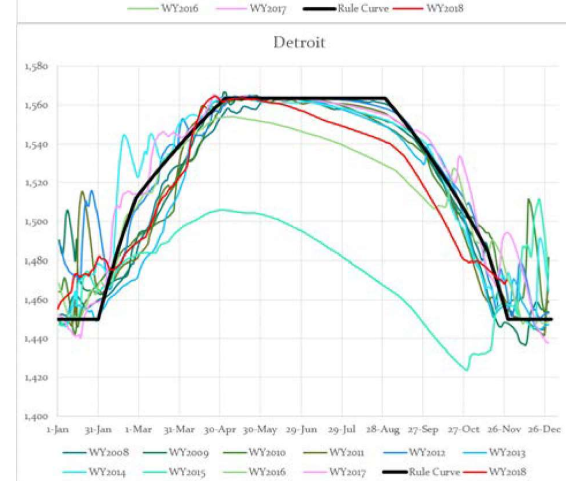



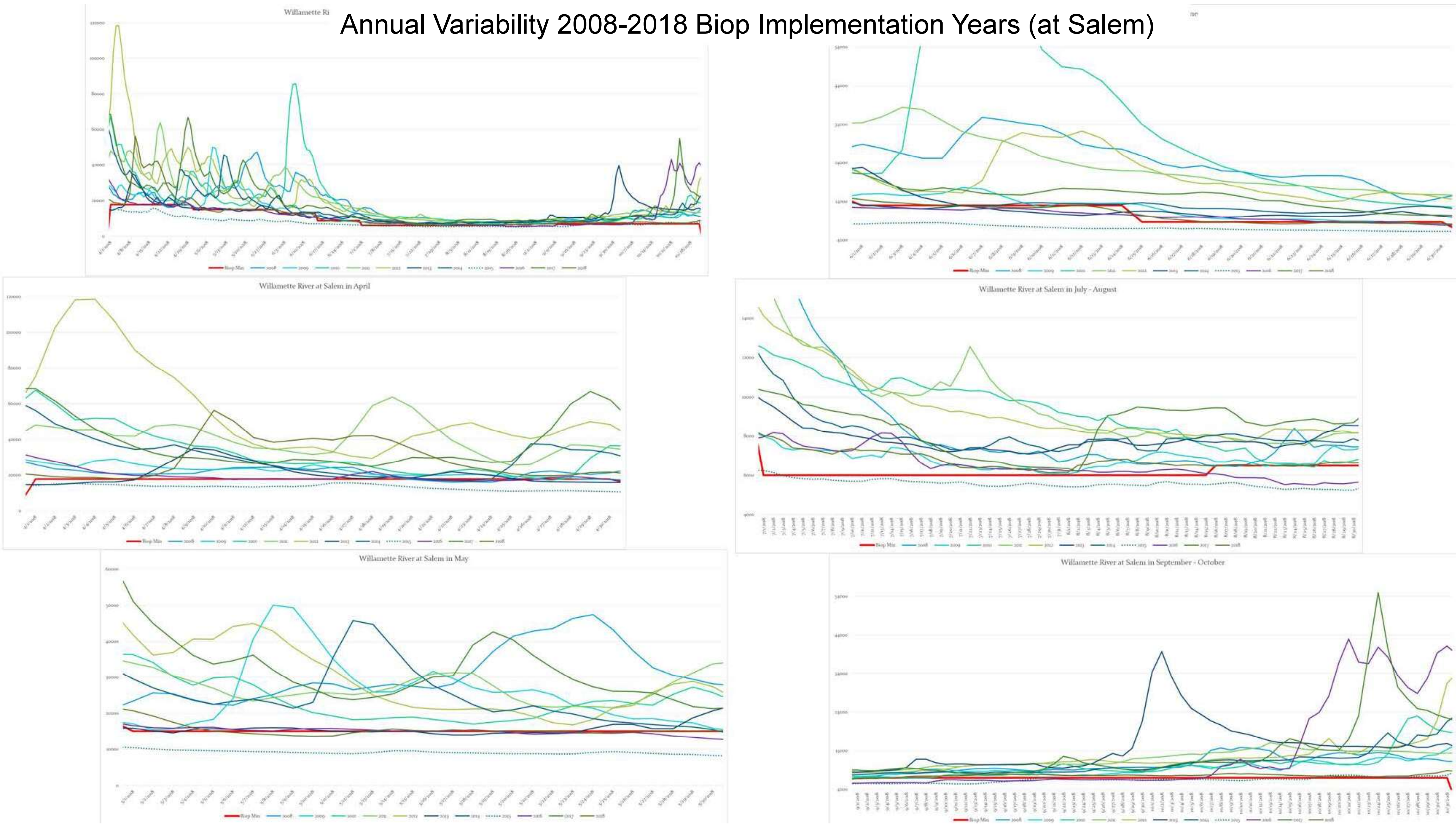




Learning Point-Even though
the reservoirs fill in May
the Biop flow targets may be missed
in fall due to lack of storage

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




ANY QUESTIONS ABOUT SPRING THRU FALL SYSTEM OPERATIONS?
27
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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

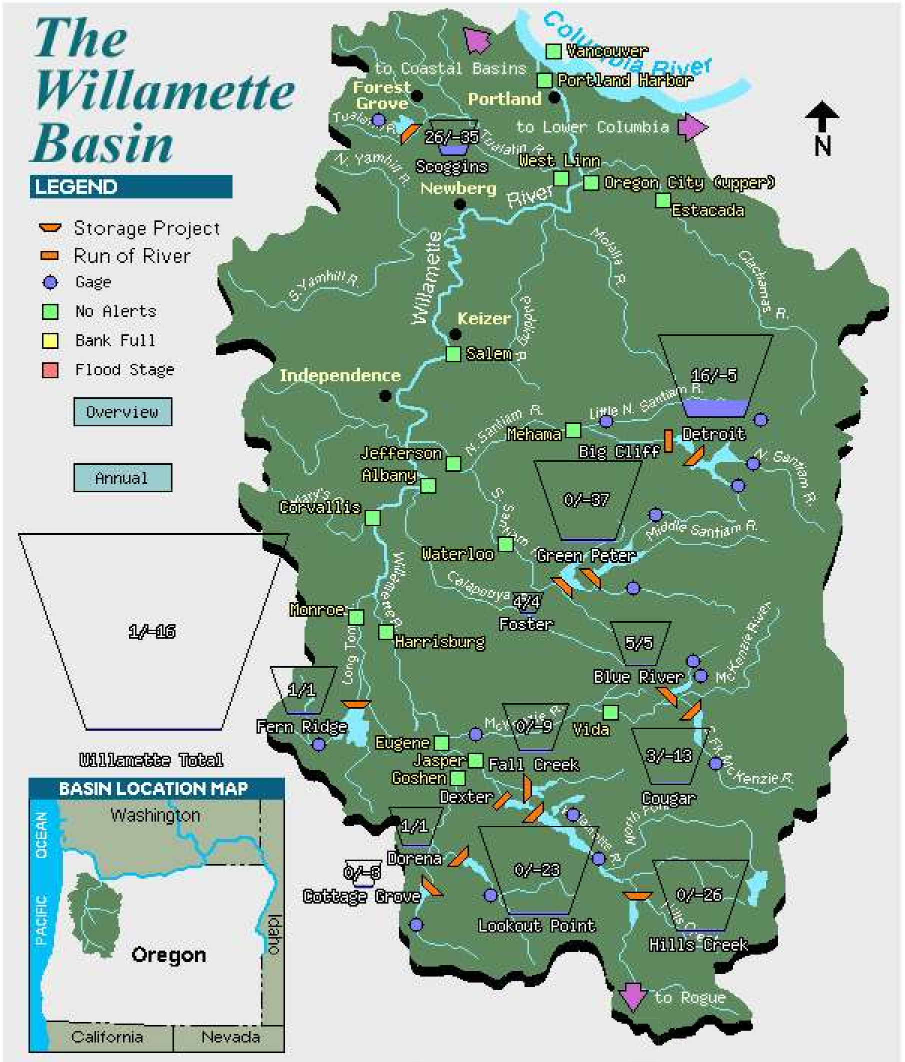
Portland District Water Management Reservoir Regulation and Water Quality Section http://www.nwd-wc.usace.army.mil/nwp/wm/

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/




**Created:** Fri Nov 16 19:35:22 2018
**WCD:** Water Control Diagram
**Project numbers:** percent full / percent above WCD, where
percent full = ( current storage - minimum conservation storage ) / ( maximum conservation storage - minimum conservation storage )
percent above water control diagram = ( current storage - WCD storage ) / ( maximum conservation storage - minimum conservation storage )

# 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

1

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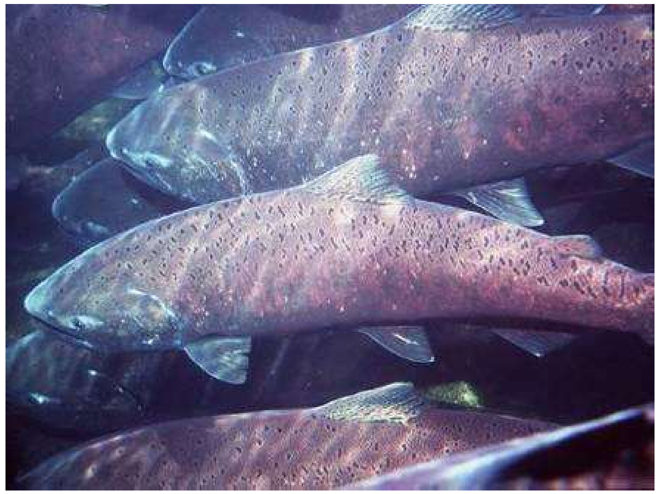
# ESA- listed anadromous fish in the Willamette Basin



*National Marine Fisheries Service (NMFS) jurisdiction*

**Upper Willamette River winter steelhead**

**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*

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# ESA- LISTED RESIDENT FISH IN THE WILLAMETTE BASIN

*US Fish and Wildlife Service (USFWS) jurisdiction*

**Oregon chub**

**Bull trout**

*Resident fish spend entire lifecycle in fresh water*

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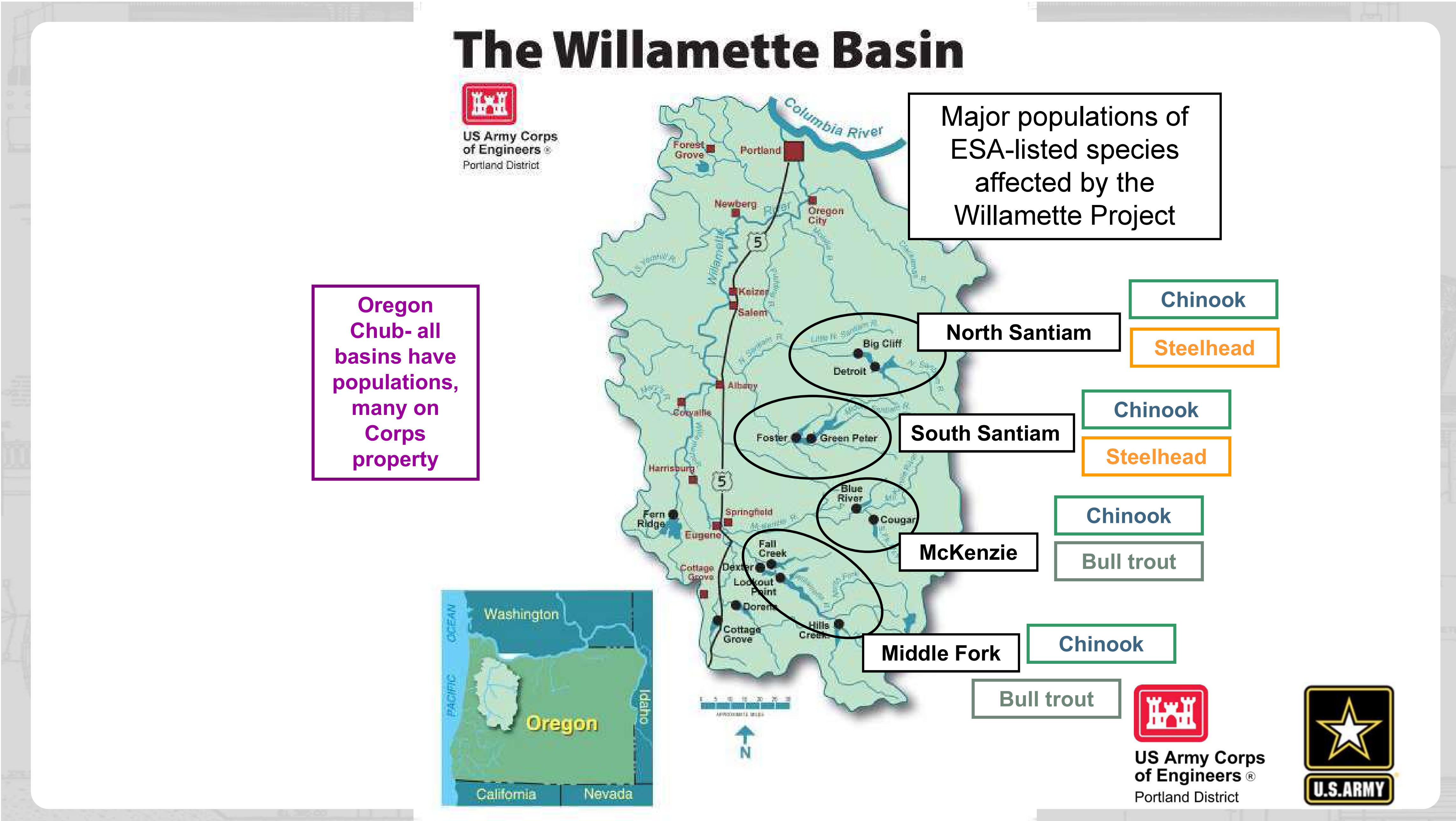
The Willamette Basin
US Army Corps of Engineers
Portland District
Major populations of ESA-listed species affected by the Willamette Project
Oregon Chub- all basins have populations, many on Corps property
North Santiam
Chinook
Steelhead
South Santiam
Chinook
Steelhead
McKenzie
Chinook
Bull trout
Middle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

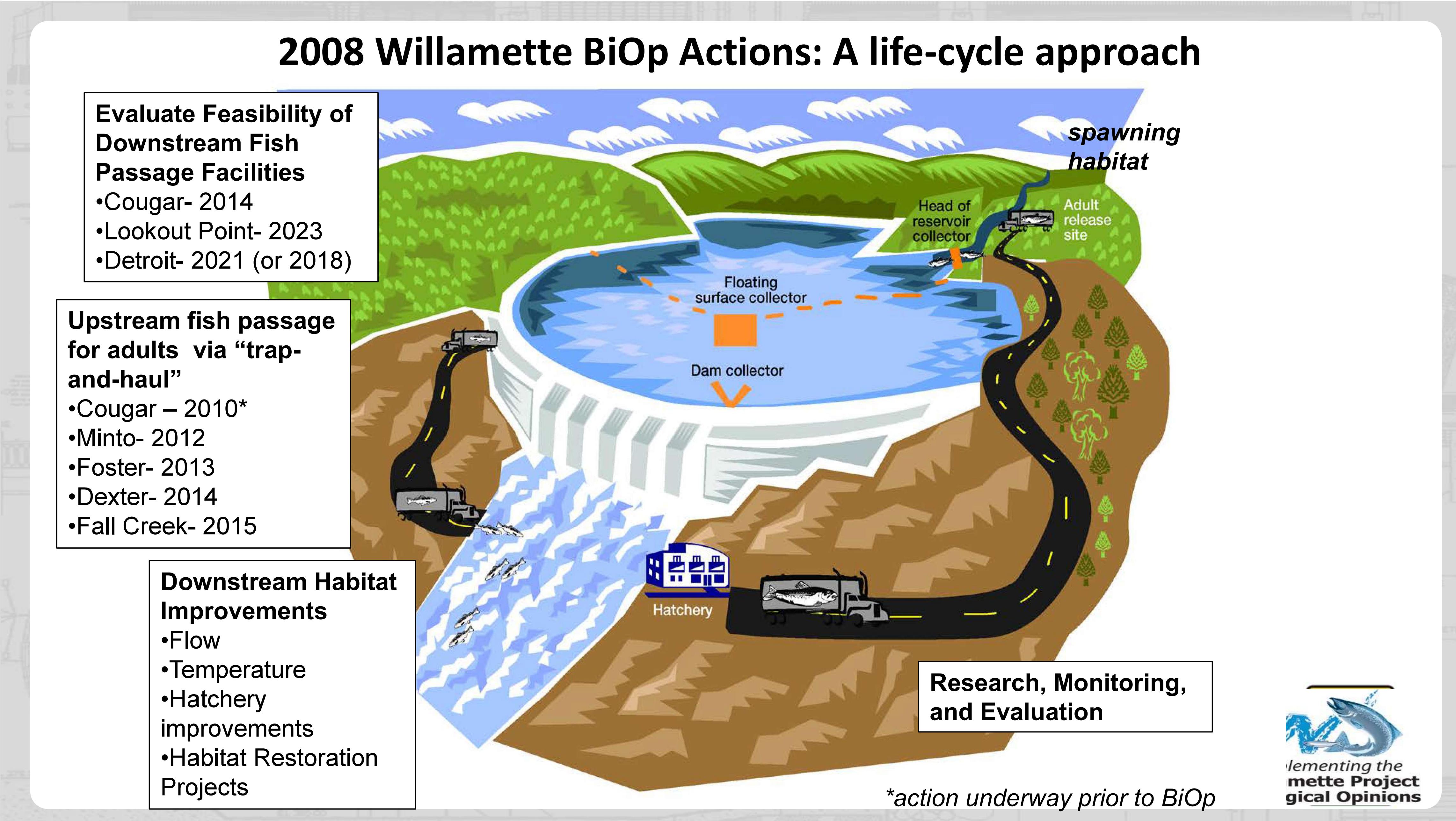
ODFW/NMFS, 2011

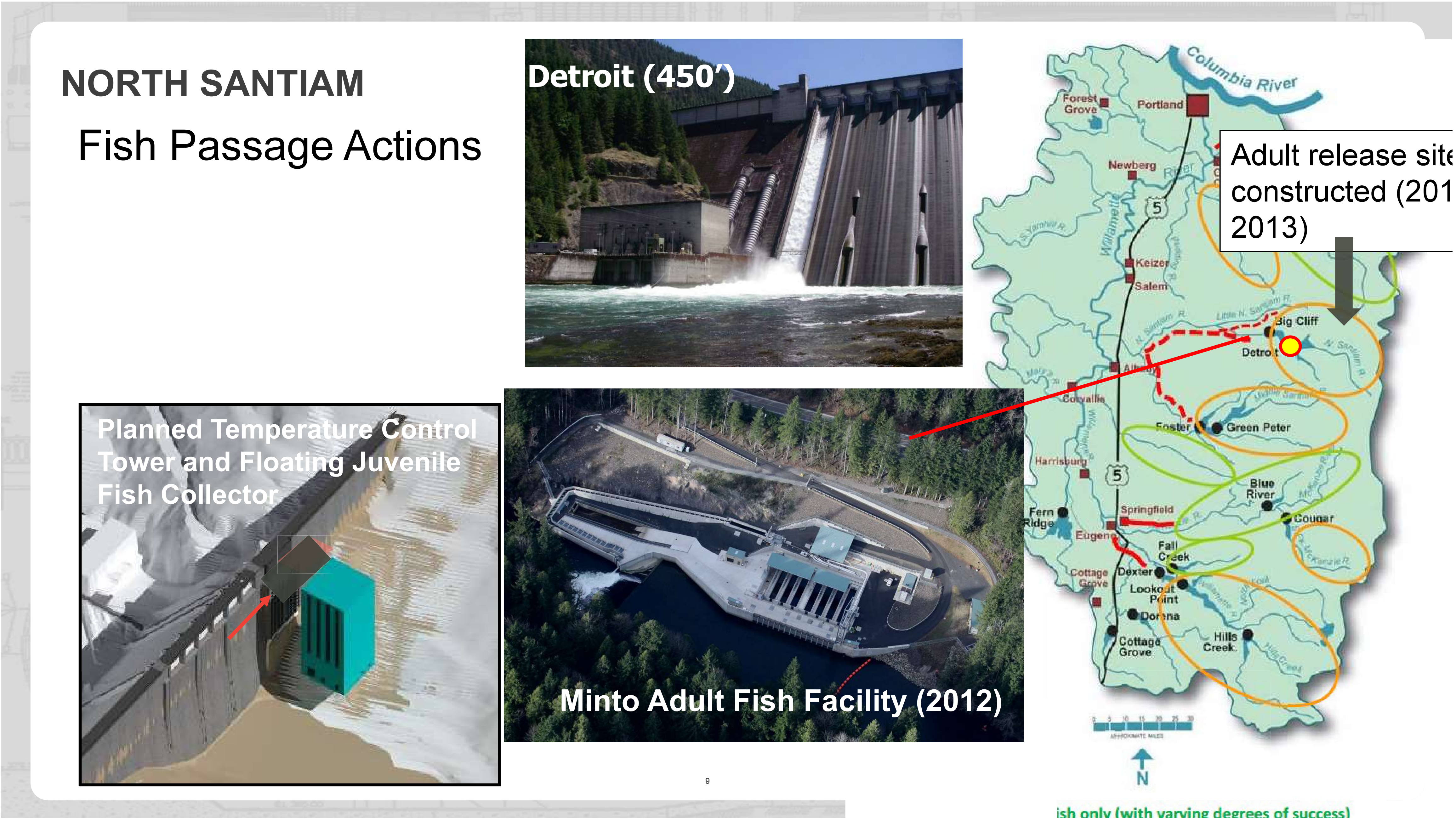
**“Split-Basin” strategy**

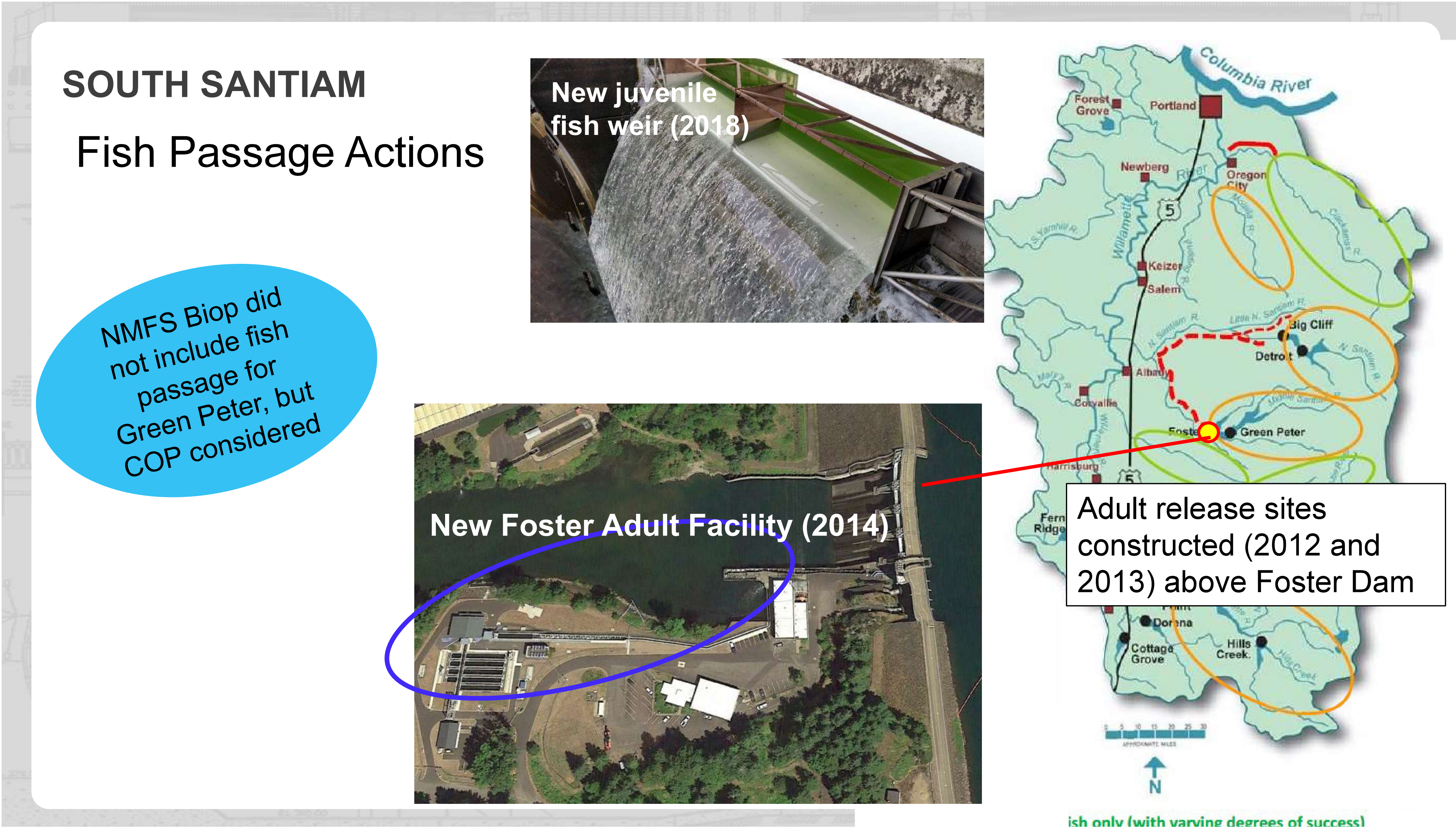
Wild fish above dams, maintain hatchery area below

- 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.

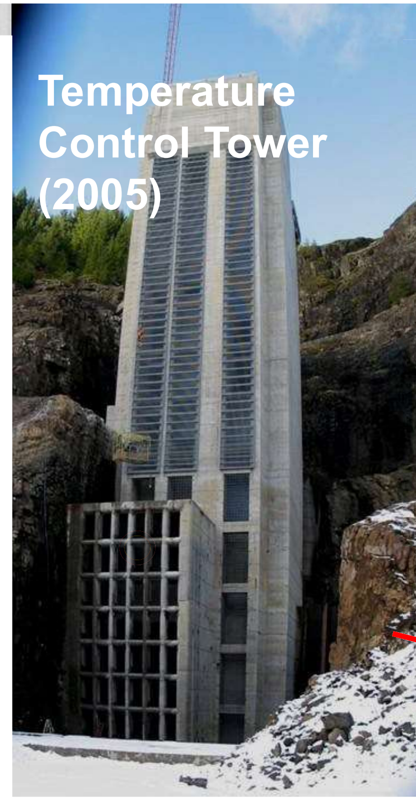

2008 Willamette BiOp Actions: A life-cycle approach
Evaluate Feasibility of Downstream Fish Passage Facilities
•Cougar- 2014
•Lookout Point- 2023
•Detroit- 2021 (or 2018)
Upstream fish passage for adults via "trap-and-haul"
•Cougar – 2010*
•Minto- 2012
•Foster- 2013
•Dexter- 2014
•Fall Creek- 2015
Downstream Habitat Improvements
•Flow
•Temperature
•Hatchery improvements
•Habitat Restoration Projects
spawning habitat
Head of reservoir collector
Adult release site
Floating surface collector
Dam collector
Hatchery
Research, Monitoring, and Evaluation
*action underway prior to BiOp

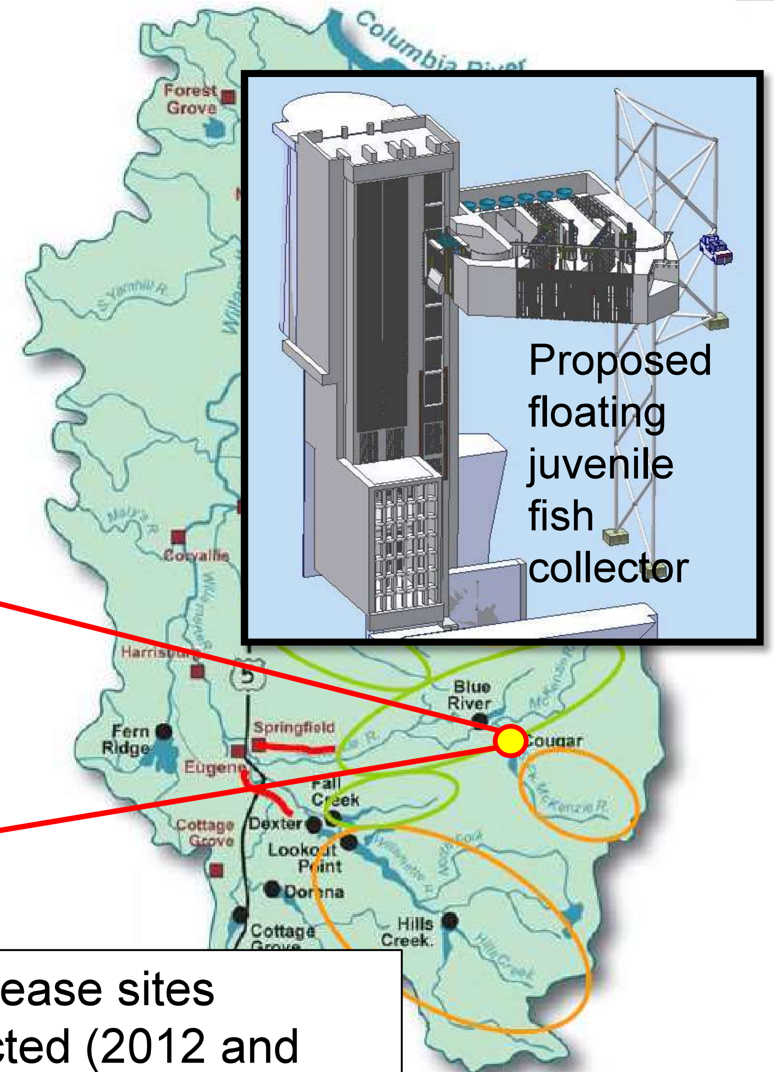

NORTH SANTIAM
Fish Passage Actions
Detroit (450')
Planned Temperature Control Tower and Floating Juvenile Fish Collector
Minto Adult Fish Facility (2012)
Adult release site constructed (201
2013)
Columbia River
Forest Grove
Portland
Newberg
Keizer
Salem
Big Cliff
Detroit
Albany
Corvallis
Foster
Green Peter
Harrisburg
Blue River
Cougar
Fern Ridge
Springfield
Eugene
Fall Creek
Dexter
Lookout Point
Dorena
Cottage Grove
Hills Creek
N
9
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
New juvenile fish weir (2018)
New Foster Adult Facility (2014)
Adult release sites constructed (2012 and 2013) above Foster Dam
Columbia River
Forest Grove
Portland
Newberg
Oregon City
Keizer
Salem
Big Cliff
Detroit
Albany
Corvallis
Foster
Green Peter
Harrisburg
Fern Ridge
Dorena
Cottage Grove
Hills Creek
N
ish only (with varying degrees of success)

## MCKENZIE

### Fish Passage Actions

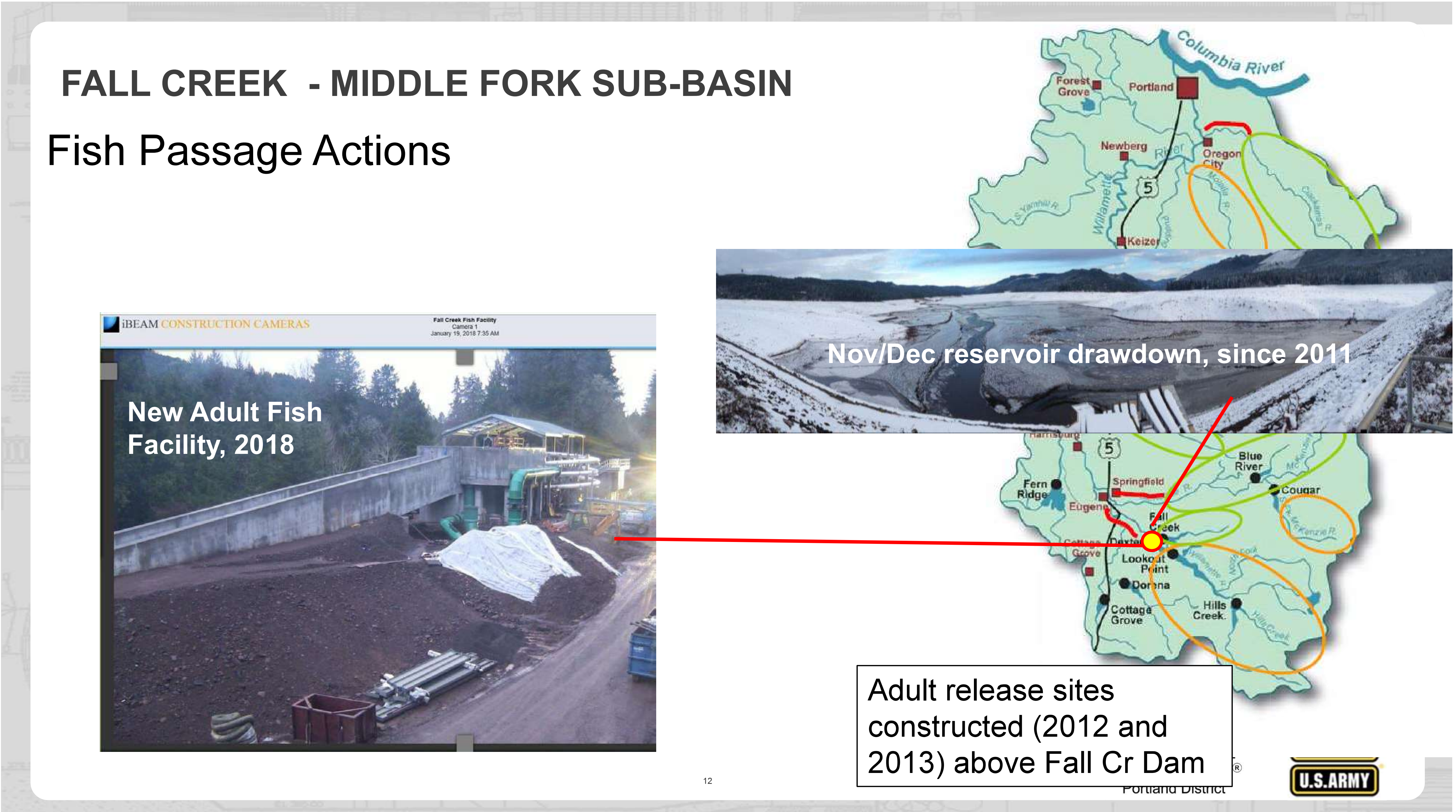




Adult release sites constructed (2012 and 2013) above Cougar Dam

11


FALL CREEK - MIDDLE FORK SUB-BASIN
Fish Passage Actions
iBEAM CONSTRUCTION CAMERAS
New Adult Fish Facility, 2018
Nov/Dec reservoir drawdown, since 2011
Columbia River
Forest Grove
Portland
Newberg
Oregon City
Keizer
5
Fern Ridge
Eugene
Springfield
Blue River
Cougar
Fall Creek
Dexter
Lookout Point
Dorena
Cottage Grove
Hills Creek
Adult release sites constructed (2012 and 2013) above Fall Cr Dam
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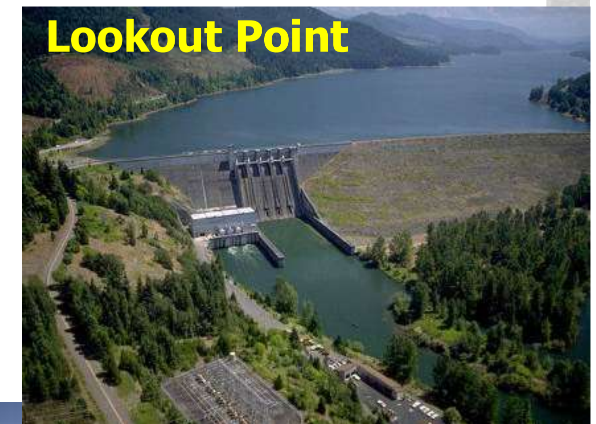
## MIDDLE FORK SUB-BASIN

- 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)

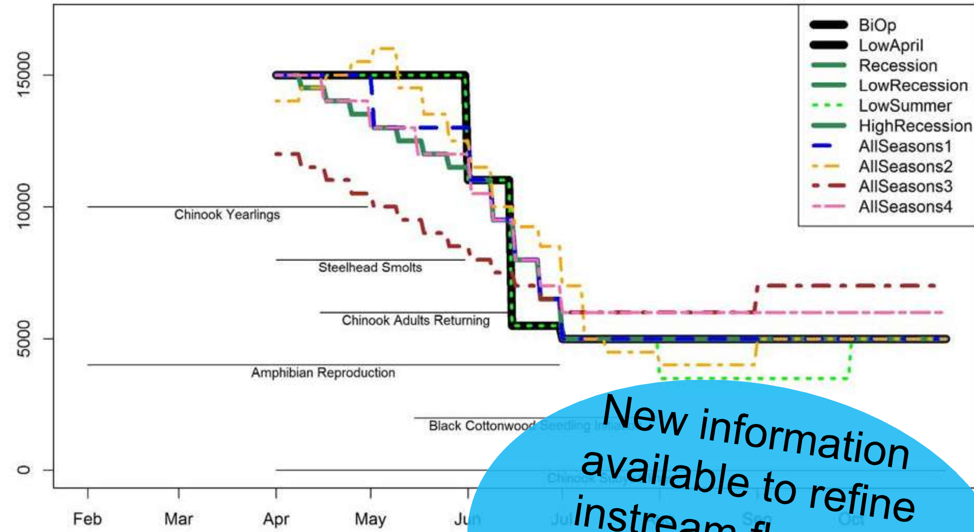
## Minimum flow targets

**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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# 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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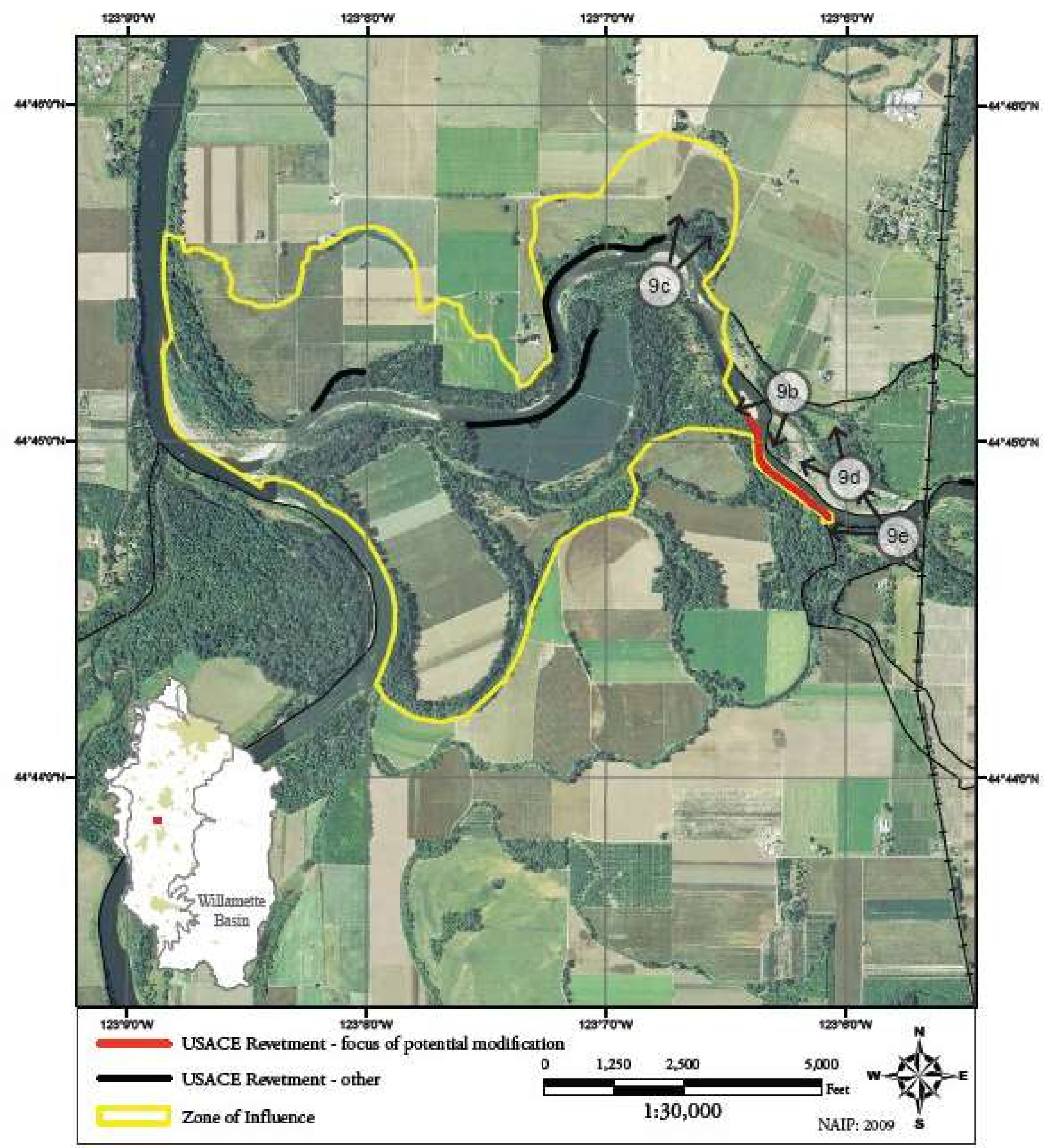

# HATCHERIES

## 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 | Middle Fork Fall Creek |
|---|---|---|---|---|---|
| Upstream fish passage | Minto | Foster | Cougar | Continuing feasibility evaluations / alternative development | New adu 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 | | Operation |
| Streamflow & Ramping Rates | | | | | |

Green = Implemented Orange = In progress

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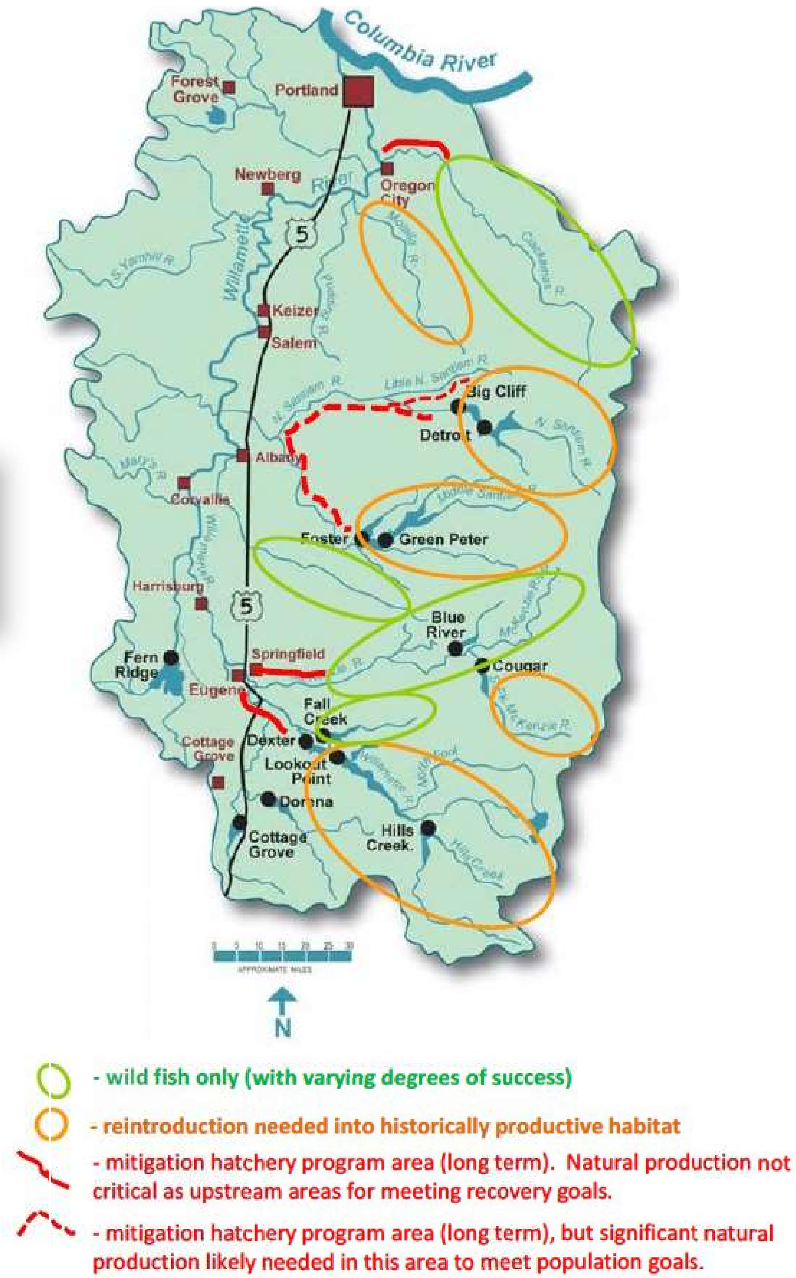

# WILLAMETTE BASIN REVIEW REALLOCATION STUDY

Kathryn Warner
4 December 2018

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

1

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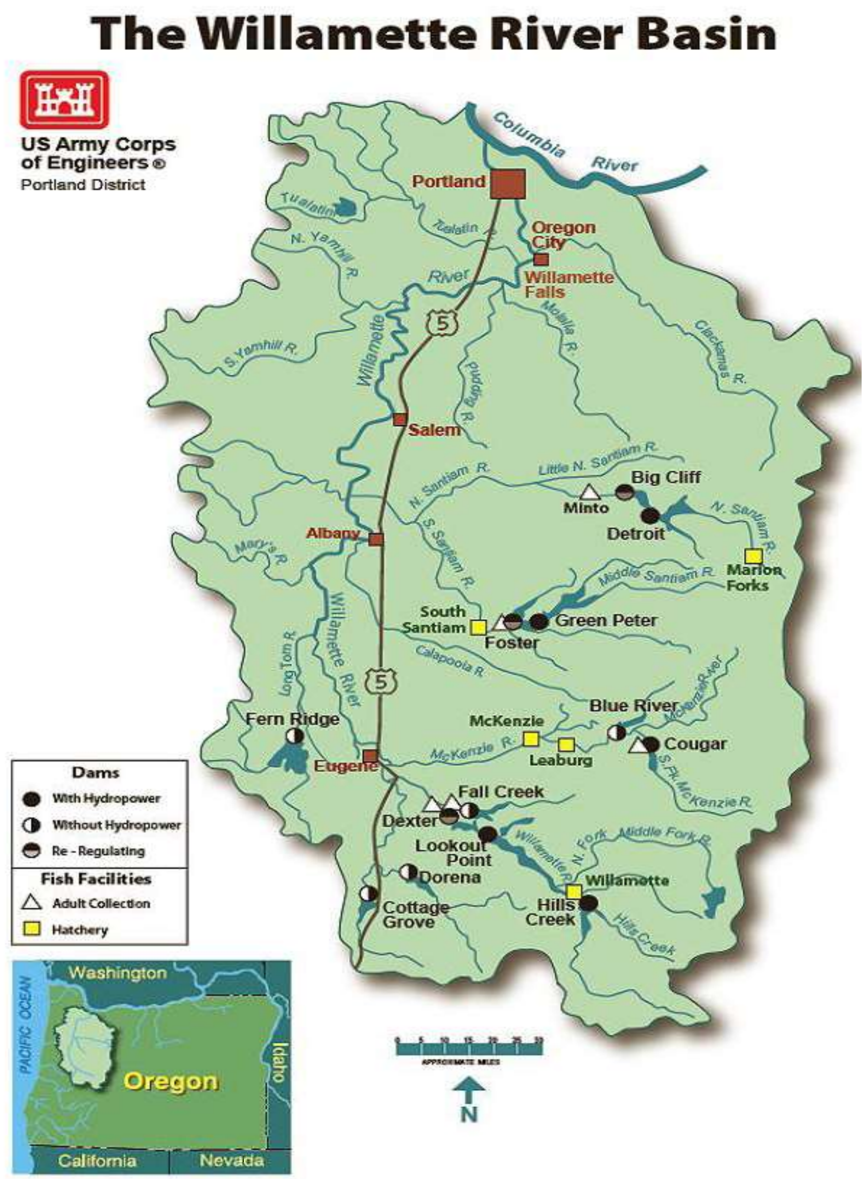
WATER RESOURCES DEPARTMENT
WRD

# OUTLINE

Background

Project status

Next steps

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# 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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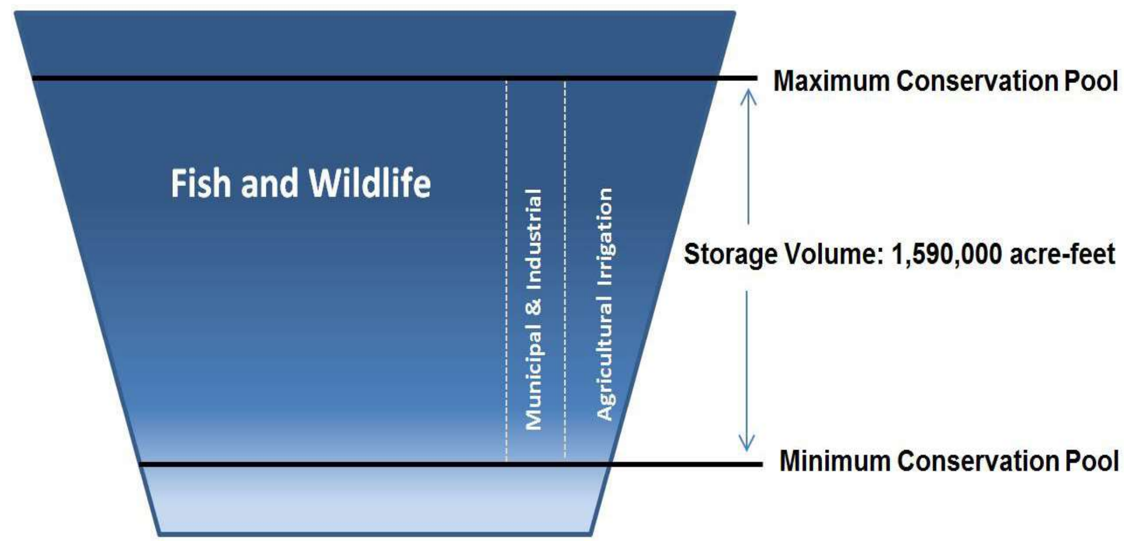
# PROPOSED REALLOCATION VOLUMES (ACRE-FEET)

| | |
|---|---|
| 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

1

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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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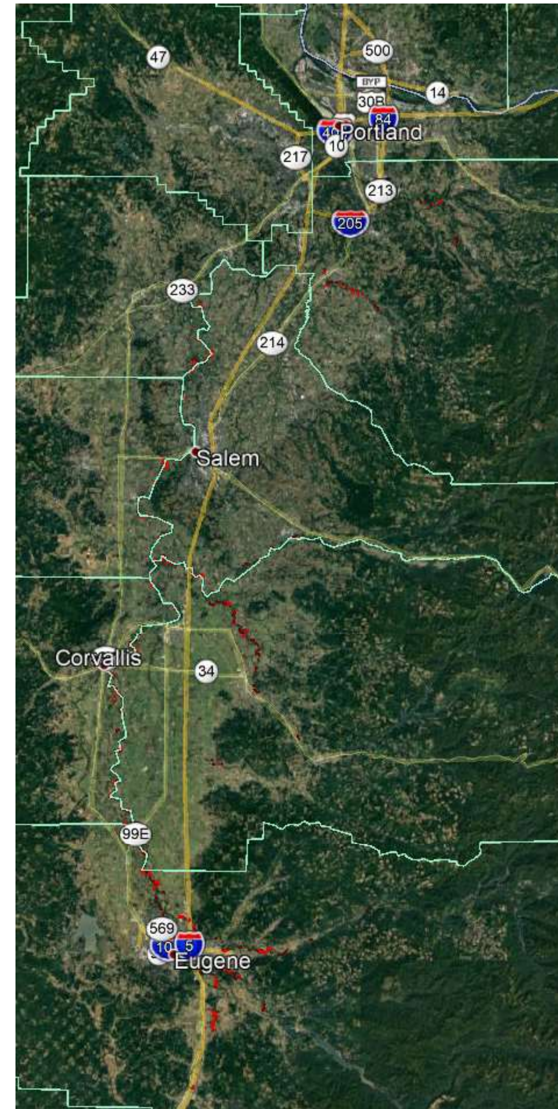
# WILLAMETTE RIVER BANK PROTECTION (WRBP)

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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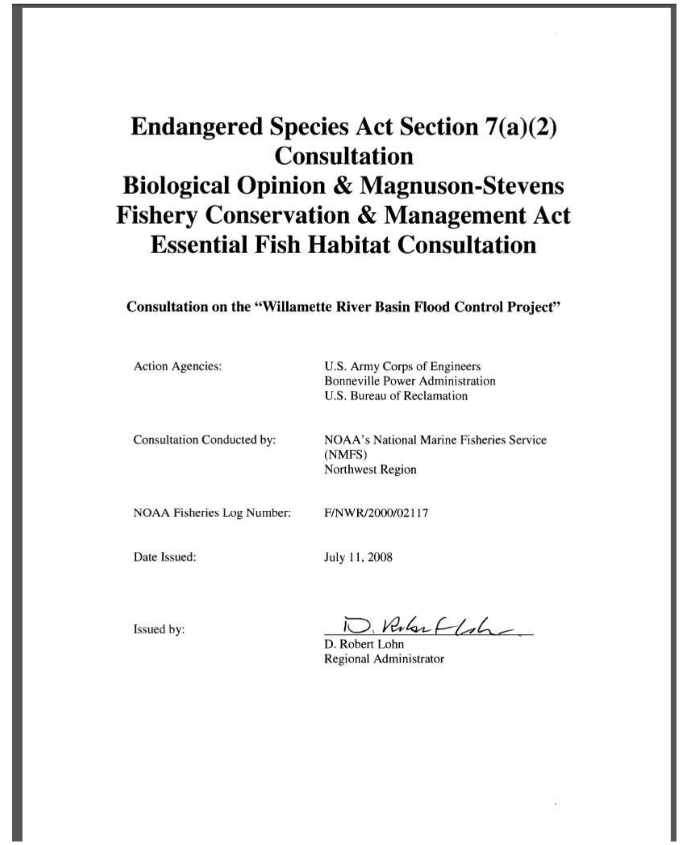
# WILLAMETTE RIVER BANK PROTECTION (WRBP)

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

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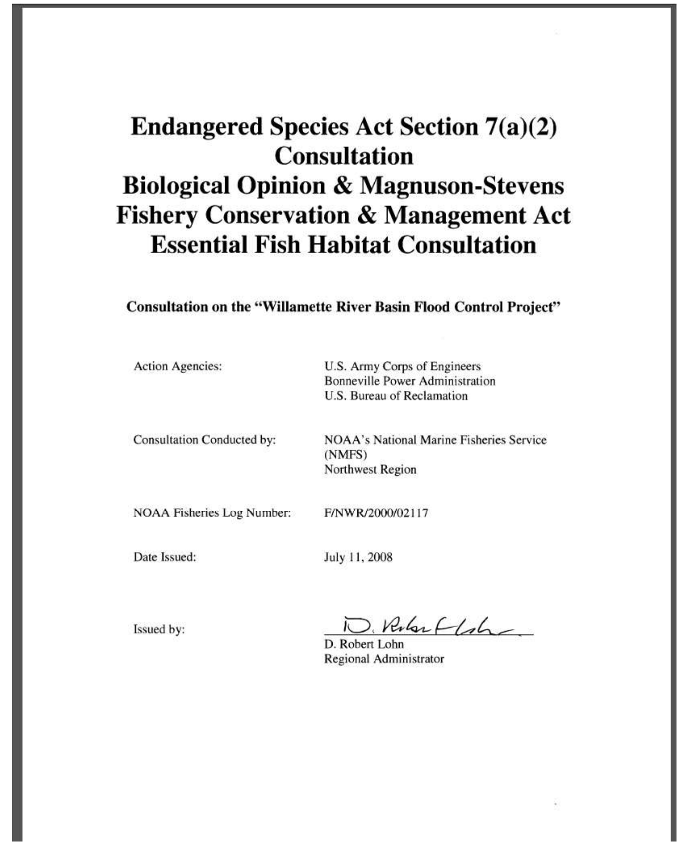
# WILLAMETTE RIVER BANK PROTECTION (WRBP)

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



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| Issued by: | D. Robert Lohn<br>Regional Administrator |

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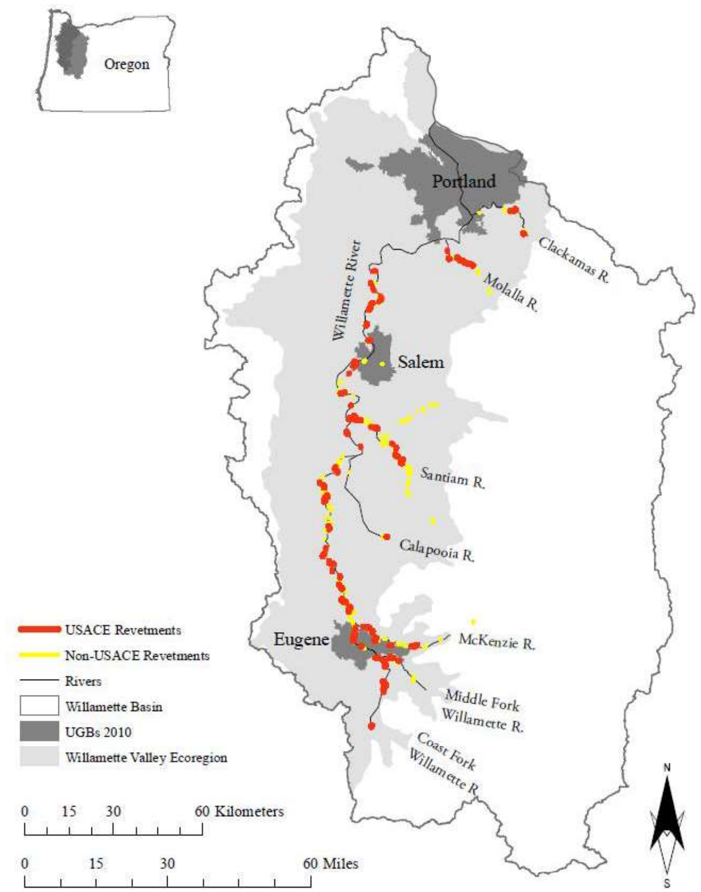
# WILLAMETTE RIVER BANK PROTECTION (WRBP)

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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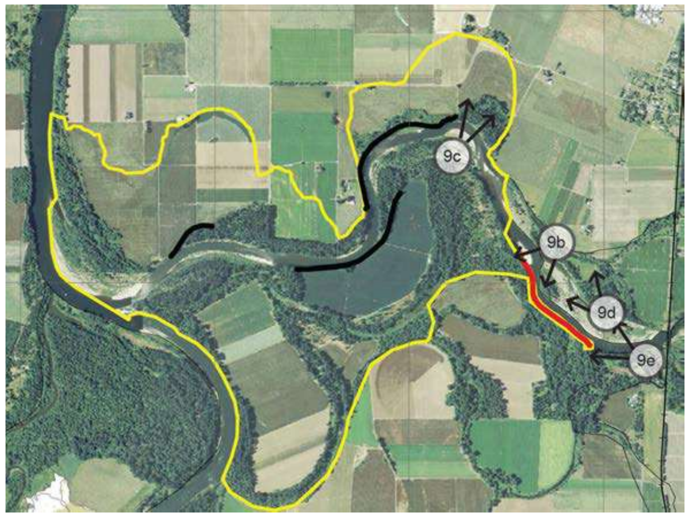
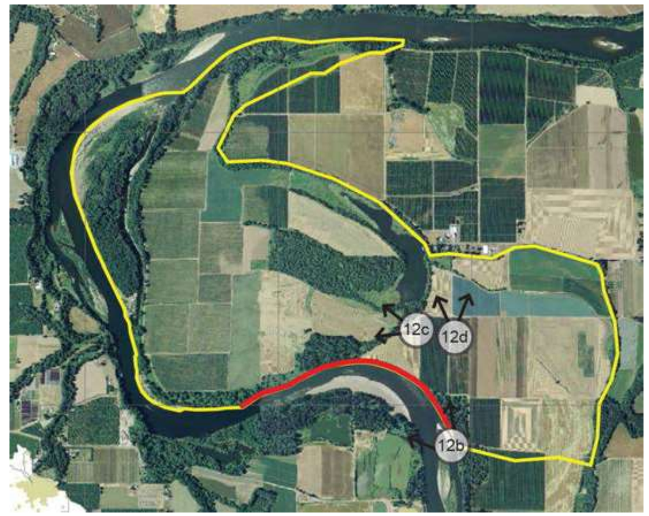
# WILLAMETTE RIVER BANK PROTECTION (WRBP)

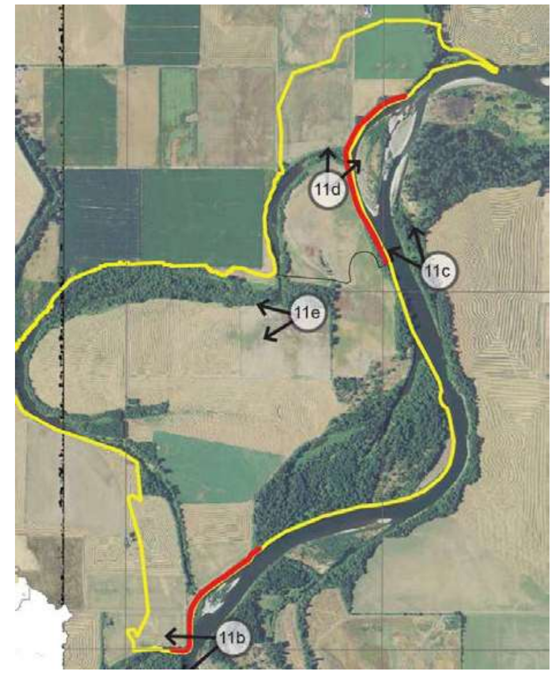
2013 UofO Study




Cole Revetment (Wilfert)




Horseshoe




Harkens Lake (Irish Bend)

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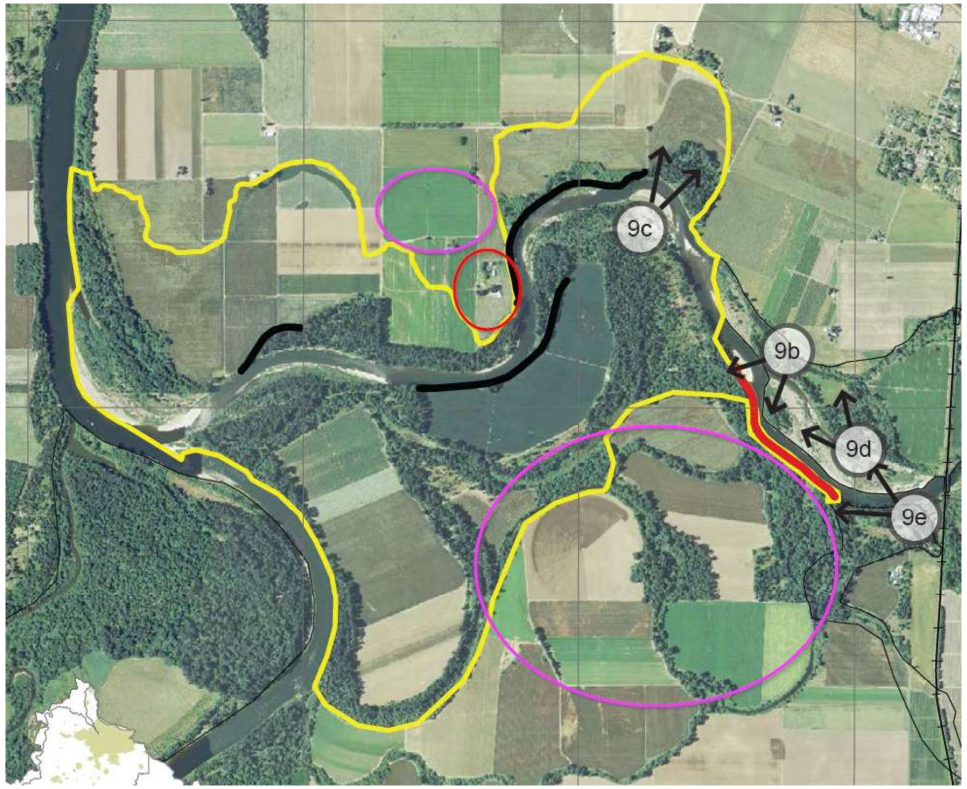
# WILLAMETTE RIVER BANK PROTECTION (WRBP)

2013 UofO Study – Cole Revetment




Uncertainties may impact private property and residences.

Need to reduce uncertainties

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# WILLAMETTE RIVER BANK PROTECTION (WRBP)

2017 WRBP Inspection and Concept Plan

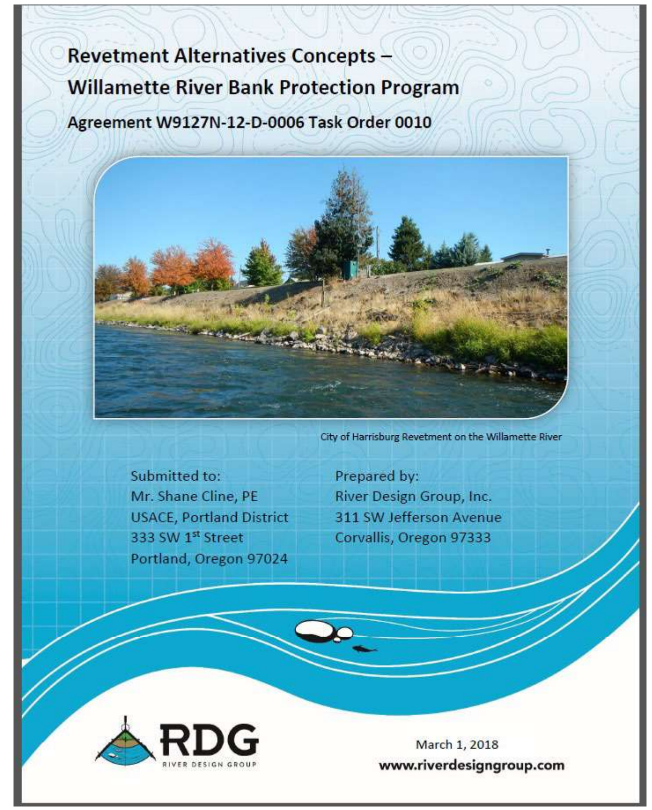
- Visually Inspected all FED/FED Revetments
- Developed conceptual alternatives for 34 revetment sites

**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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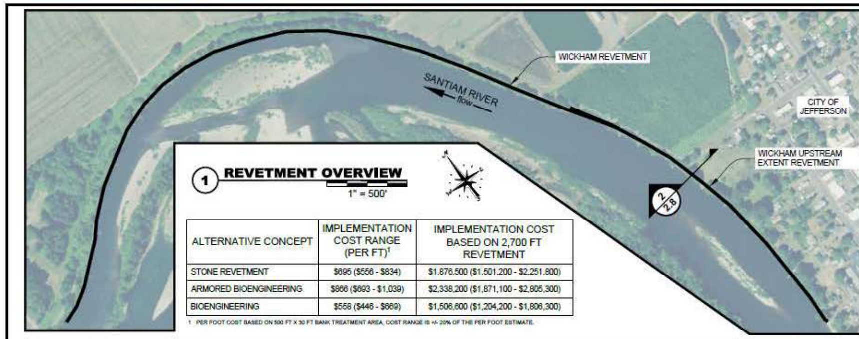
# WILLAMETTE RIVER BANK PROTECTION (WRBP)

2017 WRBP Inspection and Concept Plan
- Visually Inspected all FED/FED Revetments
- Developed conceptual alternatives for 24 revetment potential sites




1 REVETMENT OVERVIEW
1" = 500'

| ALTERNATIVE CONCEPT | IMPLEMENTATION COST RANGE (PER FT)[1] | IMPLEMENTATION COST BASED ON 2,700 FT REVETMENT |
|---|---|---|
| STONE REVETMENT | \$695 (\$556 - \$834) | \$1,876,500 (\$1,501,200 - \$2,251,800) |
| ARMORED BIOENGINEERING | \$866 (\$693 - \$1,039) | \$2,338,200 (\$1,871,100 - \$2,805,300) |
| BIOENGINEERING | \$558 (\$446 - \$669) | \$1,506,600 (\$1,204,200 - \$1,806,300) |

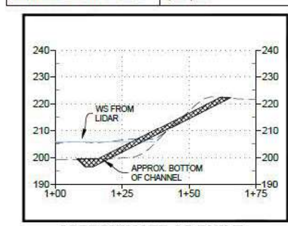
1 PER FOOT COST BASED ON 500 FT X 30 FT BANK TREATMENT AREA, COST RANGE IS +/- 20% OF THE PER FOOT ESTIMATE.

SITE PHOTO

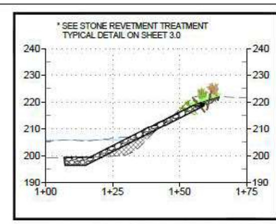
| REVETMENT FEATURE | METRIC |
|---|---|
| NAME (SEGMENT ID) | WICKHAM AND WICKHAM UPSTREAM EXTENSION (5032010186) |
| LOCATION | SANTIAM RM 8.3 AT JEFFERSON, OR |
| YEAR CONSTRUCTED | 1950 |
| AUTHORIZATION AND O&M RESPONSIBILITY | FCA(U), USACE |
| LENGTH AND MATERIAL | 4,270 ft (WICKHAM) AND 2,124 ft (UPSTREAM EXTENSION), STONE REVETMENT |
| CURRENT CONDITION FROM MOST RECENT INSPECTION | DAMAGE NOTED DURING THE 2017 SURVEY INCLUDING LOSS OF TOE AND MID-SLOPE REVETMENT STONE, COMPLETE REVETMENT LOSS, VARIED REVETMENT CONDITIONS FROM FUNCTIONAL TO EXPOSED UNDERLYING SOILS |
| RISK PROFILE | HIGH - FLOODPLAIN USE VARIES INCLUDING AGRICULTURAL LAND, RESIDENTIAL DEVELOPMENT, AND MUNICIPAL WASTE WATER TREATMENT |
| LENGTH AND PERCENT DESTROYED | 1,300 ft, 20% |
| LENGTH AND PERCENT DAMAGED | 1,400 ft, 22% |

**WICKHAM & UPSTREAM EXTENSION REVETMENT SUMMARY**

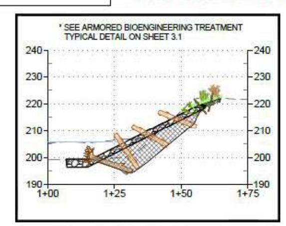
THE WICKHAM AND WICKHAM UPSTREAM EXTENSION REVETMENTS ARE CONTINUOUS REVETMENTS LOCATED ON THE EAST AND NORTH BANK OF THE SANTIAM RIVER AT RM 8.3 AT JEFFERSON, OREGON. THE WICKHAM UPSTREAM EXTENSION REVETMENT BEGINS AT THE JEFFERSON BOAT RAMP AND CONTINUES DOWNSTREAM 2,124 FT. THE WICKHAM REVETMENT BEGINS AT THE DOWNSTREAM EXTENT OF THE WICKHAM UPSTREAM EXTENSION, AND EXTENDS 4,270 FT DOWNSTREAM AROUND THE MEANDER BEND IN THE REACH. BOTH REVETMENTS ARE STONE REVETMENT CONSTRUCTED IN 1950. REVETMENT CONDITIONS VARY CONSIDERABLY OVER THE LENGTHS OF THE TWO REVETMENTS. THE UPSTREAM REVETMENT INCUDES EXTENDED REACHES OF SCOURED REVETMENT, DENSE VEGETATION, AND INTACT REVETMENT. AT LEAST SEVEN STONE BARBS HAVE ALSO BEEN ADDED TO THE UPSTREAM REVETMENT. THE BARBS TRAIN THE THALWEG OFF OF THE ADJACENT BANKLINE, BUT BARBS MAY ALSO INFLUENCE RECIRCULATION EDDIES THAT SCOUR THE DOWNSTREAM BANKLINE. THE DOWNSTREAM WICKHAM REVETMENT ALSO EXHIBITS A RANGE OF CONDITIONS. MUCH OF THE UPSTREAM PORTION OF THE REVETMENT REMAINS INTACT WITH VISIBLE TOE ROCK, DENSE UNDERSTORY VEGETATION AND MATURE OVERSTORY TREES. HOWEVER, THERE ARE ALSO EXTENDED REACHES OF SCOURED REVETMENT AND EXPOSED UNDERLYING SOIL. DENSE UNDERSTORY AND OVERSTORY VEGETATION CONDITIONS PERSIST OVER THE LENGTHS OF THE TWO REVETMENTS. REVETMENT ALTERNATIVES WOULD SATISFY THE ORIGINAL INTENT OF THE REVETMENT AND IMPROVE THE RIPARIAN CONDITION AND HABITAT CHARACTERISTICS OF THE REVETMENT. THE WICKHAM REVETMENT WAS IDENTIFIED BY CENWP IN RDG'S TASK ORDER AS A REVETMENT FOR REVIEW. THE WICKHAM REVETMENT WAS ALSO IDENTIFIED FOR REPAIR IN THE CH2M HILL REPORT (2011).



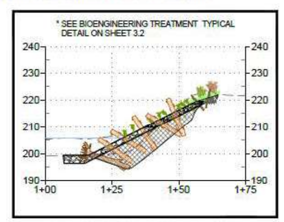

2 APPROXIMATE AS-BUILT CROSS SECTION
HORIZ 1" = 30'
VERT 1" = 30'




3 ALT 1 - STONE REVETMENT TREATMENT
HORIZ 1" = 30'
VERT 1" = 30'




4 ALT 2 - ARMORED BIOENGINEERING TREATMENT
HORIZ 1" = 30'
VERT 1" = 30'




5 ALT 3 - BIOENGINEERING TREATMENT
HORIZ 1" = 30'
VERT 1" = 30'

RDG

WICKHAM & UPSTREAM EXTENSION (RM 8.3) REVETMENT CONCEPTS
REVETMENT CONCEPTS
WILLAMETTE RIVER BASIN, OR

PROJECT NUMBER RDG-17-069
DRAWING NUMBER 2.8
Drawing 10 of 31

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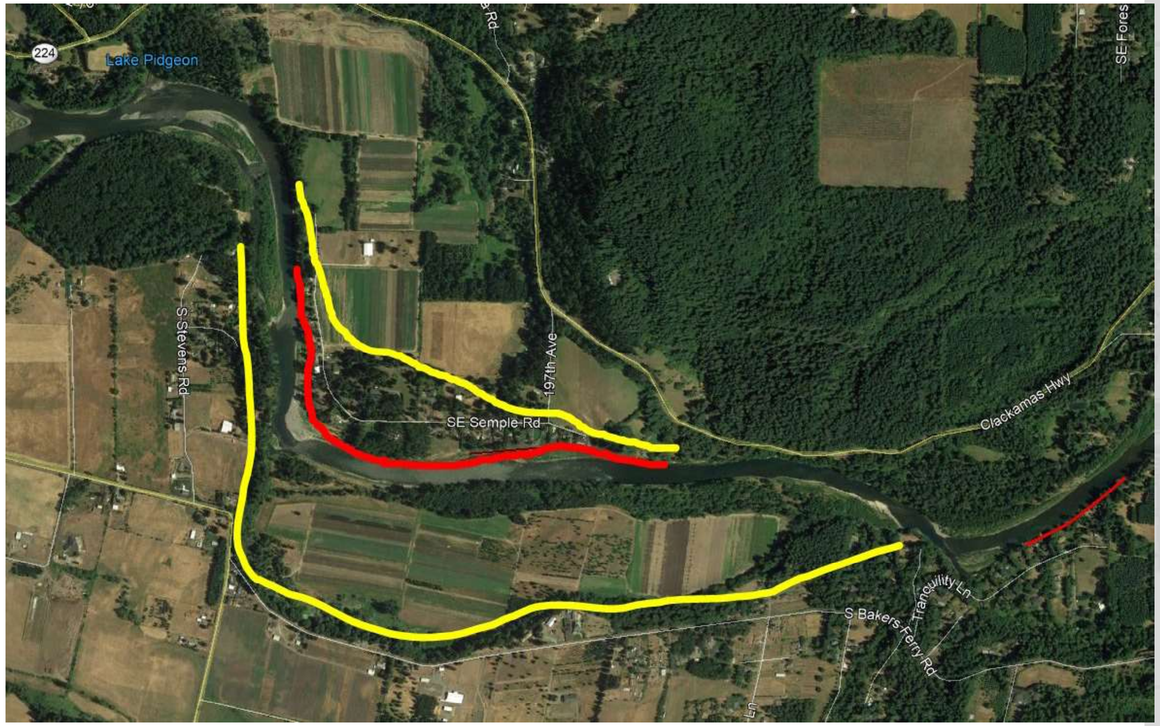
# WILLAMETTE RIVER BANK PROTECTION (WRBP)

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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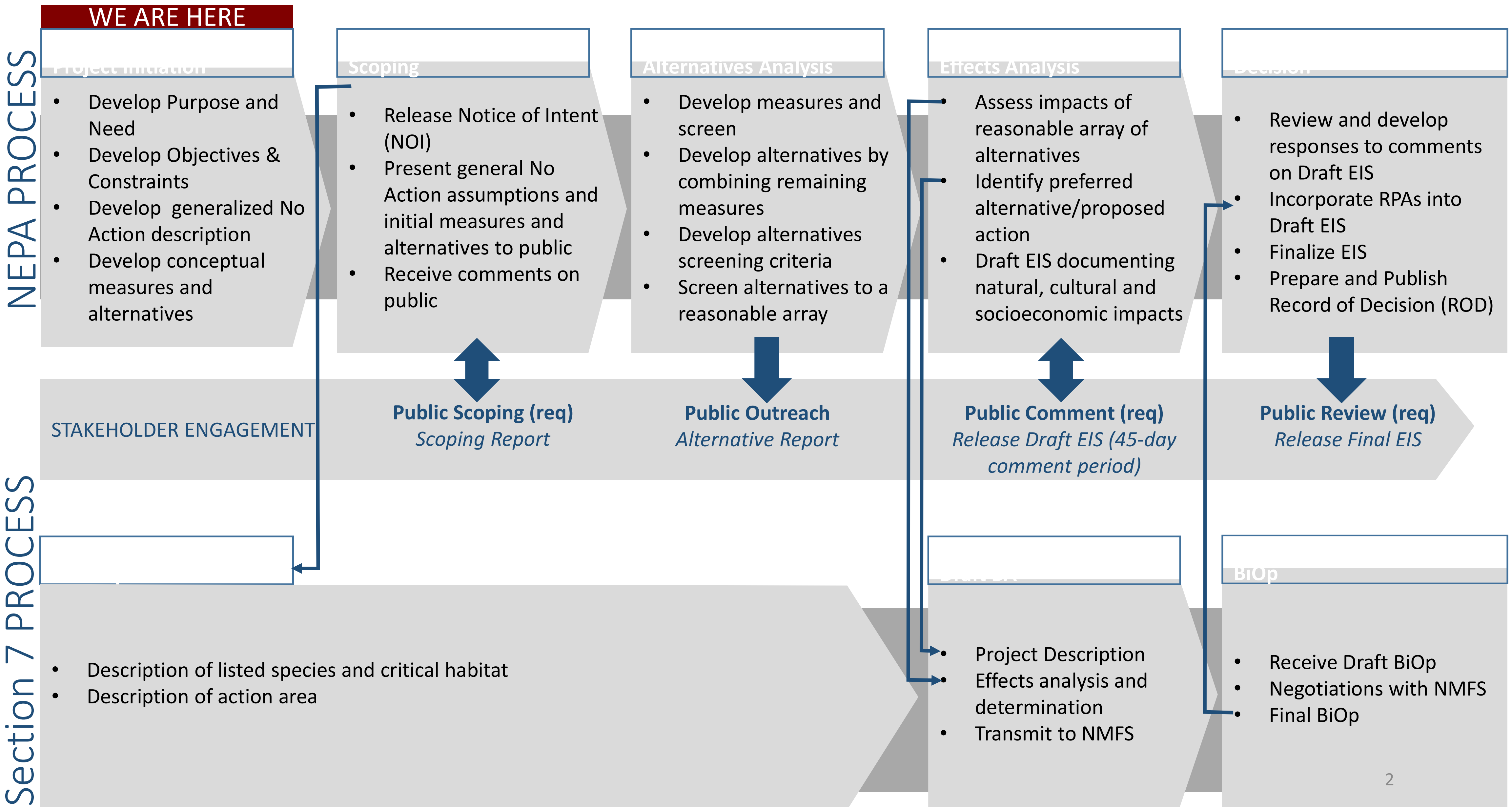
# NEPA Process Overview

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).

1


WE ARE HERE
NEPA PROCESS
Scoping
Alternatives Analysis
Effects Analysis
• Develop Purpose and Need
• Develop Objectives & Constraints
• Develop generalized No Action description
• Develop conceptual measures and alternatives
• Release Notice of Intent (NOI)
• Present general No Action assumptions and initial measures and alternatives to public
• Receive comments on public
• Develop measures and screen
• Develop alternatives by combining remaining measures
• Develop alternatives screening criteria
• Screen alternatives to a reasonable array
• Assess impacts of reasonable array of alternatives
• Identify preferred alternative/proposed action
• Draft EIS documenting natural, cultural and socioeconomic impacts
• 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
BiOp
• Description of listed species and critical habitat
• Description of action area
• Project Description
• Effects analysis and determination
• Transmit to NMFS
• 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

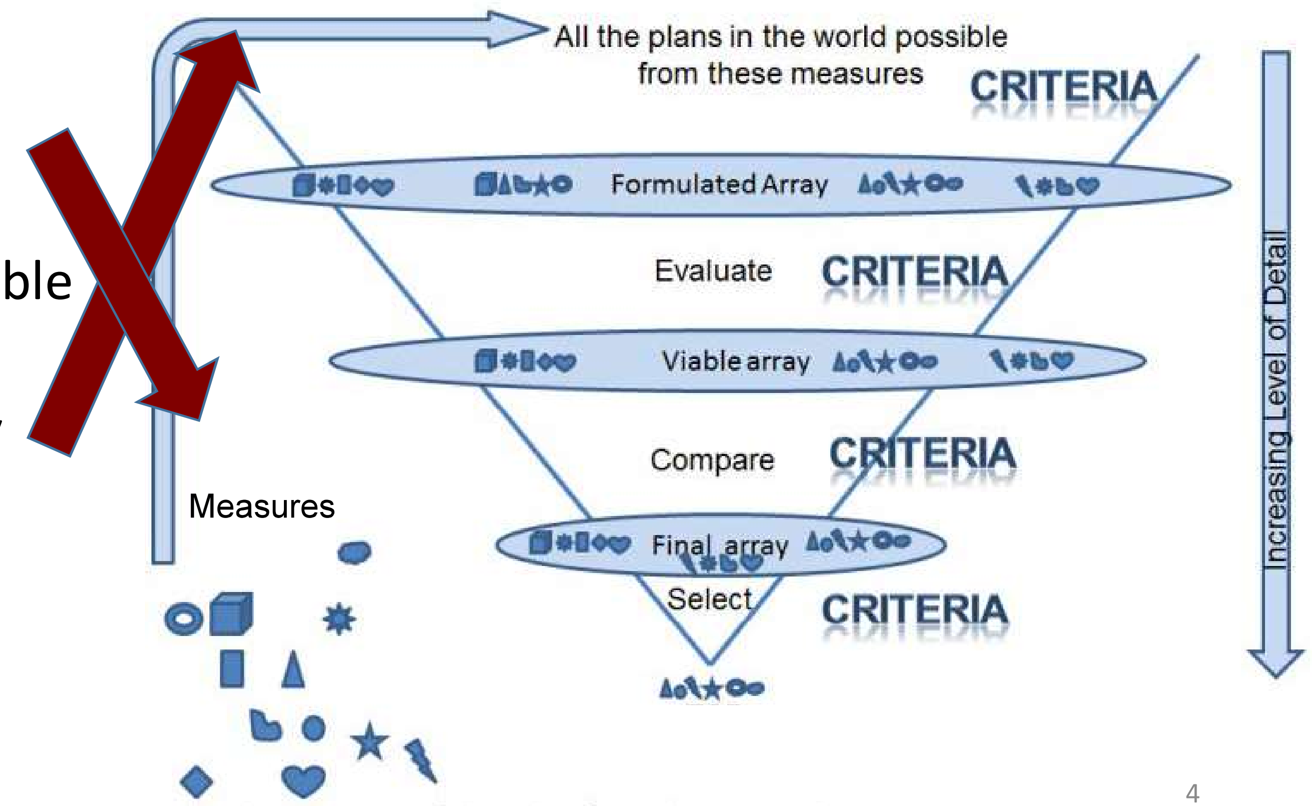
Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

# 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

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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*)**

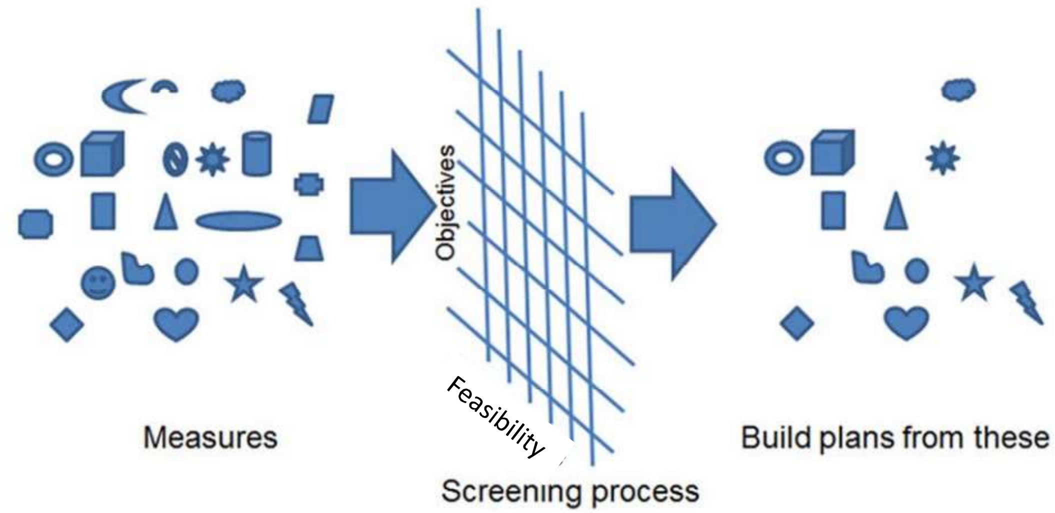
- Brainstorm as many measures as possible that meet one or more objectives.

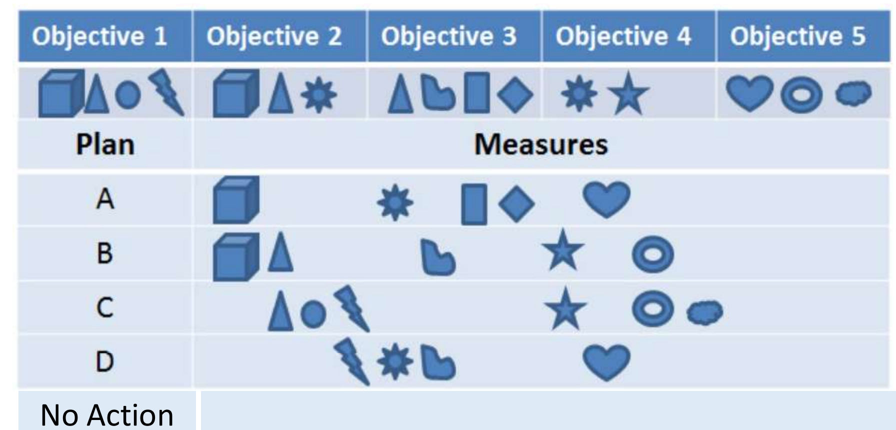
**Initial Screening**

- 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

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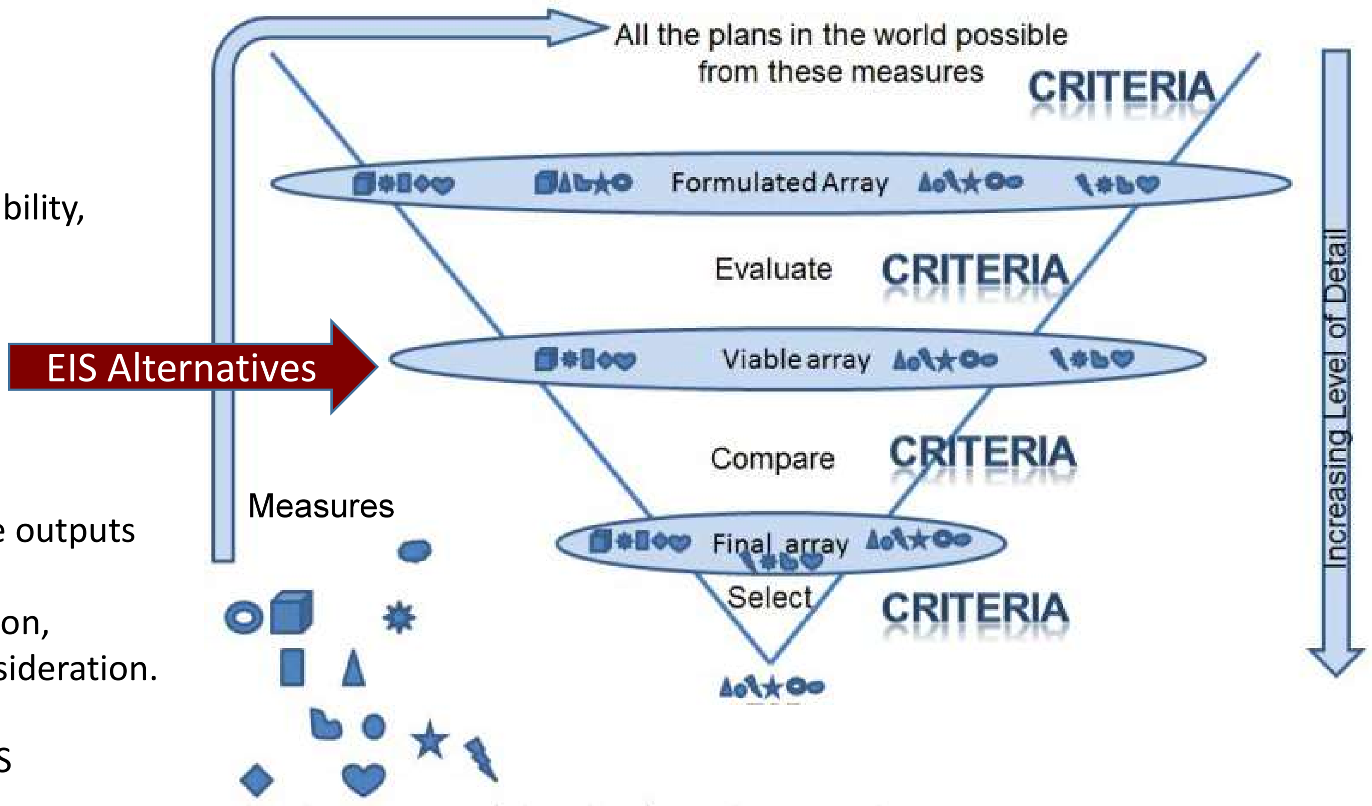
Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

# 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 & **environmental impacts**
- Cost analysis

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

# 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)

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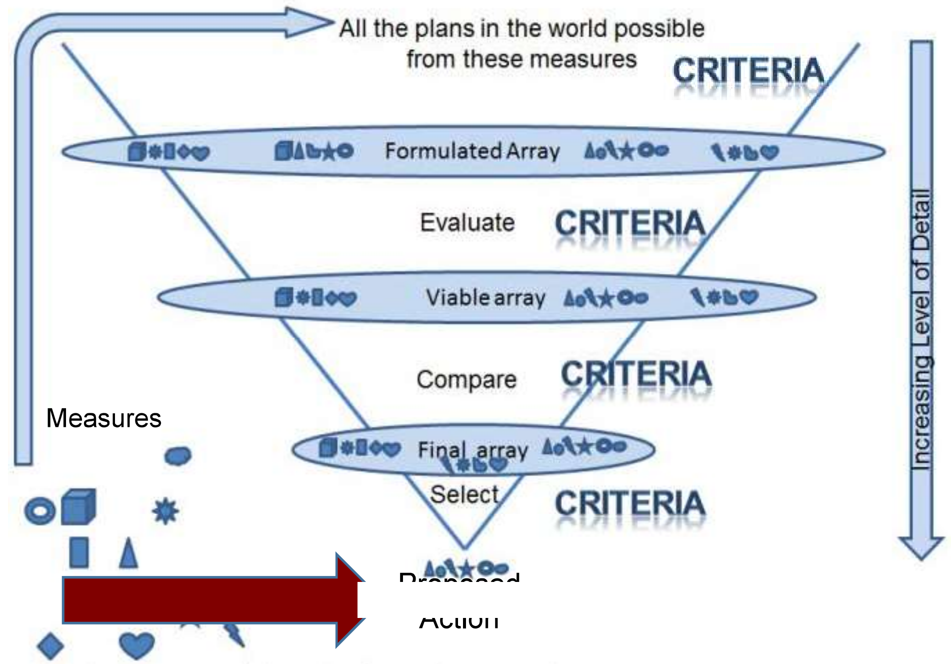
Step 1: Project Initiation | Step 2: Scoping | Step 3: Alternatives Analysis | Step 4: Effects Analysis | **Step 5: Decision**

# 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)

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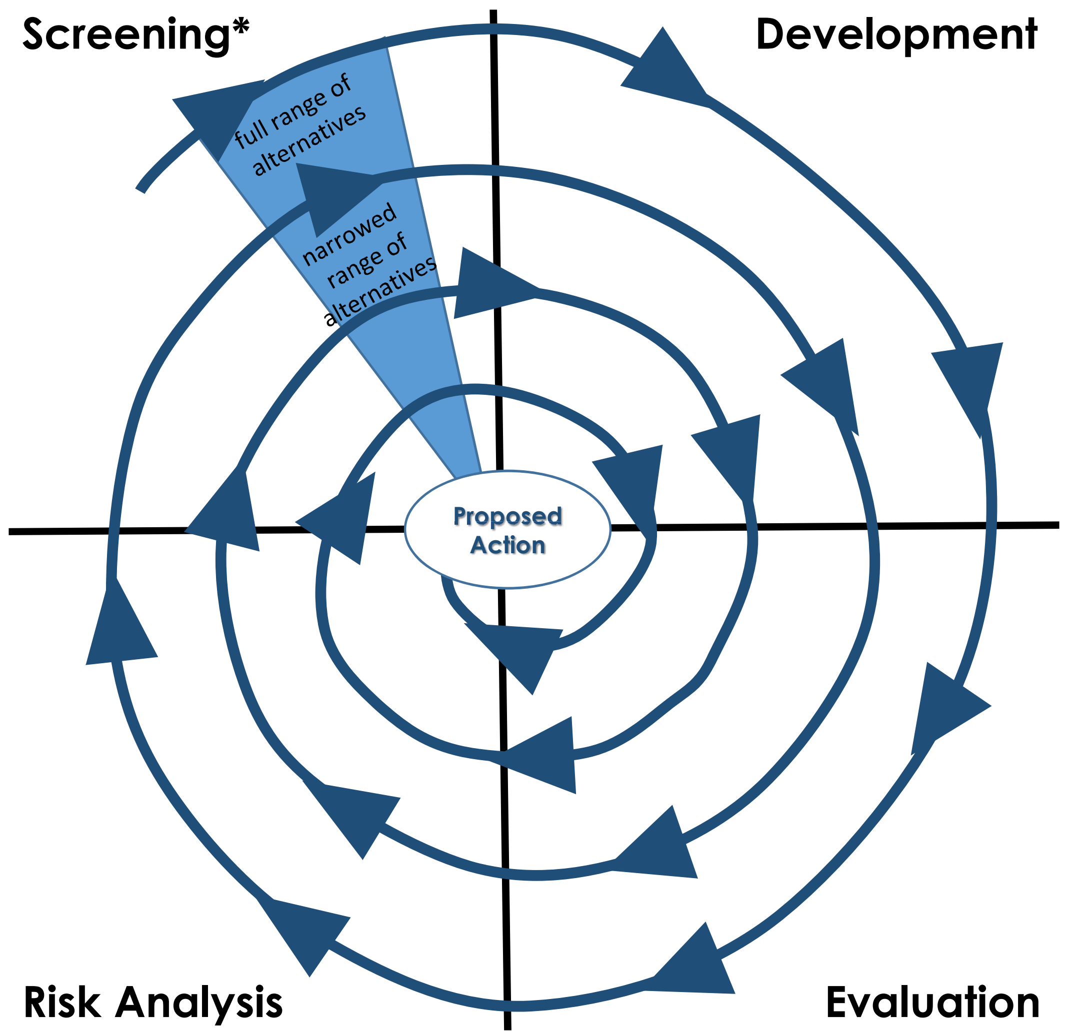
# Iterative Risk Informed Decision Making

- 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.

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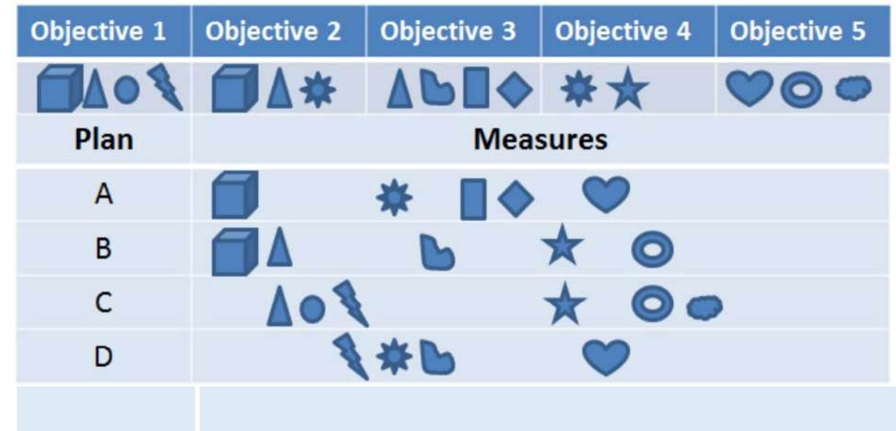
# Extra

10

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

# Alternatives Evaluation

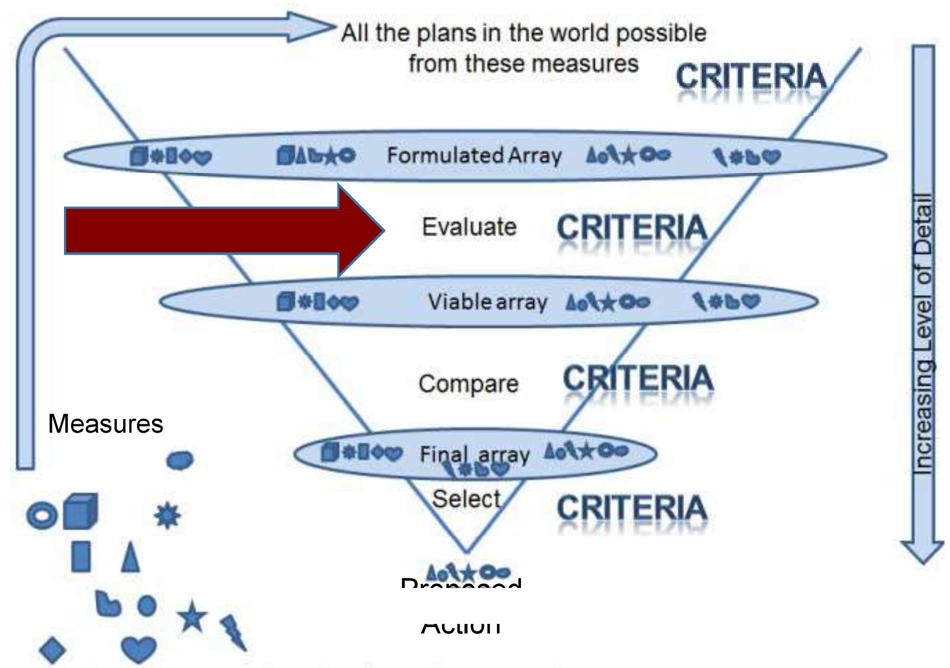
***Yields a set of viable alternatives** from which to select the best.*




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. →



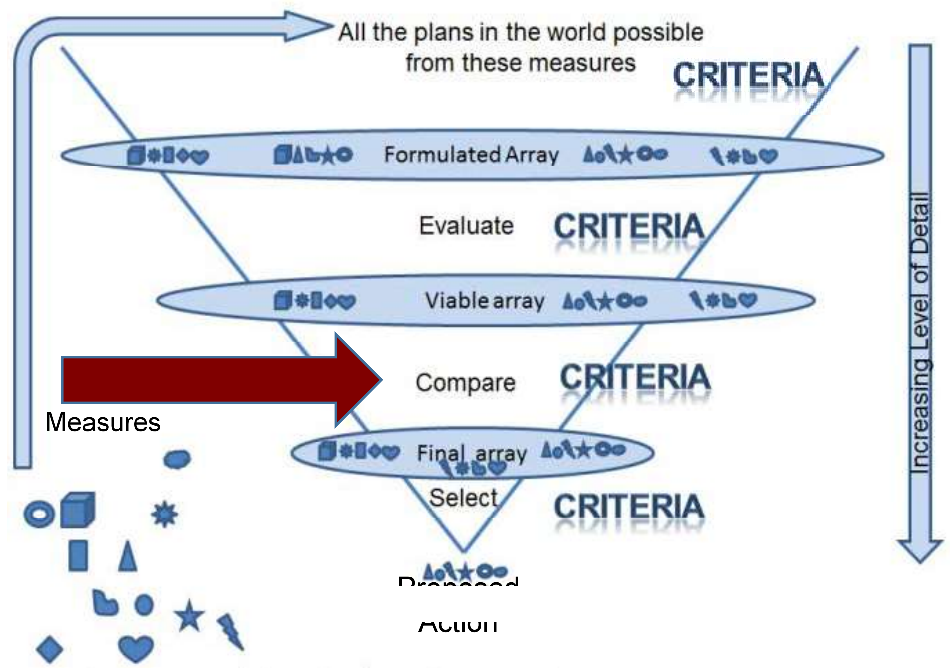
Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | **Step 4: Effects Analysis** | **Step 5: Decision**

# 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.

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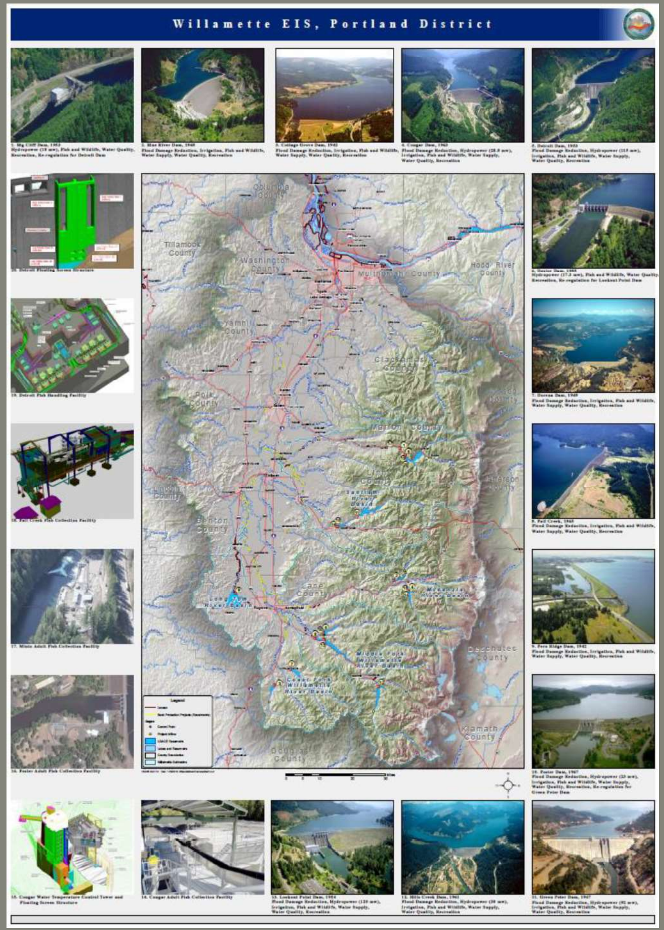
# WILLAMETTE VALLEY SYSTEM OPERATIONS EIS

# 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)<br><br>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<br><br>Congressional Authorizations | Changing the rule curve requires congressional authorization.<br><br>Changing flood maps likely requires a policy decision. | System only partially regulated.<br><br>Ability to forecast precipitation patterns<br><br>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<br><br>Maintain emergency power pools until they are needed (intended use was winter cold snap) | Daily and annual hydropower generated<br><br>Number of days/yr reservoirs below conservation pool elevations<br><br>BPA's Revenue<br><br>$CO_2$ offsets<br><br>Extent and duration that ramping rates are exceeded annually | Water Control Manual<br>BPA/Corps operating agreements<br><br>Congressional authorizations | Modifying power pools requires<br><br>Congressional authorizations | Ramp rates<br><br>Operating parameters<br><br>Outages<br><br>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.<br><br>Optimize Detroit, Foster, and Fern Ridge Reservoir elevations. | Days boat ramps are available per year in reservoirs<br><br>Days boat ramps are available per year in rivers below dams<br><br>Sport fishing (angler/days)<br><br>Annual number of special recreation permits – boat races, athletic events, etc.<br><br>Reservoir aesthetics during the summer recreation season (reservoir elevation or percent full per month during conservation season) | Congressional authorizations<br><br>Water Control Manual<br><br>Engineering Regulation 1130-2-550, Recreation Operations and Maintenance Policies;<br><br>Willamette COP Phase II<br><br>Ops support to community and watershed councils<br><br>Federal Lakes “agreement” 2001<br><br>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.<br><br>Bank full flows.<br><br>ESA obligations for minimum flows, ramping rates, TDG, and temperature<br><br>Annual water storage availability.<br><br>WBR allocations for AI, M&I and FW. |

# 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<br><br>Operate to provide flows for ESA-listed fish:<br>• Minimum flow targets<br>• Operate to meet water temperature targets<br>• Operate to meet TDG targets | Daily or seasonal flows, temperature, TDG, turbidity, and algae [locations TBD] | Congressional Authorizations<br><br>Water Control Manual<br><br>Willamette COP Phase II<br><br>Willamette Basin Review draft Feasibility Study and BA<br><br>CWA - TMDLs | Same as for recreation. | Rule curves<br><br>Bank full flows<br><br>Structural configuration of outlets<br><br>ESA obligations for minimum flows, ramping rates, TDG, and temperature<br><br>Annual water storage availability<br><br>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<br><br>Delivery schedule from each reservoir (timing and volume) | Congressional Authorizations<br><br>Willamette Basin Review draft Feasibility Study and BA | Same as for recreation<br><br>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<br><br>Annual water storage availability<br><br>WBR allocations and demand estimates for AI, M&I and FW<br><br>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<br><br>Downstream minimum flows, ramping rates and temperature targets<br><br>Production and release of hatchery fish to mitigate for lost access to habitat, in accordance with Draft HGMPs<br><br>Production and release of hatchery fish to supplement natural populations<br><br>Revetment modifications: increase habitat and restore ecosystem function to benefit fish and wildlife. | Habitat connectivity<br><br>Fish passage survival<br><br>Frequency minimum flows, ramping rates and temperature targets met.<br><br>Fish abundance, distribution, and life history diversity<br><br>Area of habitat available<br><br>Number of hatchery fish released annually<br>Number of adult hatchery salmon and steelhead collected at traps annually<br>Number of adult hatchery salmon and steelhead caught in sport and commercial fisheries | Congressional Authorizations<br><br>Willamette COP Phase II and 5-yr Plan<br><br>2008 NMFS and USFWS Biop's<br><br>2007 BA<br><br>Congressional Authorizations<br><br>Draft Hatchery Genetic Management Plans<br><br>NMFS EIS for HGMPs | Project-specific authorities for temperature management and fish passage<br><br>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).<br><br>Mitigation fish production amount is discretionary | Feasibility of fish passage at high head dams.<br><br>Operational constraints relating to flood risk reduction and hydropower.<br><br>Limitations of the partially regulated system on the ability to manage flow and water temperature<br><br>Limitations of water storage to meet downstream demands for FW, AI, and M&I, etc.<br><br>Crediting approach for addressing original mitigation need not established, and agreed to among stakeholders. |

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# Measures

## The building blocks of alternatives.

1

# Measures

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

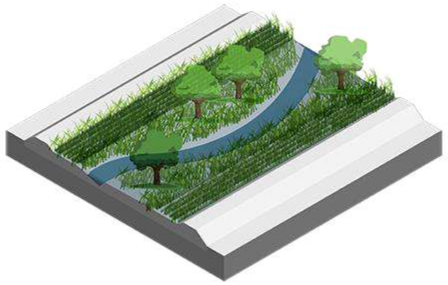
- Type
  - **Structural feature:** requires construction or assemble on-site.

## Example:

Flood Risk Management/ Ecosystem Restoration Multipurpose Project

Structural Measures:

Set Back Levees



Detention Ponds

Restore Wetlands

2

# 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

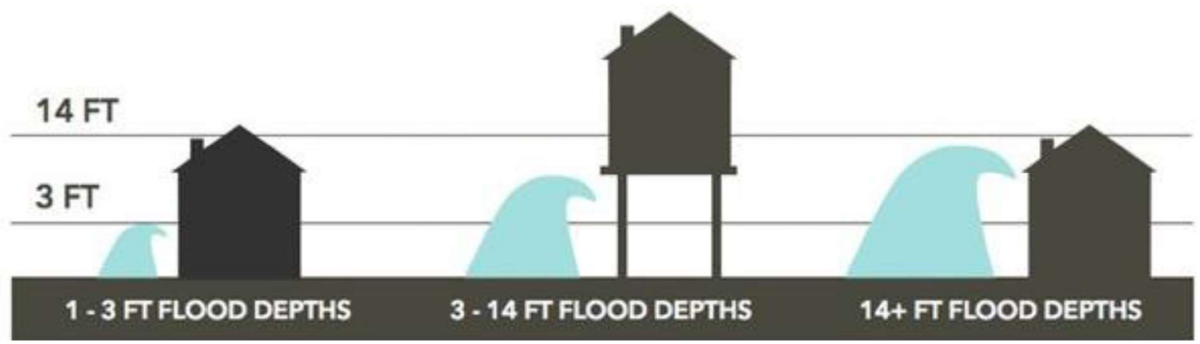
Non-structural Measures:

Dam Operations

Flood Proofing

Elevate Structures

Voluntary Acquisition

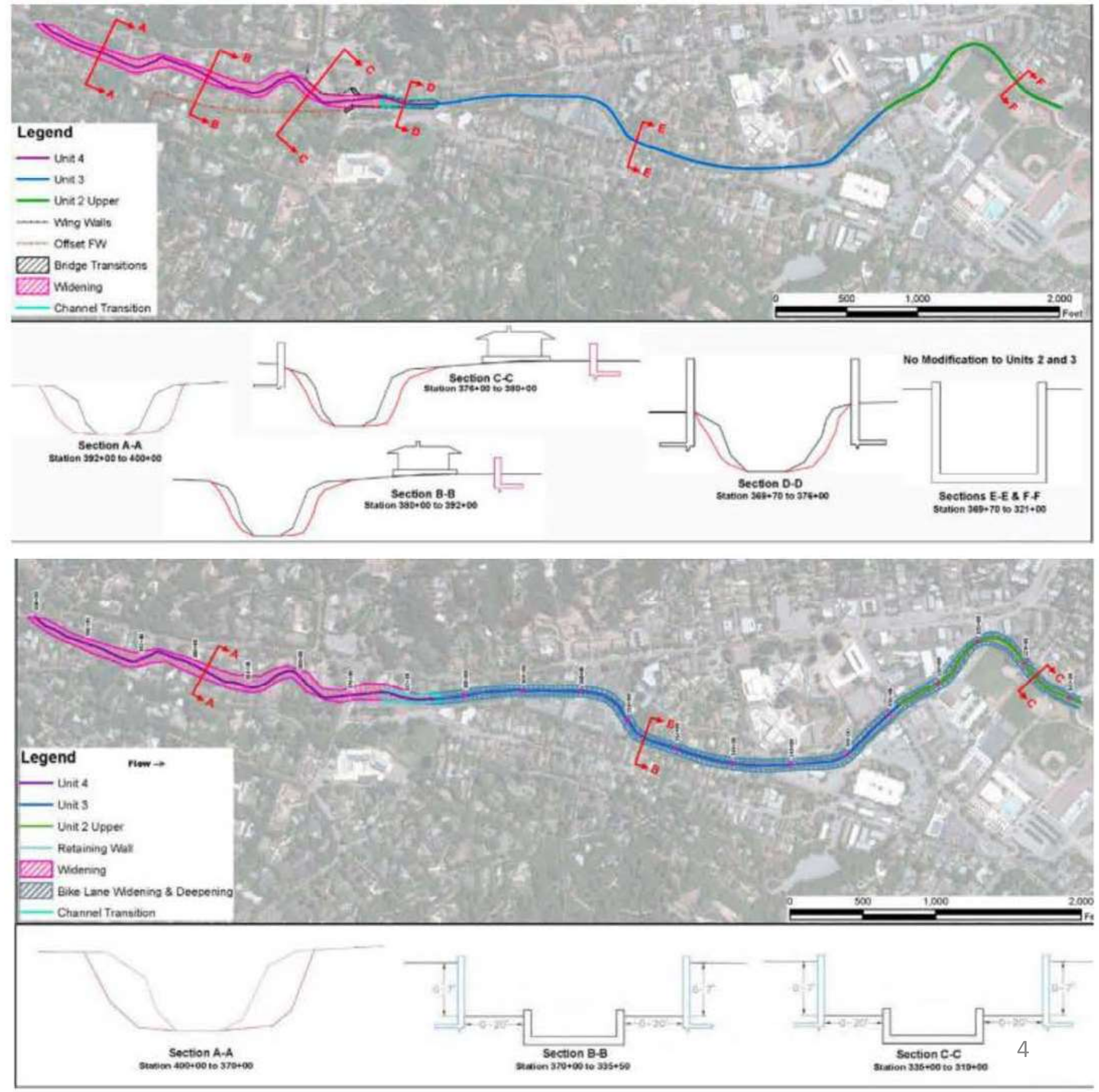



3

# 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




4

# 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.

5

# 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

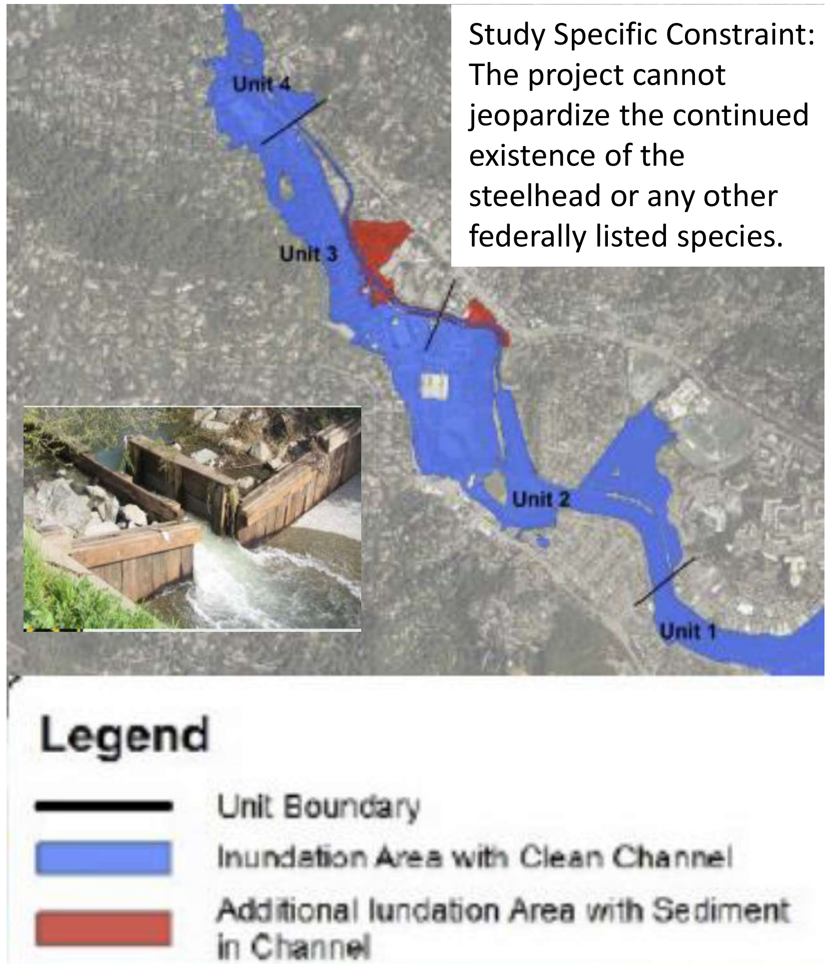
Objective 2: Maintain or increase the quantity and/or quality of fish and wildlife habitat in protected area

- **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




*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?*

7

# Alternatives

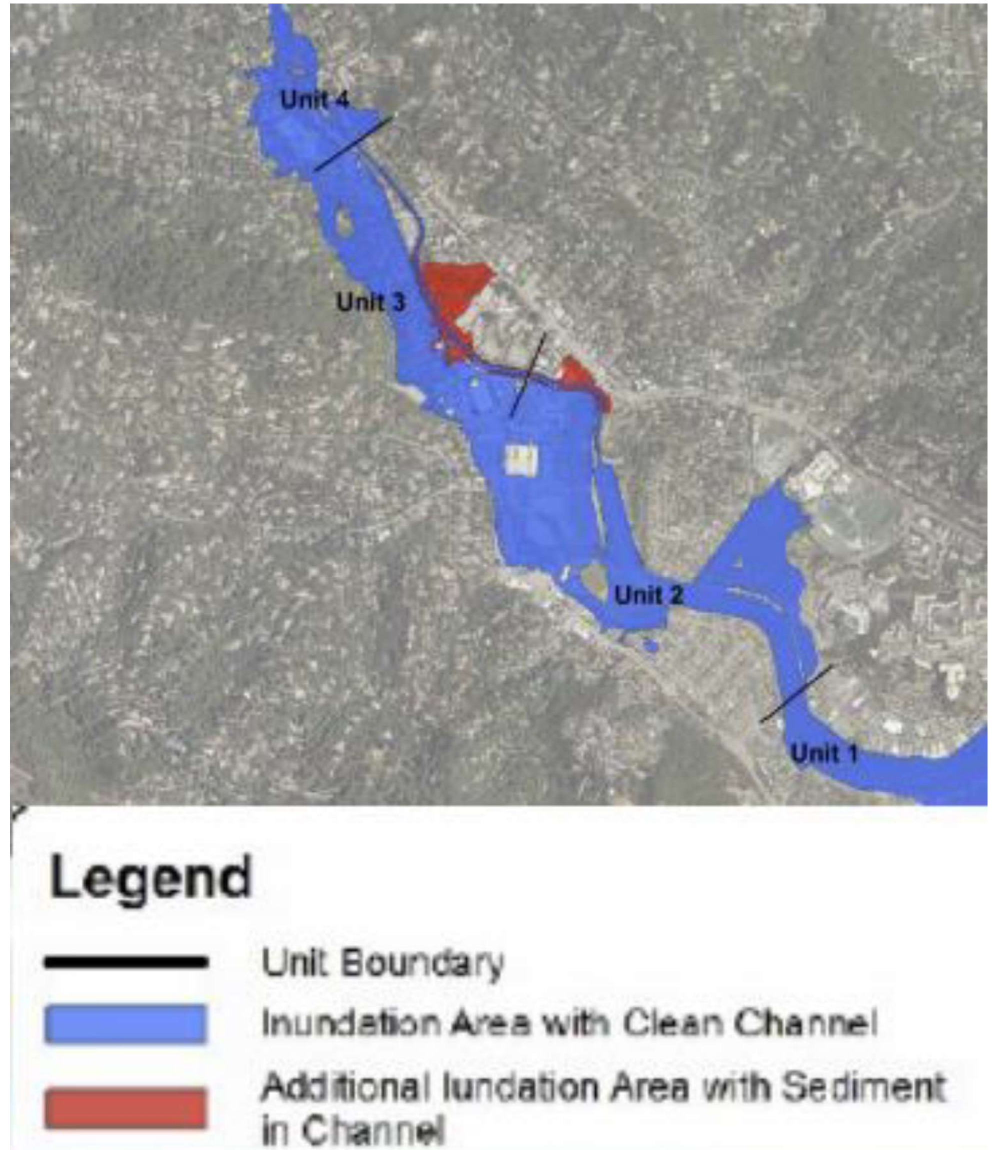
A set of one or more measures functioning together to address one or more objectives.

8

# Alternatives

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

- measures,
- strategies, or
- programs

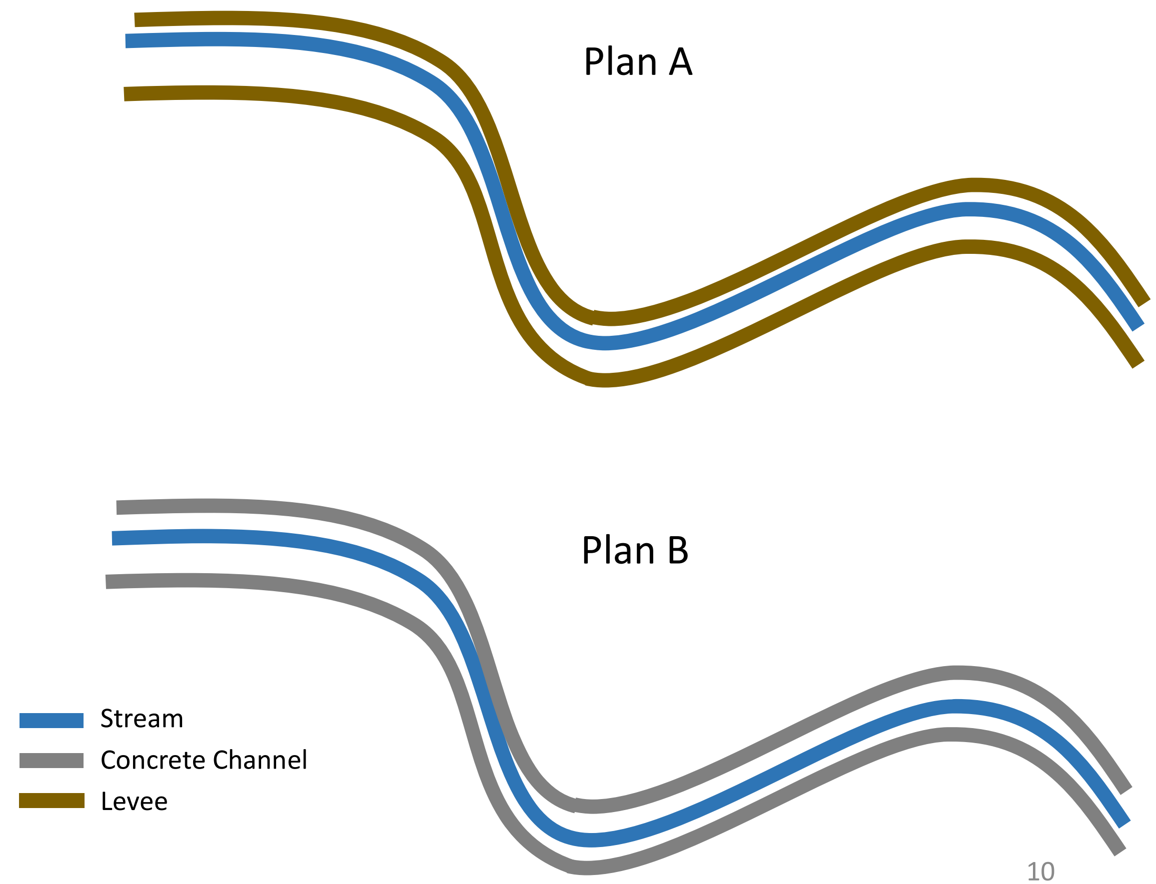



9

# Formulating Alternatives

Alternatives should be significantly differentiated from each other.

- Different plans have different measures or

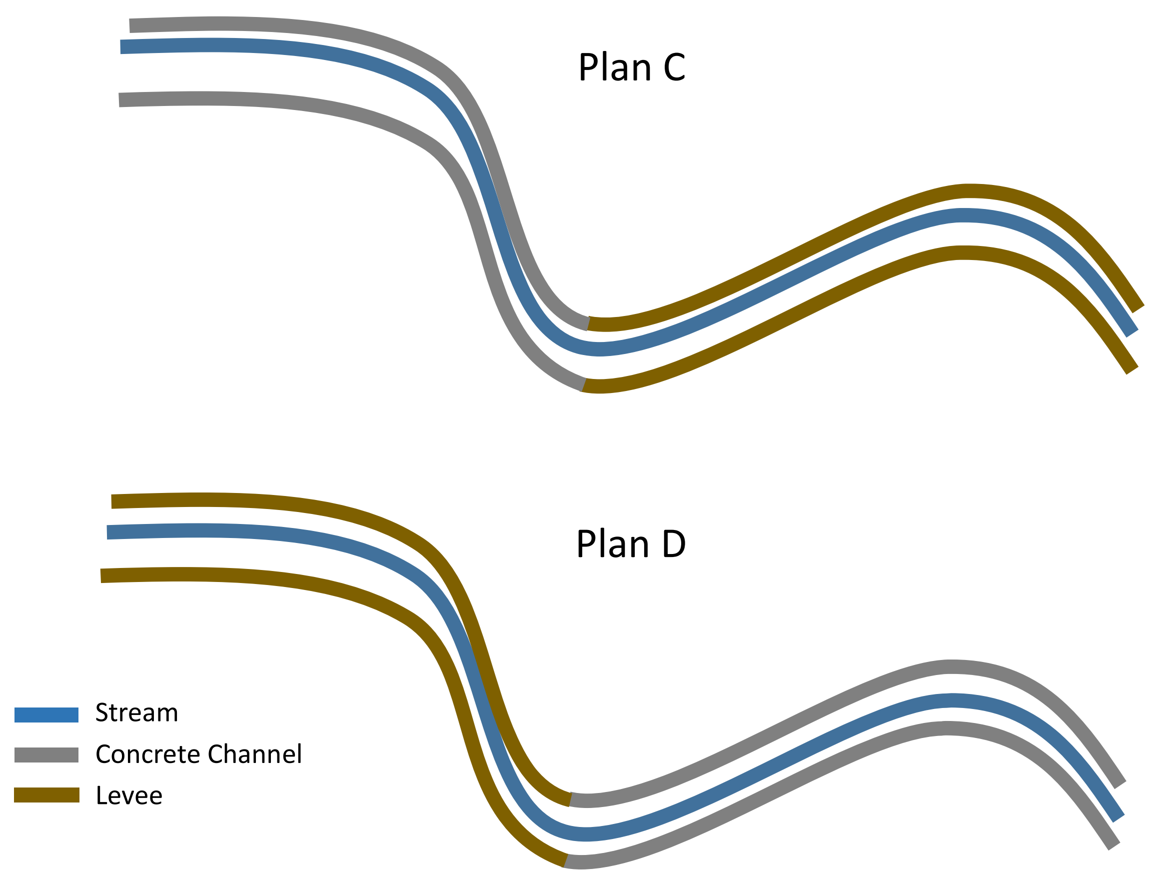


# Formulating Alternatives

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.




11

# 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

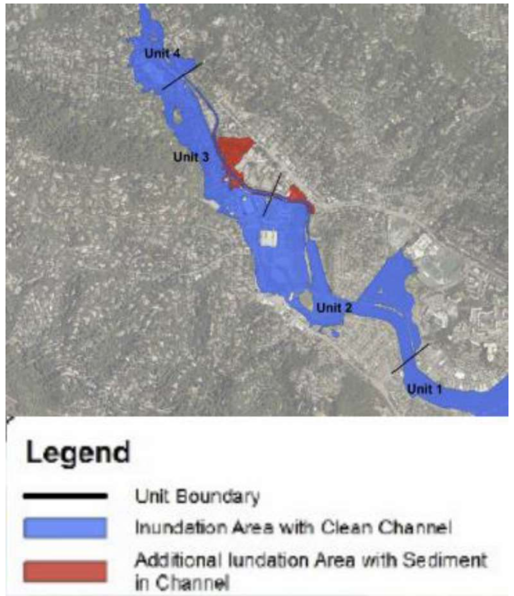
- **Single purpose**: formulating alternative to meet one objective, e.g., an ecosystem plan, a flood risk management plan, a recreation plan etc. (may leave out alternatives that contribute to multiple or all the objectives)

12

# 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

13

# 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?

14

# 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.

15

# 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.

16

# 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.

18

# 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 | | | | | | | | | | | | | | | | | | | | | 19 | 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.

20

## 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

**Day 2: 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<br>REVIEW DAY 2<br>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;<br>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.

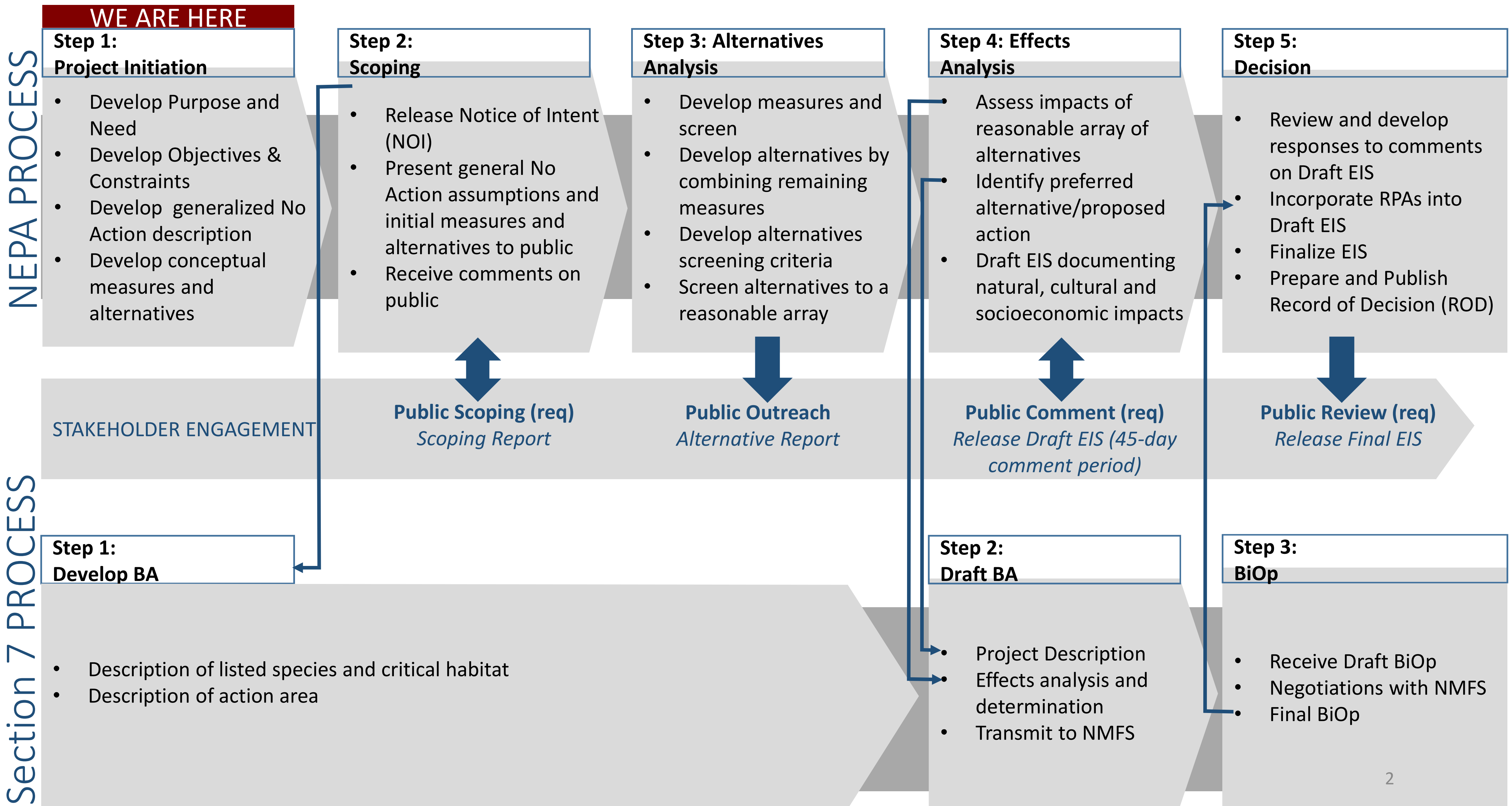
**Objectives:**
- Identify robust initial list of measures to address Willamette EIS objectives and opportunities with a focus on Maintenance Measures (regular and infrequent) and Recreation Measures.
- Identify next steps for the PDT on this study.

| TIME | DURATION | ACTION | WHO |
|---|---|---|---|
| 1230 – 1240 | 10 minutes | Welcome and Agenda Overview | Suzy Hill, NEPA TL;<br>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 |

1

# Process Overview

1


WE ARE HERE
NEPA PROCESS
Step 1: Project Initiation
• Develop Purpose and Need
• Develop Objectives & Constraints
• Develop generalized No Action description
• Develop conceptual measures and alternatives
Step 2: Scoping
• Release Notice of Intent (NOI)
• Present general No Action assumptions and initial measures and alternatives to public
• Receive comments on public
Step 3: Alternatives Analysis
• Develop measures and screen
• Develop alternatives by combining remaining measures
• Develop alternatives screening criteria
• Screen alternatives to a reasonable array
Step 4: Effects Analysis
• Assess impacts of reasonable array of alternatives
• Identify preferred alternative/proposed action
• Draft EIS documenting natural, cultural and socioeconomic impacts
Step 5: 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
Step 1: Develop BA
• Description of listed species and critical habitat
• Description of action area
Step 2: Draft BA
• Project Description
• Effects analysis and determination
• Transmit to NMFS
Step 3: BiOp
• Receive Draft BiOp
• Negotiations with NMFS
• Final BiOp
2

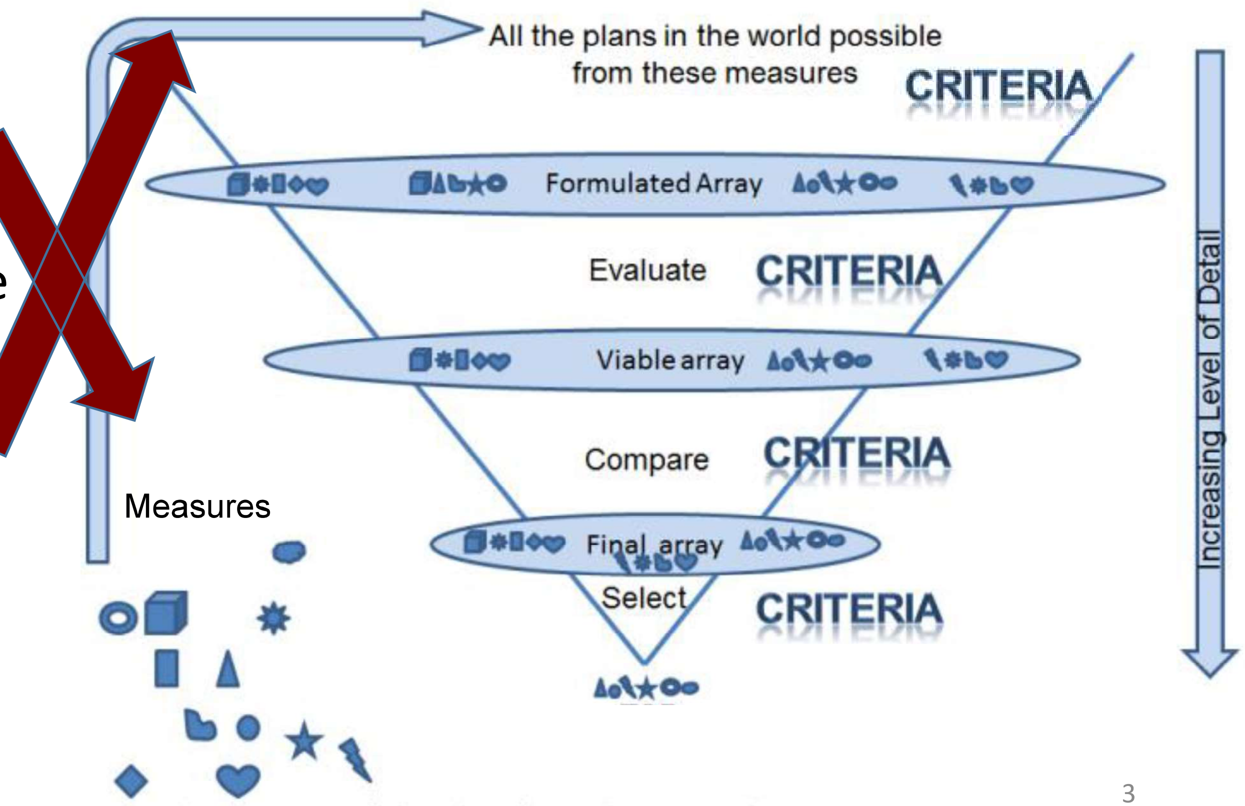
Step 1: Project Initiation | Step 2: Scoping | **Step 3: Alternatives Analysis** | Step 4: Effects Analysis | Step 5: Decision

# 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

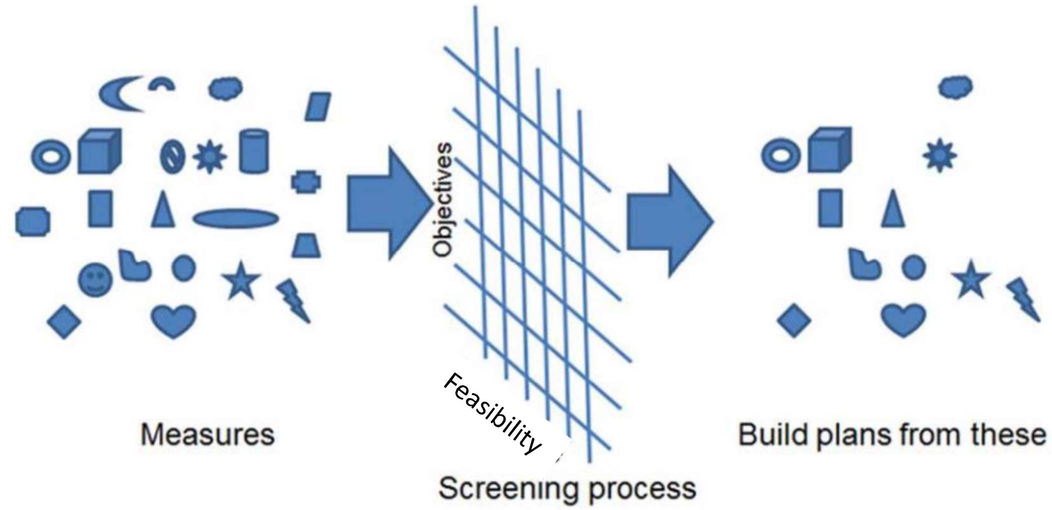



3

| 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*)**

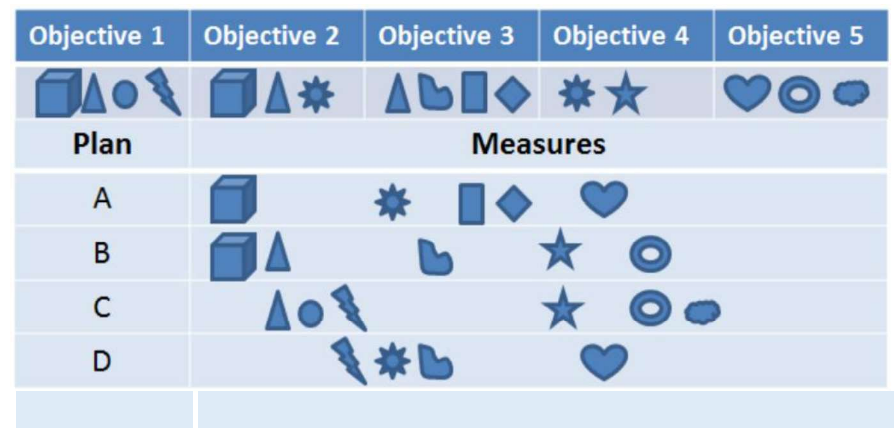
- Brainstorm as many measures as possible that meet one or more objectives.

**Initial Screening**

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

**Comparative Screening**

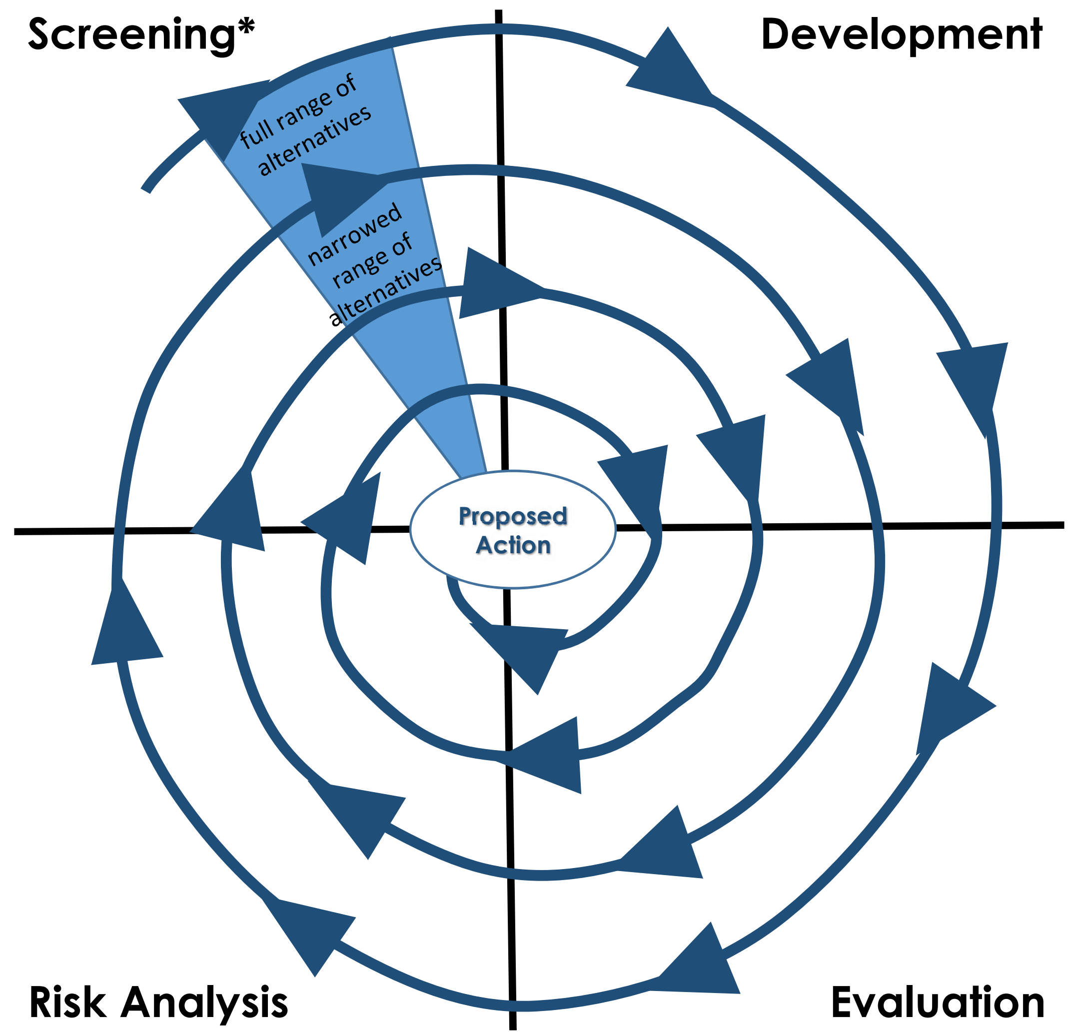
- Detailed look at measures to determine if some were clearly better than others.
- A qualitative (good/better/best) approach to categorize how measures meet the various objectives and identify which more effectively meet the purpose and need




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.

5

# 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.

6

# 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.

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 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/FAC/ES

Col Michael D. Helton, Portland District Commander & Engineer
U.S. Army Corps of Engineers, Portland District
P.O. Box 2870
Portland, Oregon 97208-2870

Dear Col. Helton:

In accordance with the Scope of Work from September 1, 2021, the U.S. Fish and Wildlife Service (Service) has completed a draft of the Fish and Wildlife Coordination Act 2(b) Report (FWCAR) for the Willamette Valley System (WVS) Project. The Service understands that the draft FWCAR will be included in Environmental Impact Statement (EIS) scheduled for public review in September 2022.

This draft FWCAR is the culmination of work from across Service programs, and it documents the Service's analysis and conclusions of how the six WVS EIS alternatives (the No Action Alternative, four Alternatives, and two Sub-alternatives) would impact fish and wildlife species and their habitats. The draft 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 draft Report were informed by input from local and species experts across the Willamette River Basin.

We look forward to working with you to finalize this report before the Final EIS release in June 2023.

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 Report, please contact our WVS FWCA Technical Lead, Courtney Newlon (telephone: 503-231-6972; email: Courtney_Newlon@fws.gov).

Sincerely,

JUDITH GORDON

Digitally signed by JUDITH GORDON
Date: 2022.05.24 16:38:36 -07'00'

Assistant Regional Director
Fish and Aquatic Conservation

Enclosure:

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

# 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

MAY 19, 2022

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| A1 | Alternative 1 |
| A2a | Alternative 2a |
| A2b | Alternative 2b |
| A3a | Alternative 3a |
| A3b | Alternative 3b |
| A4 | Alternative 4 |
| 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

| | |
|---|---|
| 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) for the WVS (Corps, 2022). The Service considered the No Action Alternative (NAA) (i.e., current operations), four Alternatives, and two Sub-alternatives (Section 1.2.1) (Corps, 2022). 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 2a, 2b, 3a, and 3b. While no alternative was projected to be wholly beneficial to fish, wildlife, and plant resources, measures associated with Alternatives 1 and 4 could either 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. 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 western 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 20-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 20-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, 2022).

#### *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, 2022).

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 three dams (Corps, 2022).

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, 2022).

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, 2022).

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.

## 1.3. 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 | SF 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<br>U.S. Geological Survey<br>National Oceanic and Atmospheric Administration |
| Tribes | Conf. Tribes of Siletz Indians<br>Conf. Tribes of Grand Ronde<br>Conf. Tribes of the Warm Springs Reservation of Oregon |
| Other | Institute for Applied Ecology<br>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 dolomieui*), 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<br>Channel avulsion<br>Natural disturbance<br>Channel migration<br>Sediment transport<br>Water flow |
| Ecosystem function | Disturbance<br>Instream temperature regimes<br>Sediment transport<br>Nutrient cycling<br>Plant and animal interactions (e.g., growth) |
| Habitat complexity and diversity<br>Species diversity | Channel avulsion<br>Disturbance<br>Forest succession<br>Sediment transport<br>Sediment bar formation<br>Nutrient cycling<br>Plant and animal reproduction<br>Recruitment and transport of large wood<br>Sediment dynamics (e.g., sediment transport)<br>Soil formation |
| Native vegetation (e.g., riparian) | Natural disturbance<br>Nutrient cycling<br>Pollination<br>Seasonal flooding |
| Natural disturbance | Bioturbation (e.g., spawning or burrowing)<br>Erosion (e.g., bank sloughing)<br>Fire occurrence (i.e., frequency, intensity)<br>Flooding<br>Sediment dynamics (e.g., deposition)<br>Channel migration |
| Natural flood regime | Precipitation<br>Soil formation<br>Storing water (e.g., floodwater)<br>Water flow and timing |
| Pre-dam hydrograph | Natural disturbance (e.g., storms)<br>Sediment transport<br>Precipitation<br>Storing water (e.g., floodwater)<br>Water flow (e.g., base flow, subsurface flow) |

| Indicators | Ecological and Physical Processes |
|---|---|
| Water quality (in this report, total dissolved gas, and temperature) | Climate variability patterns<br>Cooling/warming of water<br>Sediment dynamics (e.g., deposition)<br>Storing/biodegrading pollutants<br>Stratification |
| Water quantity | Evaporation<br>Flooding<br>Groundwater discharge<br>Precipitation<br>Water flow (e.g., subsurface flow)<br>Water storage<br>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*)<br>Western Ridged Mussel (*Gonidea angulata*)<br>American Beaver (*Castor canadensis*) [a]<br>Oregon Chub (*Oregonichthys crameri*) [b] |
| **Wetland/ Off-Channel** | Northern Red-Legged Frog (*Rana aurora*)<br>Pacific Lamprey (*Entosphenus tridentatus*)<br>American Beaver (*Castor canadensis*) [a]<br>Black Cottonwood (*Populus balsamifera*) [a]<br>Oregon Chub (*Oregonichthys crameri*) [b] |
| **Riparian** | Foothill Yellow-Legged Frog (*Rana boylii*)<br>Western Pond Turtle (*Actinemys marmorata*)<br>American Beaver (*Castor canadensis*) [a]<br>Black Cottonwood (*Populus balsamifera*) [a] |
| **Upland** | Monarch Butterfly (*Danaus plexippus*)<br>Wayside Aster (*Eucephalus vialis*)<br>Black Cottonwood (*Populus balsamifera*) [a]<br>Bradshaw's Lomatium (*Lomatium bradshawii*) [b] |
| **Prairie** | Dusky Canada Goose (*Branta canadensis occidentalis*)<br>Shaggy Horkelia (*Horkelia congesta*)<br>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<br>Wet Prairie | Monarch Butterfly<br>Wayside Aster<br>Dusky Canada Goose<br>Shaggy Horkelia<br>Black Cottonwood<br>American Beaver<br>Bradshaw's Lomatium | February 25, 2022<br>9:00 AM to 12:00 PM |
| Riverine/Reservoir<br>Riparian<br>Off-Channel/Wetland | Northern Red-Legged Frog<br>Pacific Lamprey<br>Foothill Yellow-Legged Frog<br>Western Pond Turtle<br>Coastal Cutthroat Trout<br>Western Ridged Mussel<br>Black Cottonwood<br>American Beaver<br>Bradshaw's Lomatium<br>Oregon Chub | February 25, 2022<br>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<br>U.S. Geological Survey<br>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 (Jaeger et al., 2017, p. 5). 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 western 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, 2022) (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).

**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 |
|---|---|---|---|---|---|---|---|
| Riverine/Reservoir | - | ++ | 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 |
|---|---|---|---|---|---|---|---|
| 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 |
|---|---|---|---|---|---|---|---|
| Riverine/Reservoir | - | - | - | - | -- | -- | - |
| Off-channel/Wetland | - | - | - | - | -- | -- | - |
| Riparian | - | - | - | -- | -- | -- | - |
| Prairie | - | - | - | - | o | - | - |
| Upland | - | - | - | - | | | - |

**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 |
|---|---|---|---|---|---|---|---|
| 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 |
|---|---|---|---|---|---|---|---|
| Riverine/Reservoir | - | ++ | ++ | ++ | ++ | ++ | ++ |
| Off-channel/Wetland | - | ++ | ++ | ++ | ++ | ++ | ++ |
| Riparian | - | ++ | ++ | ++ | ++ | ++ | ++ |
| Prairie | - | + | + | + | + | + | + |
| Upland | - | - | - | - | - | - | - |

# 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.

- 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. 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 is currently developing an 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 DEIS is 2b. While some measures in the draft 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). Passage at Hill's Creek Dam (Middle Fork Willamette subbasin) is not in currently in Alternative 2b but is under discussion. Dams where fish passage is being planned under draft Alternative 2b include Green Peter, 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 DEIS. 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 western 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 late 2023. 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 spawning 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., more than 1 day).

- 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 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 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 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 this group 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 (Clemens et al., 2020).
- 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.

- 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).
- 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. Western Pond Turtle (*Actinemys marmorata*)

- Continue efforts to survey for and inventory western 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 western 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 western pond turtles throughout the Willamette Basin.
- Monitor and remove red-eared sliders (*Trachemys scripta elegans*) in western 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 western 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 western pond turtles. Consider creating new habitat adjacent to the Fall Creek spillway to mitigate impacts of future use of the spillway on western 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 western 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 western 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, 2020). 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, 2020). 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 Summer 2022.

| 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 |
| TBD | The Corps released the WVS DEIS and the draft WVS FWCAR, attached as an appendix, and began the review and comment period |
| TBD | The Corps’ review and comment period closed |
| June 1, 2023 | The WVS FWCAR was finalized as an appendix in the Corps’ final 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' DEIS 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 $mt^3/s$ 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.

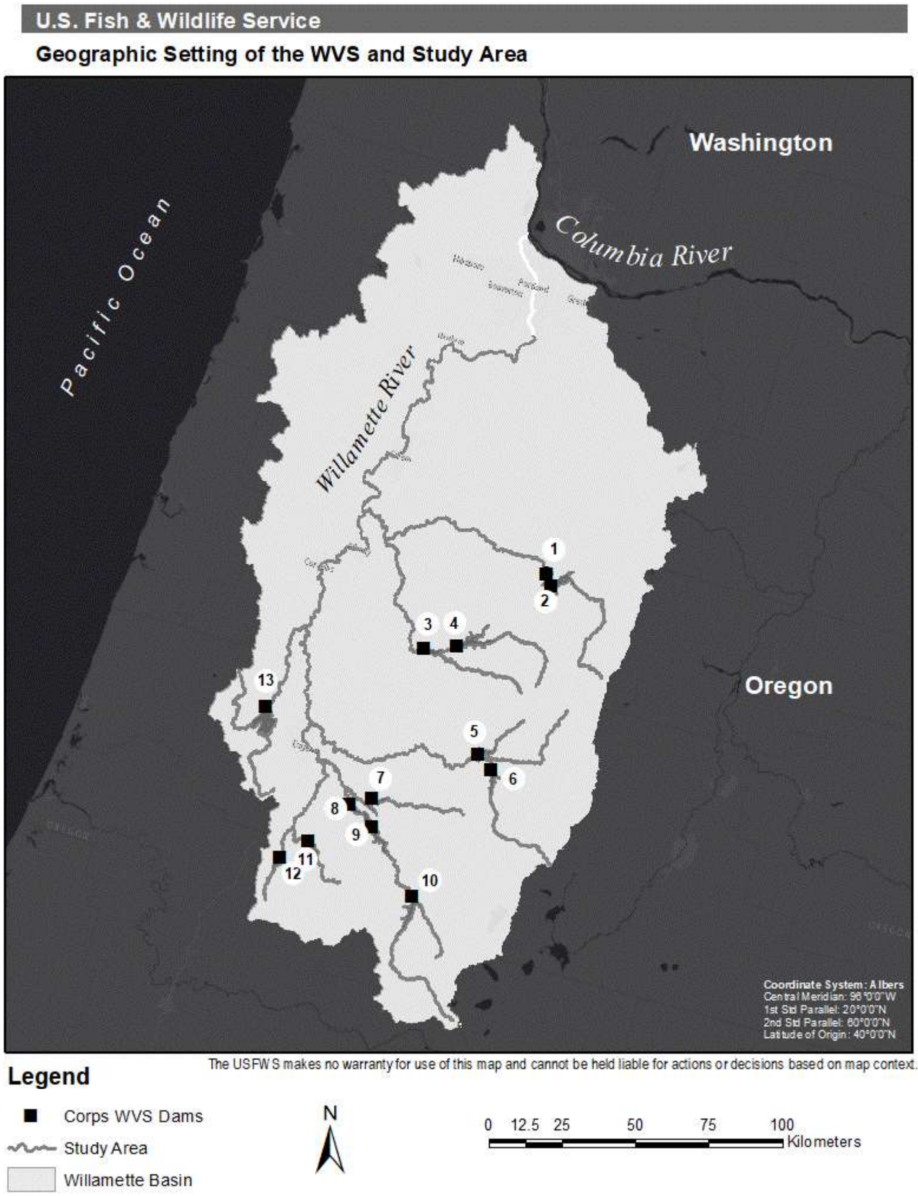


**Figure 1. Geographic setting of the WVS and river reaches included in the FWCAR analysis and 0.4 km (0.25 mile) buffer. Projects include 1) Big Cliff and 2) Detroit on the North Santiam River; 3) Foster on the South Santiam River; 4) Green Peter on the Middle Santiam River; 5) Blue River; 6) Cougar 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*)<br>Wayside Aster (*Eucephalus vialis*) |
| Prairie / Wet-Prairie | Dusky Canada Goose (*Branta canadensis occidentalis*)<br>Shaggy Horkelia (*Horkelia congesta ssp. congesta*) |
| Wetland/ Off-Channel | Northern Red-Legged Frog (*Rana aurora*)<br>Pacific Lamprey (*Entosphenus tridentatus*) |
| Riparian | Foothill Yellow-Legged Frog (*Rana boylii*)<br>Western Pond Turtle (*Actinemys marmorata*) |
| Riverine / Reservoirs | Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*)<br>Western Ridged Mussel (*Gonidea angulata*) |
| Keystone Species | Black Cottonwood (*Populus balsamifera*)<br>American Beaver (*Castor canadensis*) |

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

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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*)<br>Wayside Aster (*Eucephalus vialis*) |
| Prairie/Wet Prairie | Dusky Canada Goose (*Branta canadensis occidentalis*)<br>Shaggy Horkelia *(Horkelia congesta)* |

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

Thank you for your consideration,

Courtney Newlon, Brian Bangs, and Brook Silver

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:** 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*)<br>Wayside Aster (*Eucephalus vialis)* |
| **Prairie/Wet-Prairie** | Dusky Canada Goose (*Branta canadensis occidentalis*)<br>Shaggy Horkelia (*Horkelia congesta ssp. congesta*) |
| **Keystone Species** | Black Cottonwood (*Populus balsamifera*)<br>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 –**<br>*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**<br>Study area<br>Brief orientation to habitat types<br>How we chose our species and habitats | Brook Silver |
| | ***Discussion Topics*** | |
| 9:50 am | **Key Areas (Landscapes, Reaches or Sites)**<br>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:*<br>*Upland*<br>*Prairie / Wet-Prairie* | Courtney Newlon |

| | | |
|---|---|---|
| 10:15 am | **BREAK** | |
| 10:30 am | **"What must we maintain?"**<br>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?*<br>*Upland*<br>*Prairie / Wet-Prairie* | Courtney Newlon |
| 10:50 am | **"How could it all change?"**<br>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)?*<br>*Upland*<br>*Prairie / Wet-Prairie* | Brian Bangs |
| 11:15 am | **Conservation Recommendations**<br>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?*<br>*Upland*<br>*Prairie / Wet-Prairie* | Brian Bangs |
| 11:50 am | **Next Steps…**<br>*Further comments, due February 28 via email, survey link*<br>*How we will incorporate your feedback?*<br>*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*)<br>Pacific Lamprey (*Entosphenus tridentatus*) |
| **Riparian** | Foothill Yellow-Legged Frog (*Rana boylii*)<br>Western Pond Turtle (*Actinemys marmorata*) |
| **Riverine/Reservoir** | Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*)<br>Western Ridged Mussel (*Gonidea angulata*) |
| **Keystone Species** | Black Cottonwood (*Populus balsamifera*)<br>American Beaver (*Castor canadensis*) |
| **Delisted Species** | Bradshaw's Lomatium (*Lomatium bradshawii*)<br>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 –**<br>*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**<br>*Study area*<br>*Brief orientation to habitat types*<br>*How we chose our species and habitats* | Brook Silver |
| | ***Discussion Topics*** | |
| 1:50 pm | **Key Areas (Landscapes, Reaches or Sites)**<br>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:*<br>*Riverine/Reservoir*<br>*Off-Channel/Wetland*<br>*Riparian* | |
| 2:15 pm | **BREAK** | |
| 2:30 pm | **"What must we maintain?"**<br>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?*<br>*Riverine/Reservoir*<br>*Off-Channel/Wetland*<br>*Riparian* | Courtney Newlon |
| 2:50 pm | **"How could it all change?"**<br>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)?*<br>*Riverine/Reservoir*<br>*Off-Channel/Wetland*<br>*Riparian* | Brain Bangs |
| 3:15 pm | **Conservation Recommendations**<br>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?*<br>*Riverine/Reservoir*<br>*Off-Channel/Wetland*<br>*Riparian* | Brian Bangs |
| 3:50 pm | **Next Steps…**<br>*Further comments, due February 28 via email, survey link*<br>*How we will incorporate your feedback?*<br>*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 is a species that 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 (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., 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 (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. *Western Pond Turtle*

*Range:* The western 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 western 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*: Western 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). Western 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 western 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 western 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 Center for Biological Diversity listed the western pond turtle as one of the 10 most vulnerable reptiles in the United States in 2013 (ODFW, 2015, p. 7). They are a Federal Species of Concern throughout their range, 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 is scheduled to conclude, at a minimum, in 2023. 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** | | **Upstream Fish Passage Measures** | | | **Downstream 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 | | | | | x | x |
| | Foster | | | | 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 | | | | | | |
| | 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 | 711 | 718 | 723 | 304 | 30 | 639 | 722 | 52 | 392 | 40 | 720 | 714 | 384 | 719 | 9 | 726 |
| 1 | Big Cliff | | | x | | | | | | | | | | | | | | | x | x | x | x |
| | Detroit | | x | 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 |
| | 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 |
| | 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 |

| Alternative | Project | Water Quality Measures | | | | | | Storage and Flow Measures | | | | Fish Passage Measures | | | | | | | Basin-wide Measures | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 479 | 105 | 174 | 166 | 721 | 711 | 718 | 723 | 304 | 30 | 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 | 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 | 711 | 718 | 723 | 304 | 30 | 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 | 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 |

| Alternative | Project | Water Quality Measures | | | | | | Storage and Flow Measures | | | | Fish Passage Measures | | | | | | | | Basin-wide Measures | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 479 | 105 | 174 | 166 | 721 | 711 | 718 | 723 | 304 | 30 | 639 | 670 | 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 | 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 | 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 | 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 | 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 | 711 | 718 | 723 | 304 | 30 | 639 | 670 | 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 | 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 | 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 |
| | 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 | 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 | 711 | 718 | 723 | 304 | 30 | 639 | 722 | 52 | 392 | 40 | 720 | 714 | 384 | 719 | 9 | 726 |
| 4 | Big Cliff | | | x | | | x | | | | 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 | 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 | 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 |

## 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 western 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 western 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 effect 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 western 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 and A2b 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 and A4 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 Big Cliff, 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 western 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 and A4 at Foster; A3a at Detroit, Blue River, and Hills Creek; A3b at Detroit, Blue River, Hills Creek and Cougar.

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 711: Mechanical Degassing*

Summary: Mechanical degassing methods in fish collection (Minto, Foster, and Dexter Adult Fish Facilities) and hatchery areas below the dams to reduce TDGs. This measure is being considered for A4 at Big Cliff, Foster, and Dexter.

Interactions with Riverine/Reservoir Habitat and Species: The implementation of mechanical degassing methods to reduce total dissolved gasses downstream of Foster and Big Cliff dams could benefit coastal cutthroat trout, Oregon chub and the western ridged mussel by improving water quality.

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.2.2.6. *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, and A4 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 30: 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 – June 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 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, A2b, and A3a at Detroit, Green Peter Cougar, Lookout Point, and Hills Creek; A3b at Detroit Green Peter, Lookout Point, and Hills Creek; A4 at Detroit, Green Peter, Cougar, 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.2.3.3. *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 and A2b 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.2.3.4. *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 Detroit, Green Peter, Blue River, Cougar, Fall Creek, Lookout Point, Hills Creek, Dorena, Cottage Grove, and Fern Ridge.

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 western 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 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 Detroit, Foster, Green Peter, and Lookout Point; A2a at Detroit, Foster, Cougar, and Lookout Point; A2b 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, A2a, and A2b 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 Ridged 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 and A2b 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 at Cougar; A3a at Detroit, Cougar, and Lookout Point; A3b at Green Peter, Cougar, and Hills Creek.

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 Dexter; A2a and A2b at Green Peter and Dexter; A3a and A3b at Green Peter, Blue River, and Hills Creek; A4 at Dexter 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, A2a, and A2b 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 670: Update Dexter Adult Fish Facility*

Summary: Operate existing AFF at Dexter Dam using best management practices for collection and outplanting of adult Chinook above Lookout Point and/or Dexter dams. Extend trap operations to cover season when most adult spring Chinook salmon return to the base of Dexter Dam. Use approved anesthetics and handling practices which cause the least risk to fish stress and health. Randomly sort fish for brood and those for outplanting to avoid high grading fish for either purpose. Keep densities of fish in trapping facilities and transport trucks at or below recommended levels to avoid stress. Transport and release fish daily following temperature acclimation protocols to avoid stress for large temperature differentials between trucks and release locations. This measure is being considered A3a and A3b at Dexter.

Interactions with Riverine/Reservoir Habitat and Species: This measure would increase connectivity and provide access to additional suitable habitat above Dexter dam for both native and non-native species. More specifically, it will enable upstream passage for Coastal cutthroat trout.

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.2.5.4. *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 at Green Peter; A2a and A2b at Green Peter and Dexter; A3a and A3b at Green Peter, Blue River, and Hills Creek; A4 at Dexter and 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 |
|---|---|---|---|---|---|---|---|---|
| Riverine/Reservoir | 105 | | + | + | + | | | + |
| | 166 | | | ++ | ++ | ++ | ++ | ++ |
| | 479 | | - | - | - | - | - | - |
| | 721 | | | -- | -- | -- | -- | -- |
| | 174 | | ++ | | | | | ++ |
| | 711 | | | | | | | ++ |
| | Cumulative effects | - | ++ | o | o | - | - | + |
| Off-Channel/Wetland | 105 | | o | o | o | | | o |
| | 166 | | | - | - | - | - | - |
| | 479 | | - | - | - | - | - | - |
| | 721 | | | - | - | - | - | - |
| | 174 | | | | | | | |
| | 711 | | | | | | | |
| | Cumulative effects | - | o | - | - | - | - | - |
| Riparian | 105 | | o | o | o | | | o |
| | 166 | | | o | o | o | o | o |
| | 479 | | - | - | - | - | - | - |
| | 721 | | | -- | -- | -- | -- | -- |
| | 174 | | ++ | | | | | ++ |
| | 711 | | | | | | | |
| | Cumulative effects | - | + | - | - | - | - | + |
| Prairie | 105 | | | | | | | |
| | 166 | | | | | | | |
| | 479 | | | | | | | |
| | 721 | | | | | | | |
| | 174 | | | | | | | |
| | 711 | | | | | | | |
| | Cumulative effects | | | | | | | |
| Upland | 105 | | | | | | | |
| | 166 | | | | | | | |
| | 479 | | | | | | | |
| | 721 | | | | | | | |
| | 174 | | | | | | | |
| | 711 | | | | | | | |
| | Cumulative effects | | | | | | | |

**Table 18. Flow**

| Habitat Type | Measure | NAA | Alt 1 | Alt 2a | Alt 2b | Alt 3a | Alt 3b | Alt 4 |
|---|---|---|---|---|---|---|---|---|
| Riverine/Reservoir | 30 | | | -- | -- | -- | -- | -- |
| | 304 | | - | - | - | - | - | - |
| | 718 | | - | | - | - | - | - |
| | 723 | | -- | | | | | |
| | Cumulative effects | - | -- | -- | -- | -- | -- | -- |
| Off-channel/Wetland | 30 | | | -- | -- | -- | -- | -- |
| | 304 | | - | - | - | - | - | - |
| | 718 | | - | | - | - | - | - |
| | 723 | | -- | | | | | |
| | Cumulative effects | - | -- | -- | -- | -- | -- | -- |
| Riparian | 30 | | | -- | -- | -- | -- | -- |
| | 304 | | -- | -- | -- | -- | -- | -- |
| | 718 | | -- | | -- | -- | -- | -- |
| | 723 | | - | | | | | |
| | Cumulative effects | - | -- | -- | -- | -- | -- | -- |
| Prairie | 30 | | | + | + | + | + | + |
| | 304 | | | | | | | |
| | 718 | | + | | + | + | + | + |
| | 723 | | -- | | | | | |
| | Cumulative effects | - | - | + | + | + | + | + |
| Upland | 30 | | | | | | | |
| | 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 |
|---|---|---|---|---|---|---|---|---|
| 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 | |
| | 392 | | - | - | - | | | - |
| | 714 | | | | | | | |
| | 720 | | | | -- | -- | -- | |
| | Cumulative effects | - | - | - | - | o | - | - |
| Upland | 40 | | | | | | | |
| | 392 | | - | - | - | | | - |
| | 714 | | | | | | | |
| | 720 | | | | | | | |
| | Cumulative effects | - | - | - | - | | | - |

**Table 20. Upstream Passage**

| Habitat Type | Measure | NAA | Alt 1 | Alt 2a | Alt 2b | Alt 3a | Alt 3b | Alt 4 |
|---|---|---|---|---|---|---|---|---|
| Riverine/Reservoir | 52 | | ++ | ++ | ++ | ++ | ++ | ++ |
| | 639 | | ++ | | | | | |
| | 670 | | | | | | | |
| | 722 | | ++ | ++ | ++ | ++ | ++ | ++ |
| | Cumulative effects | - | ++ | ++ | ++ | ++ | ++ | ++ |
| Off-channel/Wetland | 52 | | ++ | ++ | ++ | ++ | ++ | ++ |
| | 639 | | ++ | | | | | |
| | 670 | | | | | | | |
| | 722 | | ++ | ++ | ++ | ++ | ++ | ++ |
| | Cumulative effects | - | ++ | ++ | ++ | ++ | ++ | ++ |
| Riparian | 52 | | | | | | | |
| | 639 | | | | | | | |
| | 670 | | | | | | | |
| | 722 | | + | + | + | + | + | + |
| | Cumulative effects | - | + | + | + | + | + | + |
| Prairie | 52 | | | | | | | |
| | 639 | | | | | | | |
| | 670 | | | | | | | |
| | 722 | | - | - | - | - | - | - |
| | Cumulative effects | - | - | - | - | - | - | - |
| Upland | 52 | | | | | | | |
| | 639 | | | | | | | |
| | 670 | | | | | | | |
| | 722 | | - | - | - | - | - | - |
| | Cumulative effects | - | - | - | - | - | - | - |

**Table 21. Basin-wide measures**

| Habitat Type | Measure | NAA | Alt 1 | Alt 2a | Alt 2b | Alt 3a | Alt 3b | Alt 4 |
|---|---|---|---|---|---|---|---|---|
| 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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