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

Refer to NMFS No.:
NWR-2013-10221

December 3, 2013

Paul Henson, State Supervisor
U.S. Fish and Wildlife Service
Oregon State Office
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Kate Benkert, Deputy Manager
U.S. Fish and Wildlife Service
Oregon State Office
2600 S.E. 98th Ave, Ste 100
Portland, Oregon 97266

Jennifer A. Steger, Northwest & Alaska Regional Supervisor
NOAA Restoration Center
7600 Sandpoint Way NE
Seattle, Washington 98115-6349

Re: Programmatic Restoration Opinion for Joint Ecosystem Conservation by the Services (PROJECTS) by the U.S. Fish and Wildlife Service Using the Partners for Fish and Wildlife, Fisheries, Coastal, and Recovery Programs and NOAA Restoration Center Using the Damage Assessment, Remediation and Restoration Program (DARRP), and Community-Based Restoration Program (CRP) in the States of Oregon, Washington, and Idaho

Dear Mr. Henson, Ms. Benkert and Ms. Steger:

The enclosed document contains a joint programmatic conference and biological opinion (opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to section 7(a) (2) of the Endangered Species Act (ESA) on consultation on the effects of implementing aquatic restoration actions proposed to be funded or carried out by the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration Restoration Center (NOAA RC) in the States of Oregon, Washington, and Idaho.

USFWS funds or carries out projects under the Partners for Fish and Wildlife, Fisheries, Coastal, and Recovery programs. These actions fulfill natural resource responsibilities assigned to USFWS under the Fish and Wildlife Coordination Act, Endangered Species Act, and the Partners for Fish and Wildlife Act. NOAA RC funds or carries out projects under the Damage Assessment, Remediation and Restoration Program and the Community Based Restoration Program under the auspices of the Clean Water Act, the Superfund Act, the Oil Pollution Act of 1990, the National Marine Sanctuaries Act, and the Fish and Wildlife Coordination Act.

Actions covered in this opinion, which will occur in Oregon, Washington, and Idaho, combine and modify actions described in programmatic biological opinions previously issued to USFWS and to NOAA RC, as summarized in the consultation history section of the opinion.

During this consultation, NMFS concluded that the proposed action is not likely to adversely affect southern distinct population segment (DPS) green sturgeon *(Acipenser medirostris)*, and southern resident killer whales *(Orcinus orca),* and their designated critical habitat. NMFS also concluded that the proposed action is not likely to adversely affect the Puget Sound/Georgia Basin DPSs of yelloweye rockfish (*Sebastes ruberrimus*), canary rockfish (*Sebastes pinniger*), and bocaccio rockfish (*Sebastes paucispinis*) (and their critical habitat where it has been designated).

NMFS also concluded that the proposed action is not likely to jeopardize the continued existence of the following 20 species, or result in the destruction or adverse modification of their designated or proposed critical habitats (critical habitat for LCR coho salmon has been proposed, but not yet designated). However, NMFS' conclusion for LCR coho salmon critical habitat will not be effective until that designation is final and NMFS has adopted the conference opinion.

1. Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*)
2. Upper Willamette River (UWR) spring-run Chinook salmon
3. Upper Columbia River (UCR) spring-run Chinook salmon
4. Snake River (SR) spring/summer-run Chinook salmon
5. SR fall-run Chinook salmon
6. Puget Sound (PS) Chinook salmon
7. Columbia River chum salmon (*O. keta*)
8. Hood Canal chum salmon
9. LCR coho salmon (*O. kisutch*)
10. Oregon Coast (OC) coho salmon
11. Southern Oregon/Northern California Coasts (SONCC) coho salmon
12. Lake Ozette sockeye salmon (*O. nerka*)
13. SR sockeye salmon
14. LCR steelhead (*O. mykiss*)
15. UWR steelhead
16. Middle Columbia River (MCR) steelhead
17. UCR steelhead
18. Snake River Basin (SRB) steelhead
19. PS steelhead
20. Southern distinct population segment eulachon *(Thaleichthys pacificus*).

As required by section 7 of the ESA, NMFS is providing an incidental take statement (ITS) with the opinion. The ITS describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this program. The ITS also sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal action agency must comply with to carry out the reasonable and prudent measures.

Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of the listed species considered in this opinion, except eulachon because NMFS has not yet promulgated an ESA section 4(d) rule prohibiting take of threatened eulachon. However, anticipating that such a rule may be issued in the future, we have included terms and conditions to minimize take of eulachon. These terms and conditions are identical to the terms and conditions required to minimize take of listed salmon and steelhead. Therefore, we expect the USFWS and NOAA RC will follow these terms and conditions regardless of whether take of eulachon is prohibited. The take exemption for eulachon will take effect on the effective date of any future 4(d) rule prohibiting take of eulachon.

This document also includes the results of our analysis of the program's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes three conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the recommendations, the action agency must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

If you have any questions regarding this opinion, please contact Clayton Hawkes in the Interior Columbia Basin Office at 503-230-5406.

Sincerely,

William W. Stelle, Jr.
Regional Administrator

cc: Megan Callahan-Grant, PNWRC
Dennis Mackey, USFWS
CalLee Davenport, USFWS
Rich Carlson, USFWS
Kathleen Hendricks, USFWS

Endangered Species Act - Section 7 Programmatic Conference and Biological Opinion
and
Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

for

Programmatic Restoration Opinion for Joint Ecosystem Conservation by the Services
(PROJECTS)
by the
U.S. Fish and Wildlife Service
Using the Partners for Fish and Wildlife, Fisheries,
Coastal, and Recovery Programs
and
NOAA Restoration Center
Using the Damage Assessment, Remediation and Restoration Program (DARRP), and
Community-Based Restoration Program (CRP)
in
the States of Oregon, Washington, and Idaho

NMFS Consultation Number: NWR-2013-10221

Federal Action Agencies: U.S. Fish and Wildlife Service
Oregon, Washington, and Idaho State Offices

National Marine Fisheries Service,
NOAA Restoration Center

Affected Species and Determinations:

ESA-Listed Species	ESA Status	Is the action likely to adversely affect this species or its critical habitat?	Is the action likely to jeopardize this species?	Is the action likely to destroy or adversely modify critical habitat for this species?
Lower Columbia River Chinook salmon	T	Yes	No	No
Upper Willamette River Chinook salmon	T	Yes	No	No
Upper Columbia River spring-run Chinook salmon	E	Yes	No	No
Snake River spring/summer run Chinook salmon	T	Yes	No	No
Snake River fall-run Chinook salmon	T	Yes	No	No
Puget Sound Chinook salmon	T	Yes	No	No
Columbia River chum salmon	T	Yes	No	No
Hood Canal summer-run chum salmon	T	Yes	No	No
Lower Columbia River coho salmon	T	Yes	No	No*

Oregon Coast coho salmon	T	Yes	No	No
Southern Oregon/Northern California coasts coho salmon	T	Yes	No	No
Snake River sockeye salmon	E	Yes	No	No
Lake Ozette sockeye salmon	T	Yes	No	No
Lower Columbia River steelhead	T	Yes	No	No
Upper Willamette River steelhead	T	Yes	No	No
Middle Columbia River steelhead	T	Yes	No	No
Upper Columbia River steelhead	T	Yes	No	No
Snake River Basin steelhead	T	Yes	No	No
Puget Sound steelhead	T	Yes	No	No
Puget Sound/Georgia Basin bocaccio	E	No	No	No
Puget Sound/Georgia Basin canary rockfish	T	No	No	No
Puget Sound/Georgia Basin yelloweye rockfish	T	No	No	No
Southern green sturgeon	T	No	No	No
Southern Eulachon	T	Yes	No	No
Southern Resident killer whale	T	No	No	No

*Critical habitat has been proposed for LCR coho salmon.

Fishery Management Plan that Describes EFH in the Action Area	Would the action adversely affect EFH?	Are EFH conservation recommendations provided?
Coastal Pelagic Species	Yes	Yes
Pacific Coast Groundfish	Yes	Yes
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued by:

William W. Stelle, Jr.
Regional Administrator

Date Issued: December 3, 2013

TABLE OF CONTENTS

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the conference and biological opinion (opinion) and incidental take statement portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, *et seq.*), and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, *et seq.*) and implementing regulations at 50 CFR 600.

The opinion, incidental take statement, and EFH conservation recommendations are each in compliance with Data Quality Act (44 U.S.C. 3504(d)(1) *et seq.*) and they underwent pre-dissemination review.

1.2 Consultation History

Actions covered in this opinion combine and modify actions described in programmatic biological opinions previously issued to USFWS on June 25, 2004[1] and October 21, 2009[2] and to NOAA RC on July 12, 2004[3] and October 22, 2009[4].

On June 11, 2013, USFWS and NOAA RC requested to combine and revise the programmatic consultations completed separately on October 21 and 22, 2009, respectively. During pre-consultation NMFS, USFWS, and NOAA RC agreed on draft restoration categories that will be covered and project design criteria (PDC) for their implementation. In the 2009 opinions, USFWS restoration actions were funded or carried out in Oregon and Southwest Washington and NOAA RC's were funded or carried out in Oregon, Washington, and Idaho.

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[1] Endangered Species Act Section 7 Consultation: Programmatic Biological and Conference Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Oregon Restoration Programs: Coastal, Greenspaces, Jobs in the Woods, and Partners for Fish and Wildlife, June 25, 2004 (Refer to NMFS No.: 2004/00155).

[2] Programmatic biological and conference opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat consultation for restoration actions funded or carried out by the U.S. Fish and Wildlife Service in Oregon and Southwest Washington using the Partners for Fish and Wildlife, Coastal, and Recovery Programs (October 21, 2009) (Refer to NMFS No.:2008/03791).

[3] Endangered Species Act Section 7 consultation: programmatic biological and conference opinion and Magnuson-Stevens Fishery Conservation and Management Act essential fish habitat consultation for NOAA Restoration Center programs, July 12, 2004 (Refer to NMFS No.: 2002/01967).

[4] Programmatic biological and conference opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat consultation for restoration actions funded or carried out by the NOAA Restoration Center in the Pacific Northwest using the Damage Assessment, Remediation and Restoration Program and the Community-based Restoration Program (October 22, 2009) (Refer to NMFS No.: 2007/09078).

This joint opinion will cover programs for both agencies in all three states. Submittal of a biological assessment (BA) was deemed unnecessary to reinitiate because similar BAs and opinions were recently completed with the Bonneville Power Administration (BPA; HIP III) (NMFS 2013b) and U.S. Forest Service/Bureau of Land Management/Bureau of Indian Affairs (ARBO II) (NMFS 2013c).

USFWS' projects are implemented under the Partners for Fish and Wildlife, Fisheries, Coastal, and Recovery programs. These programs address the restoration needs of a wide range of fish and wildlife trust species, primarily on private or Tribal lands. Actions covered in this revision are pursuant to the Fish and Wildlife Coordination Act, Partners for Fish and Wildlife Act, and the Endangered Species Act. Depending on the action, other cooperating entities may include Federal agencies, states, Tribes, local governments, non-governmental and nonprofit organizations, businesses, schools, and private landowners.

Funding for NOAA RC's actions is provided by the Damage Assessment, Remediation and Restoration Program (DARRP) and the Community-Based Restoration Program (CRP), often in combination with resources provided by U.S. Fish and Wildlife programs, including the Partners for Fish and Wildlife Program and Coastal and Recovery Program. DARRP is cooperatively implemented by the NOAA Restoration Center, NOAA's National Ocean Service's Office of Response and Restoration, and the Office of General Counsel. These programs are authorized by the Comprehensive Environmental Response, Compensation, and Liability Act (also known as CERCLA or Superfund), the Oil Pollution Act, the Clean Water Act, and the Marine Protection, Research and Sanctuaries Act. The CRP, which involves communities in the restoration of local marine and estuarine habitats, is authorized by the Fish and Wildlife Coordination Act. Depending on the action, other cooperating entities may include Federal agencies, states, tribes, local governments, non-governmental and nonprofit organizations, businesses, schools, and private landowners.

During consultation, USFWS and NOAA RC concluded that categories of activities, as proposed, will likely adversely affect 20 species listed under the ESA and their proposed or designated critical habitat (Table 1), but are not likely to adversely affect southern distinct population segment (DPS) green sturgeon (*Acipenser medirostris)*, southern resident killer whales *(Orcinus orca)*, and Puget Sound/Georgia Basin (PS/GB) DPSs of yelloweye rockfish (*Sebastes ruberrimus*), canary rockfish (*Sebastes pinniger*), and bocaccio rockfish (*Sebastes paucispinis*), and their critical habitat where it has been designated. The full analysis for these species is found in the "Not Likely to Adversely Affect" Determination section (2.11). The action will adversely affect areas designated by the Pacific Fisheries Management Council as EFH for groundfish (PFMC 2005) and coastal pelagic species (PFMC 1998); and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). Estuarine areas designated as Habitat Areas of Particular Concern (HAPC) will also be adversely affected.

Table 1. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register (FR) decision notices for ESA-listed species considered in this opinion. Listing status: 'T' means listed as threatened; 'E' means listed as endangered; 'P' means proposed for listing or designation.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon *(Oncorhynchus tshawytscha)*			
Lower Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River spring-run	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River spring-run	E 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	ESA section 9 applies
Snake River spring/summer-run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall-run	T 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Puget Sound	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Chum salmon *(O. keta)*			
Columbia River	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Hood Canal summer-run	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Coho salmon *(O. kisutch)*			
Lower Columbia River	T 6/28/05; 70 FR 37160	P 1/14/13; 78 FR 2726	6/28/05; 70 FR 37160
Oregon Coast	T 6/20/11; 76 FR 35755	2/11/08; 73 FR 7816	2/11/08; 73 FR 7816
Southern Oregon/Northern California Coasts	T 6/28/05; 70 FR 37160	5/5/99; 64 FR 24049	6/28/05; 70 FR 37160
Sockeye salmon *(O. nerka)*			
Lake Ozette	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Snake River	E 8/15/11; 70 FR 37160	12/28/93; 58 FR 68543	ESA section 9 applies
Steelhead *(O. mykiss)*			
Lower Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Willamette River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Middle Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Upper Columbia River	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	2/1/06; 71 FR 5178
Snake River Basin	T 1/5/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Puget Sound	T 5/11/07; 72 FR 26722	P 1/14/13; 78 FR 2726	P 2/7/07; 72 FR 5648
Eulachon *(Thaleichthys pacificus)*			
Southern DPS	T 3/18/10; 75 FR 13012	10/20/11; 76 FR 65324	Not applicable

Since 2010, USFWS (Oregon and Southwest Washington) and NOAA RC (Oregon, Washington, and Idaho) have reported on 18 to 25 ($\bar{x} = 21$) restoration actions per year using the October 21 and 22, 2009, opinions. Those actions were distributed as follows: Puget Sound (PS) 5%, Willamette/Lower Columbia (WLC) 11%, Interior Columbia (IC) 49%, Oregon Coast (OC) 33%, and Southern Oregon/Northern California Coasts (SONCC) 2% (Table 2). Most projects (95%) occurred in Oregon, no projects were in Idaho. Over half of all the actions reported involved fish passage restoration (Table 3), and often secondary actions such as instream wood or streambank restoration.

Table 2. USFWS and NOAA RC aquatic restoration actions in the Puget Sound (PS), Willamette/Lower Columbia (WLC), Interior Columbia (IC), Oregon Coast (OC), and Southern Oregon/Northern California Coasts (SONCC) recovery domains per year, 2010 to 2012. Data for this period only includes NOAA RC and USFWS in Oregon.

year	PS	WLC	IC	OC	SONCC
2010	1	3	5	11	0
2011	0	3	9	5	1
2012	2	1	17	5	0
Total	3	7	31	21	1

Table 3. USFWS and NOAA RC actions per category per year, 2010 to 2012, in Oregon and the Northwest, respectively.

Year	Fish Passage	Stream Channel Restoration	Streambank Restoration	Water Structure Removal	Floodplain Wetland, & Riparian	Estuary & Nearshore
2010	10	3	0	2	5	0
2011	9	5	0	3	1	0
2012	14	5	3	1	1	1
Total	33	13	3	6	7	1

In the recent past, the USFWS Idaho Partners Program has worked on very few aquatic restoration projects, but may be better prepared to increase its output under this opinion. The USFWS Washington Partners Program likely completes as many aquatic restoration projects as Oregon. Their Partners Program budgets are fairly similar. Over a 7-year period (FY 2006-2012) most of Washington Partners projects were in the PS recovery domain. About 23,325 feet of "instream habitat" was treated with projects that included the placement of instream structures such as large wood (LW) and engineered log jams (ELJ), culvert and bridge replacement, side- and off-channel habitat improvement, livestock fencing and watering facilities, fish ladders, and dike removal. In the IC domain, USFWS treated 300 feet of instream habitat in the Wenatchee River watershed. We estimate that the combined number of Partners Program aquatic restoration projects for the three-state region will nearly double under this opinion.

The docket for this consultation is on file at the Oregon Washington Coastal Area Office in Portland, Oregon.

1.3 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

USFWS and NOAA RC propose to fund or carry out 18 categories of aquatic restoration actions under the Programmatic Restoration Opinion for Joint Ecosystem Conservation by the Services (PROJECTS) program. The 18 project categories of action include:

Project Categories

1. Fish Passage Restoration (Stream Simulation Culvert and Bridge Projects; Headcut and Grade Stabilization; Fish Ladders; Irrigation Diversion Replacement/Relocation and Screen Installation/Replacement)
2. Large Wood (LW), Boulder, and Gravel Placement; Engineered Logjams (ELJ); Constructed Riffles, Porous Boulder Step Structures and Vanes; Gravel Augmentation; Tree Removal for LW Projects
3. Dam and Legacy Structure Removal
4. Fluvial Channel Reconstruction/Relocation
5. Off- and Side-Channel Habitat Restoration
6. Streambank Restoration
7. Set-Back or Removal of Existing Berms, Dikes, and Levees
8. Reduction/Relocation of Recreation Impacts
9. Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering
10. Piling and other Structure Removal
11. Shellfish Bed/Nearshore Habitat Restoration
12. In-channel Nutrient Enhancement
13. Road and Trail Erosion Control and Decommissioning
14. Juniper Removal
15. Bull Trout Protection
16. Beaver Habitat Restoration
17. Wetland Restoration
18. Tide/Flood Gate Removal, Replacement, or Retrofit

1.3.1 Proposed Design Criteria

USFWS and NOAA RC propose to apply the following PDC, in relevant part, to every action authorized under this opinion. Measures described under "Administration" apply to the USFWS and NMFS as they manage the PROJECTS program. PDC described under "General Construction" apply to actions that involve construction. PDC described under "Types of Action" are measures that apply to specific types of actions.

1.3.1.1 Program Administration

1. **Initial Rollout.** USFWS, NOAA RC, and NMFS will provide an initial rollout of this opinion for restoration program staff to ensure that these conditions are considered at the onset of each project, incorporated into all phases of project design, and that any constraints, such as the need for fish passage or hydraulic engineering, are resolved early on.
2. **Failure to Report May Trigger Reinitiation.** NMFS may recommend reinitiation of this consultation if USFWS or NOAA RC fails to provide full reports or host the joint-annual coordination meeting (See 11 and 12 below).
3. **Full Implementation Required.** Failure to comply with all applicable conditions for a specific project may invalidate protective coverage of ESA section 7(o)(2) regarding "take" of listed species, and may lead NMFS to a different conclusion regarding the effects of that project.
4. **Integration of PDC, Conservation Measures, and Terms and Conditions into Project Design and Contract Language.** The USFWS and NOAA RC shall incorporate appropriate aquatic and terrestrial conservation measures and PDC, along with any terms and conditions, into contract language, force-account implementation plans, cooperative agreements, or other agency-specific means of ensuring compliance.
5. **Restoration Review Team (RRT).** The following types of projects require RRT review prior to submission to NMFS for approval:
   a. Dam Removal
   b. Fluvial Channel Reconstruction/Relocation, which includes side channel projects when the proposed side channel will contain greater than 20% of the bankfull flow
   c. Tide/Flood Gate Replacement/Retrofit
   d. Precedent or policy setting actions, such as the application of new technology.

   The RRT will be comprised of a core group, including program managers from the USFWS Partners for Fish and Wildlife, Coastal, Fisheries, and Recovery programs, and the NOAA RC, plus a representative from NMFS Habitat Conservation Division, and a NMFS fish passage engineer. Additional technical experts (highly-skilled fisheries biologists, hydrologists, geomorphologists, soil scientists, or engineers) from these agencies will be recruited depending on the project to be reviewed.

   The reviews will help ensure that projects: 1) Meet the obligations set forth in this opinion; 2) are consistent with similar projects; 3) maximize ecological benefits of restoration and recovery projects; and 4) ensure consistent use and implementation of this opinion throughout the action area. RRT review may be delayed if an incomplete or substandard design is submitted for review and significant revision is necessary.[5]

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[5] NMFS completed the effects analysis for this opinion based on the actions as described in this section, with the application of all relevant general and activity-specific conservation measures, and on our review of the best available scientific information, and our past experience with similar types of actions. We did not assume the RRT review process would result in a further reduction of the short-term adverse effects of any particular project.

The RRT will keep a record of opinion clarifications and changes approved by NMFS. The RRT does not replace any existing review process, nor shall it slow down project implementation unless significant technical, policy, or program concerns with a particular restoration approach are identified. NMFS will not approve a project for inclusion under this programmatic unless the RRT has reviewed its design.

6. **Review and Approval.** Various levels of review and approval are required for projects covered under this opinion.
   a. USFWS and NOAA RC project managers will review each project to be covered under this opinion prior to submission of an action notification form to NMFS to ensure that project are:
      i. Within the present or historic range of an ESA-listed salmon, steelhead, or eulachon, or designated critical habitat.
      ii. May affect one of the 20 endangered or threatened species considered in this opinion, or their designated critical habitat.
      iii. The effects are likely to be within the range of effects considered in this opinion.
      iv. Activities not covered by this opinion include the following actions:
         1. Use of pesticide-treated wood, including pilings.
         2. Installation of a new tide gate.
         3. Conducting in-water work in the Willamette River downstream of Willamette Falls between Dec 1 and Jan 31.
         4. Any action that requires an environmental impact statement (EIS) under the National Environmental Policy Act (NEPA) if the EIS evaluates alternatives affecting listed species.
         5. Require any earthwork at an U.S. Environmental Protection Agency (EPA)-designated Superfund Site, a state-designated clean-up area, or in the likely impact zone of a significant contaminant source, as identified by historical information or best professional judgment.
   b. NMFS engineering will review and approve any project with any of the following elements, including any additional conservation measures necessary to ensure that the effects of those projects are within range of effects considered in this opinion:
      i. Modifications or variances of any PROJECTS requirement (PDC 7)
      ii. Fish screen for pump intake(s) to dewater at rate >3 cfs (PDC 27)
      iii. Installation of pilings (PDC 30)
      iv. Culverts and bridges that do not meet width standards (PDC 33c)
      v. Grade control, stream stability, or headcut countermeasures (PDC 33d.ii)
      vi. Fish ladders and channel-spanning non-porous structures (PDC 33e)
      vii. Irrigation diversion replacement/relocation (PDC 33f)
      viii. Fish screen installation/replacement (PDC 33f)
      ix. ELJs that occupy >25% of the bankfull area (PDC 34b)
      x. Constructed or engineered riffles (PDC 34c)
      xi. Dam removal projects (PDC 35a)
      xii. Fluvial channel reconstruction/relocation (PDC 36)
      xiii. Off- and side-channel reconstruction >20% of the bankfull flow (PDC 37)

xiv. Alluvium placement that occupies >25% of the channel bed or >25% of the bank full cross sectional area (PDC 38d)
xv. LW placement that occupies >25% of the bankfull cross section (PDC 38e)
xvi. Beach nourishment projects (PDC 43c)
xvii. Tide/flood gate removal, replacement or retrofit projects (PDC 50)

c. Projects that follow PDC in this opinion do not require NMFS approval, including:
    i. Culverts and bridges that meet width standards (PDC 33a-c)
    ii. LW, boulder, and gravel placement projects (PDC 34a&e)
    iii. ELJs that occupy less than 25% of the bankfull area (PDC 34b)
    iv. Porous boulder step structures and vanes (PDC 34d)
    v. Tree removal for LW projects (PDC 34f)
    vi. Removal of legacy structures (PDC 35b)
    vii. Off and side channel reconstruction projects when the proposed side channel will contain less than 20% of the bankfull flow (PDC 37)
    viii. Streambank restoration (PDC 38)
    ix. Set-back or removal of existing berms, dikes, and levees (PDC 39)
    x. Estuary restoration (PDC 39b)
    xi. Reduction/relocation of recreation impacts (PDC 40)
    xii. Livestock fencing, stream crossings and off-channel livestock watering facilities (PDC 41)
    xiii. Piling and other structure removal (PDC 42)
    xiv. Shellfish bed restoration (PDC 43a)
    xv. Replacing shoreline armoring (PDC 43b)
    xvi. In-channel nutrient enhancement (PDC 44)
    xvii. Road and trail erosion control and decommissioning (PDC 45)
    xviii. Juniper tree removal (PDC 46)
    xix. Bull trout protection measures (47)
    xx. Beaver in-channel structures and habitat restoration (PDC 48)
    xxi. Wetland restoration (PDC 49)
    xxii. Tide/flood gate removal (PDC 50)

7. **Minor Variance Process.** Because of the wide range of proposed activities and the natural variability within and between stream systems, some projects may necessitate minor variations from criteria specified herein. NMFS Branch Chiefs may grant minor variances, including exceptions to inwater work windows, when there is a clear conservation benefit or there are no additional adverse effects beyond those covered by this opinion. Minor variances may be requested as part of the above notification process and will:
    a. Cite the opinion identifying number
    b. Cite the relevant criterion by page number
    c. Define the requested variance
    d. Explain why the variance is necessary
    e. Provide a rationale why the variance will either provide a conservation benefit or, at a minimum, not cause additional adverse effects
    f. Include as attachments any necessary approvals by state agencies

8. **Site Access.** USFWS and NOAA RC will retain the right of reasonable access to each project site to monitor the use and effectiveness of these conditions.

9. **On-Site Documentation.** The following documentation will be posted at the project site or accessible in the area of work if not feasible to post:
   a. Name(s), phone number(s), and address(es) of the person(s) responsible for oversight will be posted at the work site.
   b. A description of hazardous materials that will be used, including inventory, storage, and handling procedures will be available on-site.
   c. Procedures to contain and control a spill of any hazardous material generated, used or stored on-site, including notification of proper authorities, will be readily available on-site.
   d. A standing order to cease work in the event of high flows (above those addressed in the design and implementation plans) or exceedance of water quality limits will be posted on-site.

10. **Monitoring and Reporting.** USFWS and NOAA RC will ensure that the following notifications and reports (Appendix A) are submitted to NMFS for each project to be completed under this opinion.
    All project notifications and reports are to be submitted electronically to NMFS at usfws.biop.nwr@noaa.gov or noaarc.biop.nwr@noaa.gov, including:
    a. Project notification 30-days or more before start of construction (Part 1).
    b. Project completion within 60-days of end of construction (Part 1 with Part 2 completed).
    c. Fish salvage within 60-days of work area isolation with fish capture (Part 1 with Part 3 completed).

11. **Annual Program Report.** USFWS and NOAA RC will each submit monitoring reports to NMFS by February 15 each year that describe efforts to carry out this opinion. The reports will include assessments of overall PROJECTS program activity, maps showing the locations and types of actions authorized and carried out under this opinion, and any other data or analyses the USFWS and NOAA RC deem necessary or helpful to assess habitat trends as a result of actions authorized under this opinion. USFWS and NOAA RC will each submit reports to NMFS by email at this address: usfws.biop.nwr@noaa.gov or noaarc.biop.nwr@noaa.gov, respectively. USFWS and NOAA RC will review the tracking information for all projects implemented in a given year to ensure the accuracy and completeness of the tracking record within 60 days of provision by NMFS. USFWS and NOAA RC will also provide a record of the addendum to this opinion for the previous year, including a summary of RRT Quarterly and Annual meetings.

12. **Annual Coordination Meeting.** USFWS and NOAA RC will attend a joint annual coordination meeting with NMFS by March 31 each year to discuss annual reports and any actions that can improve conservation under this opinion, or make the PROJECTS program more efficient or accountable.

1.3.1.2 Project Design Criteria - General Construction Measures

13. Project Design

a. Use the best available scientific information regarding the likely effects of climate change on resources in the project area, including projections of local stream flow and water temperature, to ensure that the project will be adaptable to those changes.

b. Obtain all applicable regulatory permits and official project authorizations before beginning construction.

c. Minimize the extent and duration of earthwork, *e.g.*, compacting, dredging, drilling, excavation, and filling.

  i. Avoid use of heavy equipment, vehicles or power tools below bankfull elevation unless project specialists determine such work is necessary, or will result in less risk of sedimentation or other ecological damage than work above that elevation.

  ii. Complete earthwork in wetlands, riparian areas, and stream channels as quickly as possible.

d. Cease project operations when high flows may inundate the project area, except for efforts to avoid or minimize resource damage.

14. Site Contamination Assessment

a. The level of detail and resources committed to such an assessment will be commensurate with the level and type of past or current development at the site. Assessments may include the following:

  i. Review available records, such as former site use, building plans, and records of any prior contamination events.

  ii. If the project site was used for industrial processes (*i.e.*, mining or manufacturing with chemicals), inspect to determine the environmental condition of the property.

  iii. Interview people who are knowledgeable about the site, *e.g.*, site owners, operators, and occupants, neighbors, or local government officials.

b. Retain contaminant survey information in the project file. Consult with NMFS if ground disturbance to accomplish the proposed project will potentially release contaminants to aquatic habitat that supports listed fish species.

15. Site Layout and Flagging

a. Before any significant ground disturbance or entry of mechanized equipment or vehicles into the construction area, clearly mark with flagging or survey marking paint the following areas:

  i. Sensitive areas, *e.g.*, wetlands, water bodies, ordinary high water, spawning areas

  ii. Equipment entry and exit points

  iii. Road and stream crossing alignments

  iv. Staging, storage, and stockpile areas

b. Before the use of herbicides, clearly flag no-application buffer zones.

16. Staging, Storage, and Stockpile Areas

a. Designate and use staging areas to store hazardous materials, or to store, fuel, or service heavy equipment, vehicles and other power equipment with tanks larger than 5 gallons, that are at least 150 feet from any natural water body or wetland, or on an established paved area, such that sediment and other contaminants from the staging area cannot be deposited in the floodplain or stream.

b. Natural materials that are displaced by construction and reserved for restoration, *e.g.*, LW, gravel, and boulders, may be stockpiled within the 100-year floodplain.

c. Dispose of any material not used in restoration and not native to the floodplain outside of the functional floodplain.

d. After construction is complete, obliterate all staging, storage, or stockpile areas, stabilize the soil, and revegetate the area.[6]

17. Erosion Control

a. Use site planning and site erosion control measures commensurate with the scope of the project to prevent erosion and sediment discharge from the project site.

b. Before significant earthwork begins, install appropriate, temporary erosion controls downslope to prevent sediment deposition in the riparian area, wetlands, or water body.

c. During construction, if eroded sediment appears likely to be deposited in the stream during construction, install additional sediment barriers as necessary.

d. Temporary erosion control measures may include fiber wattles, silt fences, jute matting, wood fiber mulch and soil binder, or geotextiles and geosynthetic fabric.

e. Soil stabilization utilizing wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil if the materials are noxious weed free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.

f. Remove sediment from erosion controls if it reaches 1/3 of the exposed height of the control.

g. Whenever surface water is present, maintain a supply of sediment control materials and an oil-absorbing floating boom at the project site.

h. Stabilize all disturbed soils following any break in work unless construction will resume within four days.

i. Remove temporary erosion controls after construction is complete and the site is fully stabilized.

18. Hazardous Material Spill Prevention and Control

a. At the project site:

   i. Post written procedures for notifying environmental response agencies, including an inventory and description of all hazardous materials present, and the storage and handling procedures for their use.

   ii. Maintain a spill containment kit, with supplies and instructions for cleanup and disposal, adequate for the types and quantity of hazardous materials present.

   iii. Train workers in spill containment procedures, including the location and use of the spill containment kits.

b. Temporarily contain any waste liquids generated under an impervious cover, such as a tarpaulin, in the staging area until the wastes can be properly transported to, and disposed of, at an approved receiving facility.

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[6] Road and path obliteration refers to the most comprehensive degree of decommissioning and involves decompacting the surface and ditch, pulling the fill material onto the running surface, and reshaping to match the original contour.

19. Equipment, Vehicles, and Power Tools

a. Select, operate and maintain all heavy equipment, vehicles, and power tools to minimize adverse effects on the environment, *e.g.*, low pressure tires, minimal hard-turn paths for track vehicles, use of temporary mats or plates to protect wet soils.
b. Before entering wetlands or working within 150 feet of a waterbody, replace all petroleum-based hydraulic fluids with biodegradable products.[7]
c. Invasive species prevention and control.
    i. Before entering the project site, power wash all heavy equipment, vehicles and power tools, allow them to fully dry, and inspect them to make certain no plants, soil, or other organic material is adhering to their surface.
    ii. Before entering the water, inspect any watercraft, waders, boots, or other gear to be used in or near water and remove any plants, soil, or other organic material adhering to the surface.
d. Inspect all equipment, vehicles, and power tools for fluid leaks before they leave the staging area.
e. Before operation within 150 feet of any waterbody, and as often as necessary during operation, thoroughly clean all equipment, vehicles, and power tools to keep them free of external fluids and grease and to prevent leaks and spills from entering the water.
f. Generators, cranes or other stationary heavy equipment operated within 150 feet of any waterbody will be maintained and protected as necessary to prevent leaks and spills from entering the water.

20. Temporary Access Roads and Paths

a. Whenever reasonable, use existing access roads and paths preferentially.
b. Minimize the number and length of temporary access roads and paths through riparian areas and floodplains.
c. Minimize removal of riparian vegetation.
d. When it is necessary to remove vegetation, cut at ground level (no grubbing).
e. Do not build temporary access roads or paths where grade, soil, or other features suggest slope instability.
f. Any road on a slope steeper than 30% will be designed by a civil engineer with experience in steep road design.
g. After construction is complete, obliterate all temporary access roads and paths, stabilize the soil, and revegetate the area.
h. Temporary roads and paths in wet areas or areas prone to flooding will be obliterated by the end of the in-water work window. Decompact road surfaces and drainage areas, pull fill material onto the running surface, and reshape to match the original contours.

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[7] For additional information and suppliers of biodegradable hydraulic fluids, motor oil, lubricant, or grease, see Environmentally Acceptable Lubricants by the U.S. EPA (2011); *e.g.*, mineral oil, polyglycol, vegetable oil, synthetic ester; Mobil® biodegradable hydraulic oils, Total® hydraulic fluid, Terresolve Technologies Ltd.® bio-based biodegradable lubricants, Cougar Lubrication® 2XT Bio engine oil, Series 4300 Synthetic Bio-degradable Hydraulic Oil, 8060-2 Synthetic Bio-Degradable Grease No. 2, *etc*. The use of trade, firm, or corporation names in this opinion is for the information and convenience of the action agency and applicants and does not constitute an official endorsement or approval by the U.S. Department of Commerce or NMFS of any product or service to the exclusion of others that may be suitable.

21. Dust Abatement

a. Employ dust abatement measures commensurate with soil type, equipment use, wind conditions, and the effects of other erosion control measures.
b. Sequence and schedule work to reduce the exposure of bare soil to wind erosion.
c. Maintain spill containment supplies on-site whenever dust abatement chemicals are applied.
d. Do not use petroleum-based products.
e. Do not apply dust-abatement chemicals, *e.g.*, magnesium chloride, calcium chloride salts, ligninsulfonate, within 25 feet of a water body, or in other areas where they may runoff into a wetland or water body.
f. Do not apply ligninsulfonate at rates exceeding 0.5 gallons per square yard of road surface, assuming a 50:50 solution of ligninsulfonate to water.

22. Temporary Stream Crossings

a. No stream crossing may occur at active spawning sites, when holding adult listed fish are present, or when eggs or alevins are in the gravel.
b. Do not place temporary crossings in areas that may increase the risk of channel re-routing or avulsion, or in potential spawning habitat, *e.g.*, pools and pool tailouts.
c. Minimize the number of temporary stream crossings; use existing stream crossings whenever reasonable.
d. Install temporary bridges and culverts to allow for equipment and vehicle crossing over perennial streams to access construction areas.
e. Wherever possible, vehicles and machinery will cross streams at right angles to the main channel.
f. Equipment and vehicles may cross the stream in the wet only where the streambed is bedrock where the streambed is naturally stable, or where mats or off-site logs are placed in the stream and used as a crossing.
g. Obliterate all temporary stream crossings as soon as they are no longer needed, and restore any damage to affected stream banks or channel.

23. Surface Water Withdrawal and Construction Discharge Water

a. Surface water may be diverted to meet construction needs, but only if developed sources are unavailable or inadequate.
b. Diversions may not exceed 10% of the available flow and will have a juvenile fish exclusion device that is consistent with NMFS' criteria (NMFS 2011a).[8]
c. Treat all construction discharge water using best management practices to remove debris, sediment, petroleum products, and any other pollutants likely to be present (*e.g.*, green concrete, contaminated water, silt, welding slag, sandblasting abrasive, grout cured less than 24 hours, drilling fluids), to ensure that no pollutants are discharged to any perennial or intermittent waterbody.

24. Fish Passage

a. Provide fish passage for any adult or juvenile ESA-listed fish likely to be present in the action area during construction, unless passage did not exist before construction, stream isolation and dewatering is required during project implementation, or the stream is naturally impassable at the time of construction.

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[8] National Marine Fisheries Service. 2011. Anadromous salmonid passage facility design. Northwest Region.

b. After construction, provide fish passage that meets NMFS' fish passage criteria for any adult or juvenile ESA-listed fish (NMFS 2011a), for the life of the action.

25. Timing of In-Water Work

a. The inwater work window will be identified as the limit to inwater construction specified in the project notification form. The construction schedule will conform to the windows established in Oregon, Washington, and Idaho by the Oregon Department of Fish and Wildlife (ODFW 2008), Washington Department of Fish and Wildlife (WDFW 2010), and Idaho Department of Fish and Game, respectively. Any exceptions to in-water work windows recommended by ODFW, WDFW, or IDFG will be approved by NMFS. In the Willamette River below Willamette Falls, the winter work window (December 1 – January 31) is not approved for actions under this opinion.

b. Hydraulic and topographic measurements and placement of LW, boulders, or gravel may be completed anytime, provided the affected area is not occupied by adult fish congregating for spawning, or in an area where redds are occupied by eggs or pre-emergent alevins.

26. Fisheries, Hydrology, Geomorphology, Wildlife, Botany, and Cultural Surveys in Support of Aquatic Restoration include assessments and monitoring projects that are associated with planning, implementation, and monitoring of aquatic restoration projects covered by this opinion. Such support projects may include surveys to document the following aquatic and riparian attributes: fish habitat, hydrology, channel geomorphology, water quality, fish spawning, fish presence[9], macroinvertebrates, riparian vegetation, wildlife, and cultural resources (including excavating test pits less than 1 m^2 in size). This also includes effectiveness monitoring associated with projects implemented under this opinion, provided the effectiveness monitoring is limited to the same survey techniques described in this section.

a. Train personnel in survey methods to prevent or minimize disturbance of fish. Contract specifications should include these methods where appropriate.

b. Avoid impacts to fish redds. When possible, avoid sampling during spawning periods.

c. Coordinate with other local agencies to prevent redundant surveys.

d. Locate excavated material from cultural resource test pits away from stream channels. Replace all material in test pits when survey is completed and stabilize the surface.

e. Does not include research projects that have or should obtain a permit pursuant to section 10(a) of the ESA.

27. Work Area Isolation

a. Isolate any work area within the wetted channel from the active stream whenever ESA-listed fish are reasonably certain to be present, or if the work area is less than 300 feet upstream from known spawning habitats. However, work area isolation may not always be necessary or practical in certain settings; *i.e.*, dry streambeds and tidal zones, respectively.

b. Engineering design plans for work area isolation will include all isolation elements.

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[9] Capture or enumeration by non-lethal techniques, *i.e.*, snorkel, minnow trapping; not hooking or electrofishing.

c. Dewater the shortest linear extent of work area practicable, unless wetted in-stream work is deemed to be minimally harmful to fish, and is beneficial to other aquatic species.[10]
    i. Use a coffer dam and a by-pass culvert or pipe, or a lined, non-erodible diversion ditch to divert flow around the dewatered area. Dissipate flow energy to prevent damage to riparian vegetation or stream channel and provide for safe downstream reentry for fish, preferably into pool habitat with cover.
    ii. Where gravity feed is not possible, pump water from the work site to avoid rewatering. Maintain a fish screen on the pump intake to avoid juvenile fish entrainment (NMFS 2011a).
    iii. Pump seepage water to a temporary storage and treatment site, or into upland areas, to allow water to percolate through soil or to filter through vegetation before reentering the stream channel with a treatment system comprised of either a hay bale basin or other sediment control device.
    iv. Monitor below the construction site to prevent stranding of aquatic organisms.
    v. When construction is complete, re-water the construction site slowly to prevent loss of surface flow downstream, and to prevent a release of suspended sediment.

d. Whenever a pump is used to dewater the isolation area and ESA-listed fish may be present, a fish screen will be used that meets the most current version of NMFS' fish screen criteria (NMFS 2011a). NMFS approval is required for pumping that exceeds 3 cfs.

28. Fish Capture and Release

a. If practicable, allow listed fish species to migrate out of the work area or remove fish before dewatering; otherwise remove fish from an exclusion area as it is slowly dewatered with methods such as hand or dip-nets, seining, or trapping with minnow traps (or gee-minnow traps).

b. Fish capture will be supervised by a qualified fisheries biologist, with experience in work area isolation and competent to ensure the safe handling of fish.

c. Conduct fish capture activities during periods of the day with the coolest air and water temperatures possible, normally early in the morning to minimize stress and injury of species present.

d. Monitor the nets frequently enough to ensure they stay secured to the banks and free of organic accumulation.

e. Electrofishing will be used during the coolest time of day, and only after other means of fish capture are determined to be not feasible or ineffective.
    i. Follow the most recent version of NMFS (2000) electrofishing guidelines.
    ii. Do not electrofish when the water appears turbid, *e.g.*, when objects are not visible at depth of 12 inches.
    iii. Do not intentionally contact fish with the anode.
    iv. Use direct current (DC) or pulsed direct current within the following ranges:

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[10] For instructions on how to dewater areas occupied by lamprey, see *Best management practices to minimize adverse effects to Pacific lamprey* (*Entosphenus tridentatus*) (USFWS 2010).

1. If conductivity is less than 100 µs, use 900 to 1100 volts.
2. If conductivity is between 100 and 300 µs, use 500 to 800 volts.
3. If conductivity greater than 300 µs, use less than 400 volts.

v. Begin electrofishing with a minimum pulse width and recommended voltage, then gradually increase to the point where fish are immobilized.

vi. Immediately discontinue electrofishing if fish are killed or injured, *i.e.*, dark bands visible on the body, spinal deformations, significant de-scaling, torpid or inability to maintain upright attitude after sufficient recovery time. Recheck machine settings, water temperature and conductivity, and adjust or postpone procedures as necessary to reduce injuries.

f. If buckets are used to transport fish:
   i. Minimize the time fish are in a transport bucket.
   ii. Keep buckets in shaded areas or, if no shade is available, covered by a canopy.
   iii. Limit the number of fish within a bucket; fish will be of relatively comparable size to minimize predation.
   iv. Use aerators or replace the water in the buckets at least every 15 minutes with cold clear water.
   v. Release fish in an area upstream with adequate cover and flow refuge; downstream is acceptable provided the release site is below the influence of construction.
   vi. Be careful to avoid mortality counting errors.

g. Monitor and record fish presence, handling, and injury during all phases of fish capture and submit a fish salvage report (Appendix A) to NMFS within 60 days of capture that documents date, time of day, fish handling procedures, air and water temperatures, and total numbers of each salmon, steelhead and eulachon handled, and numbers of ESA-listed fish injured or killed.

29. Invasive and non-native plant control

a. ***Non-herbicide methods.*** Limit vegetation removal and soil disturbance within the riparian zone by limiting the number of workers there to the minimum necessary to complete manual, mechanical, or hydro-mechanical plant control (*e.g.*, hand pulling, bending[11], clipping, stabbing, digging, brush-cutting, mulching, radiant heat, portable flame burner, super-heated steam, pressurized hot water, or hot foam (Arsenault *et al.* 2008; Donohoe *et al.* 2010))[12]. Do not allow cut, mowed, or pulled vegetation to enter waterways.

b. ***Herbicide Label.*** Herbicide applicators will comply with all label instructions.

c. ***Power equipment.*** Refuel gas-powered equipment with tanks larger than 5 gallons in a vehicle staging area placed 150-feet or more from any natural waterbody, or in an isolated hazard zone such as a paved parking lot.

d. ***Maximum herbicide treatment area.*** Do not exceed treating 10% of the acres of riparian habitat within a 6th-field HUC with herbicides per year.

e. ***Herbicide applicator qualifications.*** Herbicides may only be applied by an appropriately licensed applicator, or under the direct supervision of a licensed

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[11] Knotweed treatment pre-treatment; See Nickelson (2013).

[12] See http://ahmct.ucdavis.edu/limtask/equipmentdetails.html

applicator, using an herbicide specifically targeted for a particular plant species that will cause the least impact. The applicator will be responsible for preparing and carrying out the herbicide transportation and safely plan, as follows.

f. ***Herbicide transportation and safety plan.*** The applicator will prepare and carry out an herbicide safety/spill response plan to reduce the likelihood of spills or misapplication, to take remedial actions in the event of spills, and to fully report the event. Most knotweed (*Polygonum cuspidatum*, *P. sachalinense*, *P. polystachyum* and hybrids) patches are expected to have overland access. However, some sites may be reached only by water travel, either by wading or inflatable raft or kayak. The following measures will be used to reduce the risk of a spill during water transport: (a) No more than 2.5 gallons of glyphosate will be transported per person or raft, and typically it will be one gallon or less; (b) glyphosate will be carried in 1 gallon or smaller plastic containers. The containers will be wrapped in plastic bags and then sealed in a dry-bag. If transported by raft, the dry-bag will be secured to the watercraft.

g. ***Herbicides.*** The only herbicides allowed for use under this opinion are (some common trade names are shown in parentheses):[13]

   i. aquatic imazapyr (*e.g.*, Habitat)
   ii. aquatic glyphosate (*e.g.*, AquaMaster, AquaPro, Rodeo)
   iii. aquatic triclopyr-TEA (*e.g.*, Renovate 3)
   iv. chlorsulfuron (*e.g.*, Telar, Glean, Corsair)
   v. clopyralid (*e.g.*, Transline)
   vi. imazapic (*e.g.*, Plateau)
   vii. imazapyr (*e.g.*, Arsenal, Chopper)
   viii. metsulfuron-methyl (*e.g.*, Escort)
   ix. picloram (*e.g.*, Tordon)
   x. sethoxydim (*e.g.*, Poast, Vantage)
   xi. sulfometuron-methyl (*e.g.*, Oust, Oust XP)

h. ***Herbicide adjuvants.*** When recommended by the label, an approved aquatic surfactant or drift retardant can be used to improve herbicidal activity or application characteristics. Adjuvants that contain alky amine etholoxylates, *i.e.*, polyethoxylated tallow amine (POEA), alkylphenol ethoxylate (including alkyl phenol ethoxylate phosphate esters), or herbicides that contain these compounds are **not** covered by this opinion. The following product names are covered by this opinion:

   i. Agri-Dex
   ii. AquaSurf
   iii. Bond
   iv. Bronc Max
   v. Bronc Plus Dry-EDT
   vi. Class Act NG
   vii. Competitor
   viii. Cut Rate
   ix. Cygnet Plus
   x. Destiny HC
   xi. Exciter
   xii. Fraction
   xiii. InterLock
   xiv. Kinetic

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[13] The use of trade, firm, or corporation names in this opinion is for the information and convenience of the action agency and applicants and does not constitute an official endorsement or approval by the U.S. Department of Commerce or NMFS of any product or service to the exclusion of others that may be suitable.

xv. Level 7
xvi. Liberate
xvii. Magnify
xviii. One-AP XL
xix. Pro AMS Plus
xx. Spray-Rite
xxi. Superb HC
xxii. Tactic
xxiii. Tronic

i. ***Herbicide carriers.*** Herbicide carriers (solvents) are limited to water or specifically labeled vegetable oil. Use of diesel oil as an herbicide carrier is not covered by this opinion.
j. ***Dyes.*** Use a non-hazardous indicator dye (*e.g.*, Hi-Light or Dynamark) with herbicides within 100-feet of water. The presence of dye makes it easier to see where the herbicide has been applied and where or whether it has dripped, spilled, or leaked. Dye also makes it easier to detect missed spots, avoid spraying a plant or area more than once, and minimize over-spraying (SERA 1997).
k. ***Herbicide mixing.*** Mix herbicides and adjuvants, carriers, and/or dyes more than 150-feet from any perennial or intermittent waterbody to minimize the risk of an accidental discharge.
l. ***Tank Mixtures.*** The potential interactive relationships that exist among most active ingredient combinations have not been defined and are uncertain. Therefore, combinations of herbicides in a tank mix are not covered by this opinion.
m. ***Spill Cleanup Kit.*** Provide a spill cleanup kit whenever herbicides are used, transported, or stored. At a minimum, cleanup kits will include Material Safety Data Sheets, the herbicide label, emergency phone numbers, and absorbent material such as cat litter to contain spills.
n. ***Herbicide application rates.*** Apply herbicides at the lowest effective label rates.
o. ***Herbicide application methods.*** Apply liquid or granular forms of herbicides as follows:
    i. Broadcast spraying – hand held nozzles attached to back pack tanks or vehicles, or by using vehicle mounted booms.
    ii. Spot spraying – hand held nozzles attached to back pack tanks or vehicles, hand-pumped spray, or squirt bottles to spray herbicide directly onto small patches or individual plants.
    iii. Hand/selective – wicking and wiping, basal bark, fill ("hack and squirt"), stem injection, cut-stump.
    iv. Triclopyr – will not be applied by broadcast spraying.
    v. Keep the spray nozzle within four feet of the ground when applying herbicide. If spot or patch spraying tall vegetation more than 15 feet away from the high water mark (HWM), keep the spray nozzle within 6 feet of the ground.
    vi. Apply spray in swaths parallel towards the project area, away from the creek and desirable vegetation, *i.e.*, the person applying the spray will generally have their back to the creek or other sensitive resource.
    vii. Avoid unnecessary run off during cut surface, basal bark, and hack-squirt/injection applications.

p. ***Washing spray tanks.*** Wash spray tanks 300-feet or more away from any surface water.

q. ***Minimization of herbicide drift and leaching.*** Minimize herbicide drift and leaching as follows:

   i. Do not spray when wind speeds exceed 10 miles per hour, or are less than 2 miles per hour.
   ii. Be aware of wind directions and potential for herbicides to affect aquatic habitat area downwind.
   iii. Keep boom or spray as low as possible to reduce wind effects.
   iv. Increase spray droplet size whenever possible by decreasing spray pressure, using high flow rate nozzles, using water diluents instead of oil, and adding thickening agents.
   v. Do not apply herbicides during temperature inversions, or when air temperature exceeds 80 degrees Fahrenheit.
   vi. Wind and other weather data will be monitored and reported for all broadcast applications.

r. ***Rain.*** Do not apply herbicides when the soil is saturated or when a precipitation event likely to produce direct runoff to salmon bearing waters from the treated area is forecasted by the NOAA National Weather Service or other similar forecasting service within 48 hours following application. Soil-activated herbicides may follow label instructions. Do not conduct hack-squirt/injection applications during periods of heavy rainfall.

s. ***Herbicide buffer distances.*** Observe the following no-application buffer-widths, measured in feet, as map distance perpendicular to the bankfull elevation for streams, the upland boundary for wetlands, or the upper bank for roadside ditches. Widths are based on herbicide formula, stream type, and application method, during herbicide applications (Table 4). Before herbicide application begins, flag or mark the upland boundary of each applicable herbicide buffer to ensure that all buffers are in place and functional during treatment.

Table 4. Herbicide buffer distances by herbicide formula, stream type, and application method.

Herbicide	**No Application Buffer Width (feet)**					
	Streams and Roadside Ditches with flowing or standing water present and Wetlands			Dry Streams, Roadside Ditches, and Wetlands		
	Broadcast Spraying	Spot Spraying	Hand Selective	Broadcast Spraying	Spot Spraying	Hand Selective
Labeled for Aquatic Use						
Aquatic Glyphosate	100	waterline	waterline	50	None	none
Aquatic Imazapyr	100	15	waterline	50	None	none
Aquatic Triclopyr-TEA	**Not Allowed**	15	waterline	**Not Allowed**	None	none
Low Risk to Aquatic Organisms						
Imazapic	100	15	bankfull elevation	50	None	none
Clopyralid	100	15	bankfull elevation	50	None	none
Metsulfuron-methyl	100	15	bankfull elevation	50	None	none
Moderate Risk to Aquatic Organisms						
Imazapyr	100	50	bankfull elevation	50	15	bankfull elevation
Sulfometuron-methyl	100	50	5	50	15	bankfull elevation
Chlorsulfuron	100	50	bankfull elevation	50	15	bankfull elevation
High Risk to Aquatic Organisms						
Picloram	100	50	50	100	50	50
Sethoxydim	100	50	50	100	50	50

30. Piling Installation

a. Pilings may be placed with concrete, or steel round pile 24 inches in diameter or smaller, steel H-pile designated as HP24 or smaller, or untreated wood.[14]
b. When possible, use a vibratory hammer for piling installation.
c. When using an impact hammer to drive or proof steel piles, one of the following sound attenuation methods will be used to effectively dampen sound pressure waves in all areas to a single strike peak threshold of 206 decibels and, for cumulative strikes, a 187 decibel sound exposure level (SEL) in areas and times where fish are larger than 2 grams and a 183 decibel SEL in areas and times when fish are smaller than 2 grams:
    i. Completely isolate the pile from flowing water by dewatering the area around the pile.
    ii. If water velocity is 1.6 feet per second or less, surround the piling being driven by a confined or unconfined bubble curtain that will distribute

[14] An individual consultation and site-specific risk assessment are required for actions that propose the use of pilings made of treated wood, including chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), alkaline copper quaternary (ACQ-B and ACQ-D), ammoniacal copper citrate (CC), copper azole (CBA-A), copper dimethyldithiocarbamate (CDDC), borate preservatives, and oil-type wood preservatives, such as creosote, pentachlorophenol, and copper naphthenate.

small air bubbles around 100% of the piling perimeter for the full depth of the water column, as described in NMFS and USFWS (2006).[15]

iii. If water velocity is greater than 1.6 feet per second, surround the piling being driven by a confined bubble curtain (*e.g.*, a bubble ring surrounded by a fabric or non-metallic sleeve) that will distribute air bubbles around 100% of the piling perimeter for the full depth of the water column.

iv. **NMFS fish passage review and approval.** Provide NMFS information regarding the timing of in-water work, the number of impact hammer strikes per pile and the estimated time required to drive piles, hours per day pile driving will occur, depth of water, and type of substrate, hydroacoustic assumptions, and the pile type, diameter, and spacing of the piles.

31. Site Restoration

a. Restore any significant disturbance of riparian vegetation, soils, stream banks or stream channel.

b. Remove all project related waste; *e.g.*, pick up trash, sweep roadways in the project area to avoid runoff-containing sediment, *etc.*

c. Obliterate all temporary access roads, crossings, and staging areas.

d. Loosen soil in compacted areas when necessary for revegetation or infiltration.

e. Although no single criterion is sufficient to measure restoration success, the intent is that the following features should be present in the upland parts of the project area, within reasonable limits of natural and management variation:

   i. Human and livestock disturbance, if any, are confined to small areas necessary for access or other special management situations.

   ii. Areas with signs of significant past erosion are completely stabilized and healed, bare soil spaces are small and well-dispersed.

   iii. Soil movement, such as active rills and soil deposition around plants or in small basins, is absent or slight and local.

   iv. Native woody and herbaceous vegetation, and germination microsites, are present and well distributed across the site; invasive plants are minimal or absent.

   v. Plants have normal, vigorous growth form, and a high probability of remaining vigorous, healthy and dominant over undesired competing vegetation.

   vi. Plant litter is well distributed and effective in protecting the soil with little or no litter accumulated against vegetation as a result of active sheet erosion ("litter dams").

   vii. A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank/shoreline.

32. Revegetation

a. Plant and seed disturbed areas before or at the beginning of the first growing season after construction.

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[15] See also Wursig *et al.* (2000) and Longmuir and Lively (2001) for additional information on how to deploy an effective, economical bubble curtain.

b. Use a diverse assemblage of vegetation species native to the action area or region, including trees, shrubs, and herbaceous species. Vegetation, such as willow, sedge and rush mats, may be gathered from abandoned floodplains, stream channels, *etc.* When feasible, use vegetation salvaged from local areas scheduled for clearing due to development.
c. Use species that will achieve shade and erosion control objectives, including forb, grass, shrub, or tree species that are appropriate for the site and native to the project area or region.
d. Short-term stabilization measures may include use of non-native sterile seed mix if native seeds are not available, weed-free certified straw, jute matting, and similar methods.
e. Do not apply surface fertilizer within 50 feet of any wetland or water body.
f. Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
g. Do not use invasive or non-native species for site restoration.
h. Conduct post-construction monitoring and treatment to remove or control invasive plants until native plant species are well-established.

1.3.1.3 Project Design Criteria – Types of Restoration Actions

Projects within the 18 aquatic restoration activity categories will be designed and implemented to help restore watershed and coastal processes. These projects are designed to improve channel dimensions and stability, sediment transport and deposition, and riparian, wetland, floodplain and hydrologic functions, as well as water quality.

As such, these improvements may help address limiting factors related to spawning, rearing, and migration of ESA-listed fish species. Aquatic habitat restoration and enhancement projects are conducted within stream channels, adjacent riparian/floodplain areas, wetlands, nearshore coastal habitats, and uplands.

33. **Fish Passage Restoration** includes the following: total removal, replacement, or resetting of culverts or bridges; stabilizing headcuts and other channel instabilities; removing, relocating, constructing, repairing, or maintaining fish ladders; and replacing, relocating, or constructing fish screens and irrigation diversions. Such projects will take place where fish passage has been partially or completely eliminated.
    a. **Stream simulation culvert and bridge projects.** All road-stream crossing structures shall adhere to the most recent version of NMFS fish passage criteria (NMFS 2011a) located at: http://www.nwr.noaa.gov/publications/hydropower/ferc/fish-passage-design.pdf NMFS engineering review, if required, shall occur at the conceptual, post-modeling, and final design phases, which is approximated by 30%, 60%, and 90% designs.
    b. All road-stream crossing structures shall simulate stream channel conditions per industry design standards found in any one of the following:
        i. *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings* (USDA-Forest Service

2008) or the most recent version, located at: http://stream.fs.fed.us/fishxing/aop_pdfs.html

ii. *Part XII Fish Passage Design and Implementation, Salmonid Stream Habitat Restoration Manual* (California Department of Fish and Game 2009) or the most recent version, located at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=12512

iii. *Water Crossings Design Guidelines* (Barnard *et al.* 2013) or the most recent version), located at: http://wdfw.wa.gov/publications/01501/

c. **General road-stream crossing criteria**

i. Span

1. Span is determined by the crossing width at the proposed streambed grade.
2. Single span structures will maintain a clear, unobstructed opening above the general scour elevation that is at least as wide as 1.5 times the active channel width.
3. Multi-span structures will maintain clear, unobstructed openings above the general scour elevation (except for piers or interior bents) that are at least as wide as 2.2 times the active channel width.
4. Entrenched streams: If a stream is entrenched (entrenchment ratio of less than 1.4), the crossing width will accommodate the floodprone width. Floodprone width is the channel width measured at twice the maximum bankfull depth (Rosgen 1996).
5. Minimum structure span is 6ft.

ii. Scour Prism

1. Designs shall maintain the general scour prism, as a clear, unobstructed opening (*i.e.,* free of any fill, embankment, scour countermeasure, or structural material to include abutments, footings, and culvert inverts). No scour or stream stability countermeasure may be applied above the general scour elevation.
2. When bridge abutments are set back beyond the applicable criteria span they may be located above the general scour elevation.

iii. Embedment

1. All culvert footings and inverts shall be placed below the thalweg at a depth of 3 feet, or the Lower Vertical Adjustment Potential (LVAP) line, whichever is deeper.
    a. LVAP, as calculated in *Stream Simulation: An ecological approach to providing passage for aquatic organisms at road crossings* (USDA-Forest Service 2008)
2. In addition to embedment depth, embedment of closed bottom culverts shall be between 30% and 50% of the culvert rise.

iv. Bridges

1. Primary bridge structural elements will be concrete, metal, fiberglass, or untreated timber. The use of treated wood for bridge construction or replacement is not allowed under this opinion. Old railroad cars, which are commonly used as bridges, may have

treated wood decking. Sample for the presence of treatment chemicals and replace treated elements with untreated wood.

2. All concrete will be poured in the dry, or within confined waters not connected to surface waters, and will be allowed to cure a minimum of 7 days before contact with surface water as recommended by Washington State Department of Transportation (2010).
3. Riprap will not be placed within the bankfull width of the stream. Riprap may only be placed below bankfull height when necessary for protection of abutments and pilings. The amount and placement of riprap will not constrict the bankfull flow.
4. Temporary work bridges will also meet NMFS (2011a) (or the latest version).

v. **NMFS fish passage review and approval.** NMFS will review crossing structure designs if the span width is determined to be less than the criteria established above or if the design is inconsistent with criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a).

d. **Headcut and grade stabilization.** Headcuts (vertical off-sets in the streambed) often occur in meadow areas, where floodplain soils are fine textured. Headcuts may develop because of channel straightening, channel avulsion, or loss of riparian vegetation.

i. Methods

1. In streams with current or historical fish presence, provide fish passage over a stabilized headcut through use of morphologically appropriate grade control. This includes constructed riffles for riffle-pool morphologies, rough constructed riffles/ramps for plane bed morphologies, wood jams, rock bands, and boulder weirs for step-pool morphologies, and roughened channels for cascade morphologies as described in part ii below.
2. Grade control materials can include both rock and LW. Material shall not in any part consist of gabion baskets, sheet piles, concrete, articulated concrete blocks, or cable anchors.
3. Rock for structures shall be durable and of suitable quality to assure permanence in the climate in which it is to be used. Gravel sizing depends on the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading.
4. Short-term headcut stabilization (including emergency stabilization projects) may occur without associated fish passage measures. However, fish passage will be incorporated into the final headcut stabilization action and be completed during the first subsequent in-water work period.

ii. Grade Stabilization to Promote Fish Passage

1. **NMFS fish passage review and approval.** NMFS will review all projects containing grade control, stream stability, or headcut countermeasures that are proposed to promote fish passage.

2. Provide fish passage over grade control structures through use of constructed riffles for pool/riffle streams or a series of log or rock structures for step/pool channels. If LW and boulder placement is used for headcut stabilization, refer to Large Wood, Boulder, and Gravel Placement (PDC 34) below.
3. Construct structures in a 'V' or 'U' shape, oriented with the apex upstream, lower in the center to direct flows to the middle of channel.
4. Key structures into the stream bed to minimize structure undermining due to scour, preferably at least 2.5 times their exposure height. The structures should also be keyed into both banks—if feasible greater than 8 feet.
5. If several structures will be used in series, space them at the appropriate distances to promote fish passage of all life stages of native fish. Incorporate NMFS (2011a) fish passage criteria (jump height, pool depth, *etc.*) in the design of step structures. Recommended spacing should be no closer than the net drop divided by the channel slope (for example, a one-foot high step structure in a stream with a two-percent gradient will have a minimum spacing of 50-feet [1/0.02]).
6. Include gradated (cobble to fine) material in the rock structure material mix to help seal the structure/channel bed, thereby preventing subsurface flow and ensuring fish passage immediately following construction if natural flows are sufficient.
7. If a project involves the removal of multiple barriers on one stream or in one watershed over the course of a work season, remove the most upstream barrier first if possible.

e. **Fish Ladders**

i. **NMFS fish passage review and approval.** NMFS will review fishways designs for consistency with criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a).

ii. Design preference is based on project type, level of maintenance, and required monitoring essential for reliable fish passage.
Typical fishway designs include: (a) roughened channels/boulder step structures, (b) channel spanning concrete sills, (c) pool and chute, and (d) pool and weir fishways. Roughened channel and boulder step structure fishways consist of a graded mix of rock and sediment in an open channel that creates enough roughness and diversity to facilitate fish passage. NMFS' review will include any appurtenant facilities (*i.e.*, fish counting equipment, pit tag detectors, lighting, trash racks, attraction water) that may be included with the fish ladder design. See the most recent version of *Anadromous Salmonid Passage Facility Design* (NMFS 2011a) for guidelines and PDC.

iii. If a project involves the removal of multiple barriers on one stream or in one watershed over the course of a work season, remove the most upstream barrier first if possible.

f. **Irrigation diversion replacement/relocation and screen installation/ replacement**
   i. **NMFS fish passage review and approval.** NMFS will review irrigation diversion replacement/relocation and screen installation/ replacement projects for consistency with criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a).
   ii. Diversion structures—associated with points of diversion and future fish screens—will pass all life stages of threatened and endangered aquatic species that historically used the affected aquatic habitat.
   iii. Water diversion intake and return points will be designed (to the greatest degree possible) to prevent all native fish life stages from swimming or being entrained into the diversion.
   iv. NMFS fish screen criteria (NMFS 2011a) applies to Federally listed salmonid species under their jurisdiction. This includes screens in temporary and permanent pump intakes.
   v. All fish screens will be sized to match the irrigator's state water right or estimated historical water use, whichever is less.
   vi. Size of bypass structure should be big enough to pass steelhead kelt into the stream.
   vii. Abandoned ditches and other similar structures will be plugged or backfilled, as appropriate, to prevent fish from swimming or being entrained into them.
   viii. When making improvements to pressurized diversions, install a totalizing flow meter capable of measuring rate and duty of water use. For non-pressurized systems, install a staff gage or other measuring device capable of measuring instantaneous rate of water flow.
   ix. Conversion of instream diversions to groundwater wells will only be used in circumstances where there is an agreement to ensure that any surface water made available for instream flows is protected from surface withdrawal by another water user.
   x. For the removal of diversion structures constructed of local rock and dirt, the project sponsor will dispose of the removed material in the following manner:
      1. Material more than 60% silt or clay will be disposed in uplands, outside of the active floodplain.
      2. Material with more than 40% gravel will be deposited within the active floodplain, but not in wetlands.
      3. Material with more than 50% gravel and less than 30% fines (silt or clay) may be deposited below the OHW mark.

34. **Large Wood (LW), Boulder, and Gravel Placement** includes LW and boulder placement, ELJs, constructed riffles, porous boulder structures and vanes, gravel placement, and tree removal for LW projects. Such activities will occur in areas where channel structure is lacking due to past stream cleaning (LW removal), riparian timber harvest, and in areas where natural gravel supplies are low due to anthropogenic disruptions. These projects will occur in stream channels and adjacent floodplains to increase channel stability, rearing habitat, pool formation, spawning gravel deposition, channel complexity, hiding cover, low velocity areas, and floodplain function.

a. **Large wood and boulder projects**
   i. Place LW and boulders in areas where they would naturally occur and in a manner that closely mimics natural accumulations for that particular stream type. For example, boulder placement may not be appropriate in low-gradient meadow streams.
   ii. Structure types shall simulate disturbance events to the greatest degree possible and include, but are not limited to, log jams, debris flows, wind-throw, and tree breakage.
   iii. No limits are to be placed on the size or shape of structures as long as such structures are within the range of natural variability of a given location and do not block fish passage.
   iv. Projects can include grade control and streambank stabilization structures, while size and configuration of such structures will be commensurate with scale of project site and hydraulic forces.
   v. The partial burial of LW and boulders is permitted and may constitute the dominant means of placement. This applies to all stream systems but more so for larger stream systems where use of adjacent riparian trees or channel features is not feasible or does not provide the full stability desired.
   vi. LW includes whole conifer and hardwood trees, logs, and rootwads. LW size (diameter and length) should account for bankfull width and stream discharge rates. When available, trees with rootwads should be a minimum of 1.5x bankfull channel width, while logs without rootwads should be a minimum of 2.0 x bankfull widths.
   vii. Structures may partially or completely span stream channels or be positioned along stream banks.
   viii. Stabilizing or key pieces of LW will be intact, hard, with little decay, and if possible have root wads (untrimmed) to provide functional refugia habitat for fish. Consider orienting key pieces such that the hydraulic forces upon the LW increase stability.
   ix. Anchoring LW – Anchoring alternatives may be used in preferential order:
      1. Use of adequate sized wood sufficient for stability
      2. Orient and place wood in such a way that movement is limited
      3. Ballast (gravel or rock) to increase the mass of the structure to resist movement
      4. Use of large boulders as anchor points for the LW
      5. Pin LW with rebar to large rock to increase its weight. For streams that are entrenched (Rosgen F, G, A, and potentially B) or for other streams with very low width to depth ratios (less than 12) an additional 60% ballast weight may be necessary due to greater flow depths and higher velocities.
      6. Anchoring LW by cable is not allowed under this opinion.

b. **Engineered Logjams (ELJs)** are structures designed to redirect flow and change scour and deposition patterns.[16] While providing valuable fish and wildlife habitat, they are also designed to redirect flow and can provide stability to a streambank or downstream gravel bar. To the extent practical, ELJs are designed to simulate stable natural log jams and can be either naturally stable due to LW size and/or stream width or anchored in place using rebar, rock, or piles (driven into a dewatered area or the streambank, but not in water). They are also designed to create a hydraulic shadow, a low-velocity zone downstream that allows sediment to settle out and scour holes adjacent to the structure.

   i. **NMFS fish passage review and approval.** For ELJs that occupy greater than 25% of the bankfull area, NMFS will review the action for consistency with criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a).
   ii. ELJs will be patterned, to the greatest degree possible, after stable natural log jams.
   iii. Grade control ELJs are designed to arrest channel down-cutting or incision by providing a grade control that retains sediment, lowers stream energy, and increases water elevations to reconnect floodplain habitat and diffuse downstream flood peaks.
   iv. Stabilizing or key pieces of LW that will be relied on to provide streambank stability or redirect flows will be intact and solid (little decay). If possible, acquire LW with untrimmed rootwads to provide functional refugia habitat for fish.
   v. When available, trees with rootwads attached should be a minimum length of 1.5 times the bankfull channel width, while logs without rootwads should be a minimum of 2.0 times the bankfull width.
   vi. The partial burial of LW and boulders may constitute the dominant means of placement, and key boulders (footings) or LW can be buried into the streambank or channel.
   vii. Angle and offset – The LW portions of ELJ structures should be oriented such that the force of water upon the LW increases stability. If a rootwad is left exposed to the flow, the bole placed into the streambank should be oriented downstream parallel to the flow direction so the pressure on the rootwad pushes the bole into the streambank and bed.
   Wood members that are oriented parallel to flow are more stable than members oriented at 45 or 90 degrees to the flow.
   viii. If LW anchoring is required, a variety of methods may be used. These include buttressing the wood between riparian trees, or the use of manila, sisal, or other biodegradable ropes for lashing connections. If hydraulic conditions warrant use of structural connections, rebar pinning or bolted connections may be used. Rock may be used for ballast but is limited to that needed to anchor the LW.

[16] ELJs are defined as structures composed of LW with at least three key members incorporating the use of an anchoring system as defined in PDC 33.a.ix.

c. **Constructed riffles**
   i. **NMFS fish passage review and approval.** NMFS will review all constructed or engineered riffles for consistency with criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a).
   ii. Constructed riffles are to be constructed to allow upstream and downstream passage of all native fish species and life stages that occur in the stream. A low flow notch shall be constructed to concentrate flows in channels where minimum flows may restrict fish passage.
   iii. Constructed riffles will be constructed out of a well-graded gravel mix, including the appropriate level of fines, to allow for compaction for stability and sealing to ensure minimal loss of surface flow through the newly placed material.
   iv. Gravel sizing depends on the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading.
   v. The project designer or an inspector experienced in these structures should be present during installation.
   vi. To ensure that the structure is adequately sealed, surface flow must be present before equipment leaves the site.

d. **Porous boulder step structures and vanes**
   i. Full channel spanning boulder structures are to be installed only in highly uniform, incised, bedrock-dominated channels to enhance or provide fish habitat in stream reaches where log placements are not practicable due to channel conditions (not feasible to place logs of sufficient length, bedrock dominated channels, deeply incised channels, artificially constrained reaches, *etc.*), where damage to infrastructure on public or private lands is of concern, or where private landowners will not allow log placements due to concerns about damage to their streambanks or property.
   ii. Install boulder structures low in relation to channel dimensions so that they are completely overtopped during channel-forming flow events (approximately a 1.0- to 1.5-year flow event).
   iii. Boulder step structures are to be placed diagonally across the channel or in more traditional upstream pointing "V" or "U" configurations with the apex oriented upstream.
   iv. Boulder step structures are to be constructed to allow upstream and downstream passage of all native fish species and life stages that occur in the stream. Plunges shall be kept less than 6 inches in height.
   v. The use of gabions, cable, or other means to prevent the movement of individual boulders in a boulder step structure is not allowed.
   vi. Rock for boulder step structures shall be durable and of suitable quality to assure long-term stability in the climate in which it is to be used. Rock sizing depends on the size of the stream, maximum depth of flow, planform, entrenchment, and ice and debris loading.
   vii. The project designer or an inspector experienced in these structures should be present during installation.

viii. Full spanning boulder step structure placement should be coupled with measures to improve habitat complexity and protection of riparian areas to provide long-term inputs of LW.

e. **Gravel augmentation**

i. Gravel can be placed directly into the stream channel, at tributary junctions, or other areas in a manner that mimics natural debris flows and erosion.

ii. Augmentation will only occur in areas where the natural supply has been eliminated, significantly reduced through anthropogenic disruptions, or used to initiate gravel accumulations in conjunction with other projects, such as simulated log jams and debris flows.

iii. Gravel to be placed in streams shall be a properly sized gradation for that stream, clean alluvium with similar angularity as the natural bed material. When possible use gravel of the same lithology as found in the watershed. Reference *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings* (USDA-Forest Service 2008) to determine gravel sizes appropriate for the stream.

iv. Gravel can be mined from the floodplain at elevations above bankfull, but not in a manner that will cause stranding during future flood events.

v. Crushed rock is not permitted.

vi. After gravel placement in areas accessible to higher stream flow, allow the stream to naturally sort and distribute the material.

vii. Do not place gravel directly on bars and riffles that are known spawning areas, which may cause fish to spawn on the unsorted and unstable gravel, thus potentially resulting in redd destruction.

viii. Imported gravel will be free of invasive species and non-native seeds. If necessary, wash gravel prior to placement.

f. **Tree removal for LW projects**

i. Live conifers and other trees can be felled or pulled/pushed over for in-channel LW placement only when riparian zone tree stands are fully stocked[17] or over-stocked.[18] Tree felling shall not create excessive streambank erosion or increase the likelihood of channel avulsion during high flows.

ii. Danger trees and trees killed through fire, insects, disease, blow-down and other means can be felled and used for in-channel placement regardless of live-tree stocking levels.

iii. Trees may be removed by cable, ground-based equipment, horses or helicopters.

iv. Trees may be felled or pushed/pulled directly into a stream or floodplain.

v. Trees may be stock piled for future instream restoration projects.

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[17] Fully stocked stands – Stands in which all the growing space is effectively occupied but which still have ample room for development of the crop trees.

[18] Overstocked stands – Stands in which the growing space is so completely utilized that growth has slowed down and many trees, including dominants, are being suppressed.

vi. The project manager for an aquatic restoration action will coordinate with an USFWS wildlife biologist in tree-removal planning efforts.

35. **Dam and Legacy Structure Removal** includes removal of dams, channel-spanning weirs, legacy habitat structures, earthen embankments, subsurface drainage features, spillway systems, outfalls, pipes, instream flow redirection structures (*e.g.,* drop structure, gabion, groin), or similar devices used to control, discharge, or maintain water levels. Legacy structures include past projects, such as LW, boulder, rock gabions, and other in-channel and floodplain structures. Removal projects will be implemented to reconnect stream corridors, floodplains, and estuaries, reestablish wetlands, improve aquatic organism passage, and restore more natural channel and flow conditions. Instream water control structures that impound contaminated sediment are not covered by this opinion.

a. **Dam removal**

i. Design Review

1. **NMFS fish passage review and approval.** NMFS will review the action for consistency with criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a).
2. **Restoration Review Team (RRT).** The action will be reviewed by the RRT prior to submission to NMFS for approval.

ii. Project Documentation – At a minimum, the following information will be necessary for review:

1. A longitudinal profile of the stream channel thalweg for 20 channel widths downstream of the structure and 20 channel widths upstream of the reservoir area (outside of the influence of the structure) shall be used to determine the potential for channel degradation.
2. A minimum of three cross-sections – one downstream of the structure, one through the reservoir area upstream of the structure, and one upstream of the reservoir area (outside of the influence of the structure) to characterize the channel morphology and quantify the stored sediment.
3. Sediment characterization to determine the proportion of coarse sediment (greater than 2 mm) in the reservoir area.
4. A survey of any downstream spawning areas that may be affected by sediment released by removal of the water control structure or dam. Reservoirs with a d35 greater than 2 mm (*i.e.,* 65% of the sediment by weight exceeds 2 mm in diameter) may be removed without excavation of stored material, if the sediment contains no contaminants; reservoirs with a d35 less than 2 mm (*i.e.,* 65% of the sediment by weight is less than 2 mm in diameter) will require partial removal of the fine sediment to create a pilot channel, in conjunction with stabilization of the newly exposed streambanks with native vegetation.

iii. Design Guidance – If a project involves the removal of multiple barriers on one stream or in one watershed over the course of a work season, remove the most upstream barrier first if possible.

iv. Monitoring – Dams greater than 10-feet in height (measured at the upstream side of the structure at the approximate centerline of the stream) require a long-term monitoring and adaptive management plan that will be developed between the NMFS and the USFWS or NOAA RC.

b. **Removal of legacy structures**

i. Remove material not typically found within the stream or floodplain at project sites (*i.e.*, LW, boulders, concrete, *etc.*) from the 100-year floodplain.

ii. Materials (*i.e.*, LW and boulders.) typically found within the stream or floodplain at that site can be reused to implement habitat improvements described under the Large Wood, Boulder, and Gravel Placement (PDC 34) activity category in this opinion.

iii. If the structure being removed is keyed into the bank, fill in "key" holes with native materials to restore contours of streambank and floodplain. Compact the fill material adequately to prevent washing out of the soil during over-bank flooding. Do not mine material from the stream channel bed to fill in "key" holes.

iv. When removal of buried log structures may result in significant disruption to riparian vegetation or the floodplain, consider using a chainsaw to extract the portion of log within the channel and leaving the buried sections within the streambank.

v. If a project involves the removal of multiple barriers on one stream or in one watershed over the course of a work season, remove the most upstream barrier first if possible.

vi. If the legacy structures (log, rock, or gabion weirs) were placed to provide grade control, evaluate the site for potential headcutting and incision due to structure removal. If headcutting and channel incision are likely to occur due to structure removal, additional measures will be taken to reduce these impacts.

vii. If the structure is being removed because it has caused an over-widening of the channel, consider implementing other restoration categories to decrease the width to depth ratio of the stream to a level commensurate with the geomorphic setting.

36. **Fluvial Channel Reconstruction/Relocation** projects include reconstruction of existing stream channels through excavation and structure placement (LW and boulders) or relocation (rerouting of flow) into historical or newly constructed channels that are typically more sinuous and complex. This proposed action applies to stream systems that have been straightened, channelized, dredged, or otherwise modified for the purpose of flood control, increasing arable land, realignment, or other land use management goals, or for streams that are incised or otherwise disconnected from their floodplains due to watershed disturbances. For tidal wetland and estuarine projects, refer to PDCs 39.b and 49.

a. **General project design criteria**
    i. Design Review
        1. **NMFS fish passage review and approval.** NMFS will review the action for consistency with criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a).
        2. **Restoration Review Team (RRT).** The action will be individually reviewed by the RRT prior to submission to NMFS for approval.
    ii. Design Guidance
        1. Construct geomorphically appropriate stream channels and floodplains within a watershed and reach context.
        2. Design actions to restore floodplain characteristics—elevation, width, gradient, length, and roughness—in a manner that closely mimics, to the extent possible, those that will naturally occur at that stream and valley type.
        3. To the greatest degree possible, remove nonnative fill material from the channel and floodplain to an upland site.
        4. When necessary, loosen compacted soils once overburden material is removed. Overburden or fill comprised of native materials, which originated from the project area, may be used within the floodplain where appropriate to support the project goals and objectives.
        5. Structural elements shall fit within the geomorphic context of the stream system. For bed stabilization and hydraulic control structures, constructed riffles shall be preferentially used in pool-riffle stream types, while roughened channels and boulder step structures shall be preferentially used in step-pool and cascade stream types.
        6. Material selection (LW, rock, gravel) shall also mimic natural stream system materials.
        7. Construction of the streambed should be based on Stream Simulation Design principles as described in section 6.2 of *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings* (USDA-Forest Service 2008) or other appropriate design guidance documents (see PDC 33b).

b. **Project documentation.** Provide NMFS and the RRT with the following documentation:
    i. Background and problem statement
        1. Site history
        2. Environmental baseline
        3. Problem description
        4. Cause of problem
    ii. Project description
        1. Goals/objectives
        2. Project elements
        3. Sequencing, implementation

4. Recovery trajectory: how does it develop and evolve?

iii. Design analysis
   1. Technical analyses
   2. Computations relating design to analysis
   3. References

iv. River Restoration Analysis Tool. The River Restoration Analysis Tool (restorationreview.com) was created to assist with design and monitoring of aquatic restoration projects. The following questions taken from the tool will be addressed in the project documentation:
   1. Problem Identification
      a. Is the problem identified?
      b. Are causes identified at appropriate scales?
   2. Project Context
      a. Is the project identified as part of a plan, such as a watershed action plan or recovery plan?
      b. Does the project consider ecological, geomorphic, and socioeconomic context?
   3. Goals & Objectives
      a. Do goals and objectives address problem, causes, and context?
      b. Are objectives measurable?
   4. Alternatives/Options Evaluation
      a. Were alternatives/options considered?
      b. Are uncertainties and risk associated with selected alternative acceptable?
   5. Project Design
      a. Do project elements collectively support project objectives?
      b. Are PDC defined for all project elements?
      c. Do project elements work with stream processes to create and maintain habitat?
      d. Is the technical basis of design sound for each project element?
   6. Implementation
      a. Are plans and specifications sufficient in scope and detail to execute the project?
      b. Does plan address potential implementation impacts and risks?
   7. Monitoring & Management
      a. Does monitoring plan address project compliance?
      b. Does monitoring plan directly measure project effectiveness?

c. **Monitoring.** Develop a monitoring and adaptive plan that has been reviewed and approved by the RRT and NMFS 30 days prior to the planned start of construction. The plan will include the following:
   i. Introduction
   ii. Existing Monitoring Protocols

    iii. Project Effectiveness Monitoring Plan
        1. Immediately upon completion of the new channel construction, the contractor shall survey the project and provide as-built monitoring data, which will be supplied to NMFS and the RRT for review. This survey will compare as-built metrics to proposed design metrics on channel length, substrate size, residual pool depth, pieces of LW, *etc.*
    iv. Project Review Team Triggers
    v. Monitoring Frequency, Timing, and Duration
    vi. Monitoring Technique Protocols
    vii. Data Storage and Analysis
    viii. Monitoring Quality Assurance Plan
    ix. Literature cited

37. **Off- and Side-Channel Habitat Restoration** projects will be implemented to reconnect historical side-channels with floodplains by removing off-channel fill and plugs. Furthermore, new side-channels and alcoves can be constructed in geomorphic settings that will accommodate such features. This activity category typically applies to areas where side channels, alcoves, and other backwater habitats have been filled or blocked from the main channel, disconnecting them from most if not all flow events.

a. **NMFS fish passage review and approval.** When a proposed side channel will contain greater than 20% of the bankfull flow,[19] the action will be reviewed by the RRT and reviewed and approved by NMFS for consistency with NMFS (2011a) *Anadromous Salmonid Passage Facility Design* criteria.
b. **Data requirements.** Data requirements and analysis for off- and side-channel habitat restoration include evidence of historical channel location, such as land use surveys, historical photographs, topographic maps, remote sensing information, or personal observation.
c. **Allowable excavation.** Off- and side-channel improvements can include minor excavation (less than or equal to 10% of volume) of naturally accumulated sediment within historical channels, *i.e.,* based on the OHW level as the elevation datum. The calculation of the 10% excavation volume does not include manually placed fill, such as dikes, berms, or earthen plugs (see PDC 39). There is no limit as to the amount of excavation of anthropogenic fill within historical side channels as long as such channels can be clearly identified through field or aerial photographs. Excavation depth will not exceed the maximum thalweg depth in the main channel. Excavated material removed from off- or side-channels shall be hauled to an upland site or spread across the adjacent floodplain in a manner that does not restrict floodplain capacity.

38. **Streambank Restoration**

a. The following streambank stabilization methods may be used individually or in combination:
    i. Alluvium placement
    ii. LW placement
    iii. Roughened toe

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[19] Large side channels projects are essentially channel construction projects if they contain more than 20% of flow.

    iv. Woody plantings
    v. Herbaceous cover, in areas where the native vegetation does not include trees or shrubs
    vi. Bank reshaping and slope grading
    vii. Coir logs
    viii. Deformable soil reinforcement
    ix. Engineered log jams (ELJ)
    x. Floodplain flow spreaders
    xi. Floodplain roughness
b. For more information on the above methods see Federal Emergency Management Agency (2009)[20] or Cramer *et al.* (2003).[21] Other than those methods relying solely upon woody and herbaceous plantings, streambank stabilization projects should be designed by a qualified engineer that is appropriately registered in the state where the work is performed.
c. Rock will not be used for streambank restoration, except as ballast to stabilize LW. Stream barbs and full-spanning weirs are not allowed for stream bank stabilization under this opinion.
d. **Alluvium Placement** can be used as a method for providing bank stabilization using imported gravel/cobble/boulder-sized material of the same composition and size as that in the channel bed and banks to halt or attenuate streambank erosion, stabilize riffles, and provide critical spawning substrate for native fish. This method is predominantly for use in small to moderately sized channels and is not appropriate for application in mainstem systems. These structures are designed to provide roughness, redirect flow, and provide stability to adjacent streambed and banks or downstream reaches, while providing valuable fish and wildlife habitat.
    i. **NMFS fish passage review and approval.** NMFS will review alluvium placement projects that occupy more than 25% of the channel bed or more than 25% of the bankfull cross sectional area.
    ii. This design method is only approved in those areas where the natural sediment supply has been eliminated, significantly reduced through anthropogenic disruptions, or used to initiate or simulate sediment accumulations in conjunction with other structures, such as LW placements and ELJs.
    iii. Material used to construct the toe should be placed in a manner that mimics attached longitudinal bars or point bars.
    iv. Size distribution of toe material will be diverse and predominately comprised of D_{84} to D_{max} size class material.
    v. Spawning gravels will constitute at least one-third of the total alluvial material used in the design.
    vi. Spawning gravels are to be placed at or below an elevation consistent with the water surface elevation of a bankfull event.

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[20] http://www.fema.gov/pdf/about/regions/regionx/Engineering_With_Nature_Web.pdf

[21] http://wdfw.wa.gov/publications/00046/wdfw00046.pdf

vii. Spawning size gravel can be used to fill the voids within toe and bank material and placed directly onto stream banks in a manner that mimics natural debris flows and erosion.

viii. All material will be clean alluvium with similar angularity as the natural bed material. When possible use material of the same lithology as found in the watershed. Reference *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings* (USDA-Forest Service 2008) to determine gravel sizes appropriate for the stream.

ix. Material can be mined from the floodplain at elevations above bankfull, but not in a manner that will cause stranding during future flood events.

x. Crushed rock is not permitted.

xi. After placement in areas accessible to higher stream flow, allow the stream to naturally sort and distribute the material.

xii. Do not place material directly on bars and riffles that are known spawning areas, which may cause fish to spawn on the unsorted and unstable gravel, thus potentially resulting in redd destruction.

xiii. Imported material will be free of invasive species and non-native seeds. If necessary, wash prior to placement.

e. **Large Wood Placements** are defined as structures composed of LW that do not use mechanical methods as the means of providing structure stability (*i.e.*, large rock, rebar, rope, cable, *etc.*). The use of native soil, run of alluvium, wood, or buttressing with adjacent trees as methods for providing structure stability are authorized. This method is predominantly for use in small to moderately sized channels and is not appropriate for application in mainstem systems. These structures are designed to provide roughness, redirect flow, and provide stability to adjacent streambed and banks or downstream reaches, while providing valuable fish and wildlife habitat.

i. **NMFS Review and Approval.** NMFS will review LW placement projects that would occupy greater than 25% of the bankfull cross section area.

ii. Structure shall simulate disturbance events to the greatest degree possible and include, but not be limited to, log jams, debris flows, wind-throw, and tree breakage.

iii. Structures may partially or completely span stream channels or be positioned along stream banks.

iv. Where structures partially or completely span the stream channel LW should be comprised of whole conifer and hardwood trees, logs, and rootwads. LW size (diameter and length) should account for bankfull width and stream discharge rates.

v. Structures will incorporate a diverse size (diameter and length) distribution of rootwad or non-rootwad, trimmed or untrimmed, whole trees, logs, snags, slash, *etc.*

vi. For individual logs that are completely exposed, or embedded less than half their length, logs with rootwads should be a minimum of 1.5 times bankfull channel width, while logs without rootwads should be a minimum of 2.0 times bankfull width.

vii. Consider orienting key pieces such that the hydraulic forces upon the LW increase stability.

f. **Roughened toe**

i. Minimum amount of wood incorporated into the treated area, for mitigation of riprap, is equal to the number of whole trees whose cumulative summation of rootwad diameters is equal to 80% of linear-feet of treated streambank.

g. **Engineered log jams**

i. See PDC 34b.

h. If LW mechanical anchoring is required, a variety of methods may be used. These include large angular rock, buttressing the wood between adjacent trees, or the use of manila, sisal or other biodegradable ropes for lashing connections. If hydraulic conditions warrant use of structural connections, rebar pinning or bolted connections may be used. Use of cable is not covered by this opinion.

i. When a hole in the channel bed caused by local scour will be filled with rock to prevent damage to a culvert, road, or bridge foundation, the amount of rock will be limited to the minimum necessary to protect the integrity of the structure.

j. When a footing, facing, head wall, or other protection will be constructed with rock to prevent scouring or down-cutting of, or fill slope erosion or failure at, an existing culvert or bridge, the amount of rock used will be limited to the minimum necessary to protect the integrity of the structure. Whenever feasible, include soil and woody vegetation as a covering and throughout the structure.

k. Use a diverse assemblage of vegetation species native to the action area or region, including trees, shrubs, and herbaceous species. Vegetation, such as willow, sedge and rush mats, may be gathered from abandoned floodplains, stream channels, *etc.*

l. Do not apply surface fertilizer within 50 feet of any stream channel.

m. Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.

n. Conduct post-construction monitoring and treatment or removal of invasive plants until native plant species are well established.

39. **Set-Back or Removal of Existing Berms, Dikes, and Levees** will be conducted to reconnect historical fresh-water deltas to inundation, stream channels with floodplains, and historical estuaries to tidal influence. Such projects will take place where estuaries and floodplains have been disconnected from adjacent rivers through drain pipes and anthropogenic fill.

a. **Floodplains and freshwater deltas**

i. Design actions to restore floodplain characteristics—elevation, width, gradient, length, and roughness—in a manner that closely mimics, to the extent possible, those that would naturally occur at that stream and valley type.

ii. Remove drain pipes, fences, and other capital projects to the extent possible.

iii. To the extent possible, remove nonnative fill material from the floodplain to an upland site.

iv. Where it is not possible to remove or set-back all portions of dikes and berms, or in areas where existing berms, dikes, and levees support abundant riparian vegetation, openings will be created with breaches. Breaches shall be equal to or greater than the active channel width to reduce the potential for channel avulsion during flood events. In addition to other breaches, the berm, dike, or levee shall always be breached at the downstream end of the project or at the lowest elevation of the floodplain to ensure the flows will naturally recede back into the main channel, thus minimizing fish entrapment.

v. When necessary, loosen compacted soils once overburden material is removed. Overburden or fill comprised of native materials, which originated from the project area, may be used within the floodplain to create set-back dikes and fill anthropogenic holes provided that floodplain function is not impeded.

b. **Estuary restoration**

i. Project implementation shall be conducted in a sequence that will not preclude repairing or restoring estuary functions once dikes/levees are breached and the project area is flooded.

ii. Culverts and tide gates will be removed using the PDC and conservation measures, where appropriate, as described in Work Area Isolation (PDC 27), Surface Water Withdrawals (PDC 23), and Fish Capture and Release (PDC 28) and Fish Passage Restoration (PDC 33) above.

iii. Temporary roads within the project area should be removed to allow free flow of water. Material either will be placed in a stable area above the ordinary high water line or highest measured tide or be used to restore topographic variation in wetlands.

iv. To the extent possible, remove segmented drain tiles placed to drain wetlands. Fill generated by drain tile removal will be compacted back into the ditch created by removal of the drain tile.

v. Channel construction may be done to recreate channel morphology based on aerial photograph interpretation, literature, topographic surveys, and nearby undisturbed channels. Channel dimensions (width and depth) are based on measurements of similar types of channels and the drainage area. In some instances, channel construction is simply breaching the levee. For these sites, further channel development will occur through natural processes.

vi. Fill ditches constructed and maintained to drain wetlands. Some points in an open ditch may be over-filled, while other points may be left as low spots to enhance topography and encourage sinuosity of the developing channel.

40. **Reduction/Relocation of Recreation Impacts** is intended to close, better control, or relocate recreation infrastructure and use along streams/shorelines/estuaries and within riparian areas. This includes removal, improvement, or relocation of infrastructure associated with designated campgrounds, dispersed camp sites, day-use sites, foot trails, and off-road vehicle roads/trails in riparian areas.

a. Design remedial actions to restore floodplain characteristics—elevation, width, gradient, length, and roughness—in a manner that closely mimics, to the extent possible, those that would naturally occur at that stream and valley type.
b. To the extent possible, non-native fill material shall be removed from the floodplain to an upland site.
c. Overburden or fill comprised of native materials, which originated from the project area, can be used to reshape the floodplain, placed in small mounds on the floodplain, used to fill anthropogenic holes, buried on site, or disposed into upland areas.
d. For recreation relocation projects—such as campgrounds, horse corrals, off-road vehicle trails—move current facilities out of the riparian area or as far away from the stream/shoreline as possible.
e. Consider de-compaction of soils and vegetation planting once overburden material is removed.
f. Place barriers—boulders, fences, gates, *etc.*—outside of the bankfull width and across traffic routes to prevent off-road vehicle access into and across streams.
g. For work conducted on off-road vehicle roads and trails, follow relevant PDC in Road and Trail Erosion Control and Decommissioning (PDC 45) below.

41. **Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering Facility** projects will be implemented by constructing fences to exclude riparian grazing, providing controlled access for walkways that livestock use to transit across streams and through riparian areas, and reducing livestock use in riparian areas and stream channels by providing upslope water facilities.

a. **Livestock fencing**
    i. To the extent possible, fences will be placed outside the channel migration zone and allow for lateral stream movement.
    ii. Minimize vegetation removal, especially potential LW recruitment sources, when constructing fence lines.
    iii. Where appropriate, construct fences at water gaps in a manner that allows passage of LW and other debris.

b. **Livestock stream crossings**
    i. The number of crossings will be minimized.
    ii. Locate crossings or water gaps where streambanks are naturally low. Livestock crossings or water gaps will not be located in areas where compaction or other damage can occur to sensitive soils and vegetation (*e.g.*, wetlands) due to congregating livestock.
    iii. To the extent possible, crossings will not be placed in areas where ESA-listed species spawn or are suspected of spawning (*e.g.*, pool tailouts where spawning may occur), or within 300-feet upstream of such areas.
    iv. Existing access roads and stream crossings will be used whenever possible, unless new construction will result in less habitat disturbance and the old trail or crossing is retired.
    v. Access roads or trails will be provided with a vegetated buffer that is adequate to avoid or minimize runoff of sediment and other pollutants to surface waters.

vi. Essential crossings will be designed and constructed or improved to handle reasonably foreseeable flood risks, including associated bedload and debris, and to prevent the diversion of streamflow out of the channel and down the trail if the crossing fails.

vii. If necessary, the streambank and approach lanes can be stabilized with native vegetation or angular rock to reduce chronic sedimentation. The stream crossing or water gap should be armored with sufficient sized rock (*e.g.*, cobble-size rock) and use angular rock if natural substrate is not of adequate size.

viii. Livestock crossings will not create barriers to the passage of adult and juvenile fish. Whenever a culvert or bridge—including bridges constructed from flatbed railroad cars, boxcars, or truck flatbeds—is used to create the crossing, the structure width will tier to project design criteria listed for Stream Simulation Culvert and Bridge Projects under Fish Passage Restoration (PDC 33).

ix. Stream crossings and water gaps will be designed and constructed to a width of 10 to 15 feet in the upstream-downstream direction to minimize the time livestock will spend in the crossing or riparian area.

x. When using pressure treated lumber for fence posts, complete all cutting/drilling offsite (to the extent possible) so that treated wood chips and debris do not enter water or flood prone areas.

xi. Riparian fencing is not to be used to create livestock handling facilities.

c. **Off-channel livestock watering facilities**

i. The development of a spring is not allowed if the spring is occupied by ESA-listed species.

ii. Water withdrawals will not dewater habitats or cause low stream flow conditions that could affect ESA-listed fish. Withdrawals may not exceed 10% of the available flow.

iii. Troughs or tanks fed from a stream or river will have an existing valid water right. Surface water intakes will be screened to meet the most recent version of NMFS fish screen criteria in *Anadromous Salmonid Passage Facility Design* (NMFS 2011a), be self-cleaning, or regularly maintained by removing debris buildup. A responsible party will be designated to conduct regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning.

iv. Place troughs far enough from a stream or surround with a protective surface to prevent mud and sediment delivery to the stream. Avoid steep slopes and areas where compaction or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock.

v. Ensure that each livestock water development has a float valve or similar device, a return flow system, a fenced overflow area, or similar means to minimize water withdrawal and potential runoff and erosion.

vi. Minimize removal of vegetation around springs and wet areas.

vii. When necessary, construct a fence around the spring development to prevent livestock damage.

42. **Piling and Other Structure Removal** includes the removal of untreated and chemically treated wood pilings, piers, vessels, boat docks, derelict fishing gear, as well as similar structures comprised of plastic, concrete, and other material. Pilings and other structures occur in estuaries, lakes, floodplains, and rivers, and are typically used in association with boat docks, structures, and other facilities.

   a. **When removing an intact pile**
      i. Install a floating surface boom to capture floating surface debris.
      ii. To the extent possible, keep all equipment (*e.g.*, bucket, steel cable, vibratory hammer) out of the water, grip piles above the waterline, and complete all work during low water and low current conditions.
      iii. Dislodge the piling with a vibratory hammer, whenever feasible. Never intentionally break a pile by twisting or bending.
      iv. Slowly lift piles from the sediment and through the water column.
      v. Place chemically-treated piles in a containment basin on a barge deck, pier, or shoreline without attempting to clean or remove any adhering sediment. A containment basin for the removed piles and any adhering sediment may be constructed of durable plastic sheeting with sidewalls supported by hay bales or another support structure to contain all sediment and return flow which may otherwise be directed back to the waterway.
      vi. After piling removal, fill the holes left with clean, native sediments from the project area.
      vii. Dispose of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

   b. **When removing a broken pile**
      i. If a pile breaks above the surface of uncontaminated sediment, or less than 2 feet below the surface, make every attempt short of excavation to remove it entirely. If the pile cannot be removed without excavation, drive the pile deeper if possible.
      ii. If dredging is likely in the area of piling removal, use a GPS (global positioning device) to note the location of all broken piles for future use in site debris characterization.

43. **Shellfish Bed/Nearshore Habitat Restoration** may involve shellfish bed restoration, replacing shore line armoring, and providing beach nourishment. An example of a sustainable restoration action might include restoration of sediment input to a nearshore by removing bulkheads at historical feeder bluff sites, thereby allowing gradual and ongoing erosion/mass wasting of bluffs and LW recruitment, instead of one-time beach nourishment. This opinion does not cover projects where the sole objective is to protect upland property or to cap contaminants.

   a. **Shellfish bed restoration**
      i. Shell or other substance used for substrate enhancement will be procured from clean sources that do not deplete the existing supply of shell bottom. Shells should be steam cleaned, left on dry land for a minimum of one month, or both, before placement in the aquatic environment. Shells from the local area should be used whenever possible.

ii. When placing shell substrate, juveniles, adults, or spat-on-shell in areas occupied by submerged aquatic vegetation, there will be an implementation plan submitted, detailing existing condition, density, and spatial extent of eelgrass; and proposed planting density and anticipated effects on eelgrass density and long-term viability. The implementation plan will provide reasonable assurances that submerged aquatic vegetation (SAV) will not be significantly affected, that there will be a net environmental benefit resulting from the action, or both.
iii. Molluscan shellfish and any co-planted submerged aquatic vegetation used for restoration will be species native to the project area.

b. **Replacing shoreline armoring** with more ecological designs to protect property, instead of riprap and traditional bulkheads. Project selection will require accurate assessment of existing conditions, erosion risks, and patterns of future degradation.
    i. Conduct a site assessment describing the conditions that created the need for the project and the mechanisms that underlie it. Site assessments also describe the natural resources and the human infrastructure within the project area and their respective risks. Effective project plans also will consider how the project fits in a broader geomorphologic and ecosystem context, the process unit. Alternatives to "hard armor" might include:
        1. Restoration of original shore geometry (bulkhead removal or setback)
        2. Beach nourishment (gravel beach design) when the goal of importing sediment is to reduce wave energy to the upper beach
        3. Grade control/slope support with large wood and/or rock
        4. Wood revetment or wood/rock revetment
        5. Biotechnical slope support (vegetated geogrids, soil pillows, *etc.*).[22]
    ii. Restrict plantings to native vegetation.

c. **Beach nourishment.** Projects may use sediment harvested during already permitted dredging activities and/or gravel from upland sources. Sediment is either trucked or barged in and placed in the high tide zone of the beach. There it is likely to be subsequently reworked and redistributed by wave action. Sustainable restoration efforts restore processes, not just specific elements or site characteristics that cannot be replenished naturally. The goal is to use indigenous materials to mimic natural processes, with the expectation that the nourished beach will perform much as a natural one. Consider extant wave exposure, supply and types of natural sources of sediment, net alongshore sediment transport, predicted sea level rise and the size of sediment. For example: if the goal is to restore historical surf smelt spawning habitat, sediment placement should include a sand/pea gravel mix, with the bulk in the 1-7 mm diameter range within the uppermost one-third of the tidal range (approximately +7 feet upward) (Penttila 2007).

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[22] See *Alternative bank protection methods for Puget Sound shorelines* (Zelo *et al.* 2000) for examples of a variety of erosion control techniques, including bioengineering, gravel beach nourishment, and the active use of logs and woody debris.

i. **NMFS review and approval.** NMFS will review beach nourishment project plans to minimize potential adverse impacts to critical habitat/EFH such as eelgrass or other SAV, sea lion haulouts, and other resources that may be present. NMFS will also review monitoring reports.
ii. **Conduct topographic and bathymetric profile surveys** of the beach and offshore within the project and control areas. Pre- and post-construction surveys shall be conducted no more than 90 days before construction commences and no more than 60 days after construction ends.
iii. **Develop post-project monitoring plan.** The frequency and duration of monitoring should be commensurate with the scale and complexity of the project. Comparisons will be made between conditions at the project site after construction and those that were present before construction, or which exist on an adjacent reference beach similar in form to the constructed beach. (For very large projects performance monitoring of beach restoration projects often continue for 10 (biological performance) to 20 (physical performance) years.)
    1. Physical monitoring surveys shall be conducted in years 1, 2, 3, 5, and 10, and during interim years as needed to investigate the functioning of the new beach. Beach/depth profile transect surveys shall be conducted during a spring or summer month and repeated as close as practicable during that same month of the year. Detailed maps of sampling locations shall be presented as needed.
    2. Biological monitoring shall be conducted in years 2, 5, and 10 after completion of construction. Biological evaluation of the restored beach may include comparing pre-post project differences in the density of epibenthic zooplankton, numbers and length frequency of juvenile salmonids, and forage fish spawning. Detailed maps of sampling locations shall be presented as needed.

44. **In-Channel Nutrient Enhancement** includes the placement of salmon carcasses, salmon carcass analogs (SCA), or inorganic fertilizers in stream channels to help return stream nutrient levels back to historical levels. This action helps restore marine-derived nutrients to aquatic systems, thereby adding an element to the food chain that is important for growth of macroinvertebrates, juvenile salmonids, and riparian vegetation. Application and distribution of nutrients throughout a stream corridor can occur from bridges, stream banks, boats, or helicopter.

a. In Oregon, follow guidelines for the placement of carcasses in the Oregon Watershed Enhancement Board's (1999) Oregon Aquatic Habitat Restoration and Enhancement Guide. Projects are permitted through Oregon Department of Environmental Quality, which regulates the placement of carcasses instream as a discharge. Use carcasses from the treated watershed or those that are certified disease free by an Oregon Department of Fish and Wildlife (ODFW) pathologist.
b. In Washington, follow WDFW's *Protocols and Guidelines for Distributing Salmonid Carcasses, Salmon Carcass Analogs, and Delayed Release Fertilizers to Enhance Stream Productivity in Washington State* (Cramer 2012) or the most recent edition.

c. Ensure that the relevant streams have the capacity to capture and store placed carcasses.
d. Carcasses should be of species native to the watershed and placed during the normal migration and spawning times that would naturally occur in the watershed.
e. Do not supplement nutrients in eutrophic or naturally oligotrophic systems.

45. **Road and Trail Erosion Control and Decommissioning** includes hydrologically closing or decommissioning roads and trails, including culvert removal in perennial and intermittent streams; removing, installing or upgrading cross-drainage culverts; upgrading culverts on non-fish-bearing steams; constructing water bars and dips; reshaping road prisms; vegetating fill and cut slopes; removing and stabilizing of side-cast materials; grading or resurfacing roads that have been improved for aquatic restoration with gravel, bark chips, or other permeable materials; contour shaping of the road or trail base; removing road fill to native soils; and soil stabilization and tilling compacted surfaces to reestablish native vegetation. Such actions will target priority roads that contribute sediment to streams, block fish passage, or disrupt floodplain and riparian functions.

a. **Road decommissioning and stormproofing**
   i. For road decommissioning and hydrologic closure projects within riparian areas, recontour the affected area to mimic natural floodplain contours and gradient to the extent possible.
   ii. When obliterating or removing segments immediately adjacent to a stream, use sediment control barriers between the project and stream.
   iii. Dispose of slide and waste material in stable sites out of the flood-prone area. Native material may be used to restore natural or near-natural contours.
   iv. Drainage features used for stormproofing and treatment projects should be spaced as to hydrologically disconnect road surface runoff from stream channels. If grading and resurfacing is required, use gravel, bark, or other permeable materials for resurfacing.
   v. Minimize disturbance of existing vegetation in ditches and at stream crossings.
   vi. Conduct activities during dry-field conditions (generally May 15 to October 15) when the soil is more resistant to compaction and soil moisture is low.
   vii. When removing a culvert from a first or second order, non-fishing bearing stream, project specialists shall determine if culvert removal should include stream isolation and rerouting in project design. Culvert removal on fish bearing streams shall adhere to the measures described in Fish Passage Restoration (PDC 33).
   viii. For culvert removal projects, restore natural drainage patterns and channel morphology. Evaluate channel incision risk and construct in-channel grade control structures when necessary.

b. **Road relocation**
   i. When a road is decommissioned in a floodplain and future vehicle access through the area is still required, relocate the road as far as practical away from the stream.

ii. The relocation will not increase the drainage network and will be constructed to hydrologically disconnect it from the stream network to the extent practical. New cross drains shall discharge to stable areas where the outflow will quickly infiltrate the soil and not develop a channel to a stream.
iii. This consultation does not cover new road construction (not associated with road relocation) or routine maintenance within riparian areas.

46. **Juniper Tree Removal** will be conducted in riparian areas and adjoining uplands to help restore plant species composition and structure that would occur under natural fire regimes. Juniper removal will occur in those areas where juniper have encroached into riparian areas as a result of fire exclusion, thereby replacing more desired riparian plant species such as willow, cottonwood, aspen, alder, sedge, and rush. The following measures will apply:

a. Remove juniper to natural stocking levels where juniper trees are expanding into neighboring plant communities to the detriment of other native riparian vegetation, soils, or streamflow.
b. Do not cut old-growth juniper, which typically has several of the following features: sparse limbs, dead limbed or spiked-tops, deeply furrowed and fibrous bark, branches covered with bright-green arboreal lichens, noticeable decay of cambium layer at base of tree, and limited terminal leader growth in upper branches, as described by Miller *et al.* (2005).
c. Felled trees may be left in place, lower limbs may be cut and scattered, or all or part of the trees may be used for streambank or wetland restoration (*e.g.*, manipulated as necessary to protect riparian or wetland shrubs from grazing by livestock or wildlife or otherwise restore ecological function in floodplain, riparian, and wetland habitats).
d. Where appropriate, cut juniper may be placed into stream channels and floodplains to provide aquatic benefits. Juniper can be felled or placed into the stream to promote channel aggradation as long as such actions do not obstruct fish movement and use of spawning gravels or increase width to depth ratios.
e. On steep or south-facing slopes, where ground vegetation is sparse, leave felled juniper in sufficient quantities to promote reestablishment of vegetation and prevent erosion.
f. If seeding is a part of the action, consider whether seeding will be most appropriate before or after juniper treatment.
g. When using feller-buncher and slash-buster equipment, operate equipment in a manner that minimizes soil compaction and disturbance to soils and native vegetation to the extent possible. Equipment exclusion areas (buffer area along stream channels) should be as wide as the feller-buncher or slash-buster arm.

47. **Bull Trout Protection** includes the removal of brook trout or other non-native fish species via electrofishing or other manual means to reduce competition or hybridization with bull trout.

a. The measures specified in this PDC are designed to protect ESA-listed species under NMFS' jurisdiction. This opinion does not authorize incidental take for bull trout.

b. For brook trout or other non-native fish species removal, staff experienced in the specific removal method shall be involved in project design and implementation.

c. When using electrofishing for removal of brook trout or other non-native fish species, use the following guidelines:

    i. Electrofishing shall be conducted using the methods outlined in the NMFS' guidelines (NMFS 2000).

    ii. Electrofishing equipment shall be operated at the lowest possible effective settings to minimize injury or mortality to bull trout.

    iii. To reduce adverse effects to bull trout, electrofishing shall only occur from May 1 (or after emergence occurs) to July 31 in known bull trout spawning areas. No electrofishing will occur in any bull trout habitat after August 15.

    iv. Electrofishing shall not be conducted when the water conditions are turbid and visibility is poor. This condition may be experienced when the sampler cannot see the stream bottom in 1 foot of water.

    v. Electrofishing will not be conducted within core areas that contain 100 or fewer adult bull trout.

d. Other removal methods, such as dip netting, spearing, and other means can be used.

48. **Beaver Habitat Restoration** includes installation of in-channel structures to encourage beavers to build dams in incised channels and across potential floodplain surfaces.

a. **In-channel structures**

    i. Consist of porous channel-spanning structures comprised of biodegradable vertical posts (beaver dam support structures) approximately 0.5 to 1 meter apart and at a height intended to act as the crest elevation of an active beaver dam. Variation of this restoration treatment may include post lines only, post lines with wicker weaves, construction of starter dams, reinforcement of existing active beaver dams, and reinforcement of abandoned beaver dams as described by Pollock *et al.* (2013 *(In prep.);* 2012a).

    ii. Place beaver dam support structures in areas conducive to dam construction as determined by stream gradient or historical beaver use.

    iii. Place in areas with sufficient deciduous shrub and trees to promote sustained beaver occupancy.

b. **Habitat Restoration**

    i. Beaver Restoration activities may include planting riparian hardwoods (species such as willow, red osier dogwood, and alder) and building exclosures (such as temporary fences) to protect and enhance existing or planted riparian hardwoods until they are established as described by the Malheur National Forest and the Keystone Project (2007).

    ii. Maintain or develop grazing plans that will ensure the success of beaver habitat restoration objectives.

49. **Wetland Restoration** restores degraded wetlands by (a) excavation and removal of fill materials; (b) contouring to reestablish more natural topography; (c) setting back existing dikes, berms and levees; (d) reconnecting or recreating historical tidal and fluvial channels; (e) planting native wetland species; or (f) a combination of the above methods.

This action does not include installation of water control structures or fish passage structures.

a. Include applicable General Construction Measures (PDC 13-32) and PDC for specific types of actions as applicable (*e.g.*, Off- and Side-Channel Habitat Restoration (PDC 37); Set-Back or Removal of Existing Berms, Dikes, and Levees for Wetland and Estuary Restoration (PDC 39); and Dam and Legacy Structure Removal (PDC 35)) to ensure that all adverse effects to fish and their designated critical habitats are within the range of effects considered in this opinion.

50. **Tide/Flood Gate Removal, Replacement, or Retrofit** projects may include the removal, replacement, or the upgrade of existing tide and flood gates by modifying gate components and mechanisms in tidal stream systems where full tidal exchange is incompatible with current land use where backwater effects are of concern. Projects will be implemented to reconnect stream/slough corridors, floodplains, and estuaries, reestablish wetlands, improve aquatic organism passage, and restore more natural channel and flow conditions. Tide/flood gate replacement or retrofit may include, but is not limited to, excavation of existing channels, adjacent floodplains, flood channels, and wetlands, and may include structural elements such as streambank restoration and hydraulic roughness elements. Placement of new gates where they did not previously exist is not covered in this consultation.

a. **NMFS review and approval.** NMFS will review tide/flood gate removal, replacement, and retrofit projects for consistency with *Anadromous Salmonid Passage Facility Design* (NMFS 2011a).

b. For removal projects, if a culvert or bridge will be constructed at the location of a removed tide gate, the structure will be large enough to allow for a full tidal exchange.

c. Follow PDC for Staging, Storage, and Stockpile Areas (#16), Hazardous Material Spill Prevention and Control (#18), Equipment, Vehicles, and Power Tools (#19), Surface Water Withdrawal and Construction Discharge Water (#23), Work Area Isolation (#27), Timing of In-Water Work (# 25), Fish Capture and Release (# 28); Site Restoration (#31), and Revegetation (#32). Excavation below the OHW line shall be conducted to the maximum extent possible during low tide cycles or low flow cycles in the downstream watercourse.

d. **Overall design goals.** Tide/flood gate replacement or retrofit design data will demonstrate:

   i. A clear linkage to limiting factors identified within an appropriate sub-basin plan or recovery plan, or based on recommendations by a technical oversight and steering committee within a localized region.

   ii. The identification and, to the extent possible, the correction of the degraded baseline condition.

   iii. The use of analytical approaches for determination of the tidal prism and exchange.

   iv. Appropriate self-sustaining hydrologic design that includes climate change to reduce maintenance.

e. **General project design criteria**
    i. Site specific project design criteria will be set based on tidal restoration, fish passage, and flood protection needs as determined and set forth by the RRT.
    ii. Tide/Flood Gate Replacement or Retrofit Options
        1. Dike removal
        2. Dike breach
        3. Dike setback
        4. Bridge
        5. Non-gated pipe (NGP) or "bare" culvert
            a. Existing pipe minus the tide gate (removed)
            b. Installation of new pipe minus a tide gate
    iii. Tide Gate
        1. Fiberglass or aluminum gate
        2. Side hinged gate
        3. Self-regulating tide gate (SRT)
            a. Tension (cable) operated
            b. Float (cam) operated
    iv. Hybrid (such as SRT coupled with NGP)
    v. Other design options as recommended by the RRT
    vi. Design actions to restore tidal exchange characteristics—elevation, cross-sectional area, timing—in a manner that closely mimics, to the greatest degree possible, those that would naturally occur at that stream type.

f. **Design report & associated documentation.** Tide/flood gate replacement and retrofit design and adaptive management documentation shall include:
    i. Background and Problem Statement
        1. Site history
        2. Environmental baseline
        3. Problem Description
        4. Cause of problem
    ii. Project Description
        1. Goals/objectives
        2. Project elements
        3. Sequencing, implementation
            a. Place cofferdam upstream of the culvert to prevent drainage water from entering the work area. A downstream cofferdam will also be installed to isolate the work area from the watercourse.
            a. The existing culvert requiring replacement is then excavated with equipment staged on the dike or shoreline above OHW.
            b. Excavated material is stockpiled upland for replacement in the dike once the new culvert is in-place.
            c. Waste water removed from within the cofferdam work area shall be discharged to a location landward of OHW line in

a manner that allows removal of fine sediments prior to the discharged water returning to the watercourses.

d. Upon completion of the tide gate/flood gate repairs and/or replacement, all material used to construct the cofferdams shall be removed from the watercourses and the project site returned to pre-project or improved conditions.
e. Restore LW features to redeveloping tidal channels.
f. Drainage ditches will be filled to become part of the surrounding contiguous tidal marsh or will be modified to become part of the tidal channel network.

4. Proposed work window
5. Recovery trajectory: How will the new stream channel develop and evolve?

iii. Design Analysis, including technical analyses, computations relating design to analysis, and references. Analyses shall be appropriate to the level of project complexity. At a minimum, analyses will include the following:

1. Hydraulic Analysis
    a. Model conditions, duration, boundary conditions, inputs, and outputs will be collaboratively developed by RRT and modeler.
2. Sediment Assessment
3. Risk Analysis

iv. Detailed construction drawings

v. Other regulatory jurisdictions for tide and floodgate repair and replacement will also be addressed: *i.e.,* ACOE, River and Harbors Act §10, Clean Water Act §404, CZMA, ODFW Fish Passage OAR; ODEQ & WDOE §401, WDFW Hydraulic Project Approval, Washington Environmental Policy Act evaluation, Washington Shoreline Management Act

vi. River Restoration Tool. Review by the RRT will also include an evaluation using the River Restoration Analysis Tool (restorationreview.com), and therefore the following questions will be addressed in the project documentation:

1. Problem Identification
    a. Is the problem identified?
    b. Are causes identified at appropriate scales?
2. Project Context
    a. Is the project identified as part of a plan, such as a watershed action plan or recovery plan?
    b. Does the project consider ecological, geomorphic, and socioeconomic context?
3. Goals & Objectives
    a. Do goals and objectives address problem, causes, and context?
    b. Are objectives measurable?

4. Alternatives Evaluation
    a. Were alternative considered?
    b. Are uncertainties and risk associated with selected alternative acceptable?
5. Project Design
    a. Do project elements collectively support project objectives?
    b. Are design criteria defined for all project elements?
    c. Do project elements work with stream processes to create and maintain habitat?
    d. Is the technical basis of design sound for each project element?
6. Implementation
    g. Are plans and specifications sufficient in scope and detail to execute the project?
    h. Does plan address potential implementation impacts and risks?
7. Monitoring and Management
    a. Does monitoring plan address project compliance?
    b. Does monitoring plan directly measure project effectiveness?
    c. Does the maintenance plan include replacement for components that corrode over time?

g. **Monitoring and adaptive management.** Develop a monitoring and adaptive management plan that has been reviewed and approved by the RRT, that includes the following:
    i. Introduction
    ii. Existing monitoring protocols
    iii. Project effectiveness monitoring plan
    iv. Project review team triggering conditions
    v. Monitoring frequency, timing, and duration
    vi. Monitoring technique protocols
    vii. Data storage and analysis
    viii. Monitoring quality assurance plan
    ix. Literature cited

The NMFS relied on the foregoing description of the proposed action, including all PDC, to complete this consultation. However, unforeseen occurrences or changed circumstances encountered while carrying out the proposed action may require a significant change in the proposed design, construction methods, or other on-the-ground practices.

These changes may, in turn, result in effects of the action which exceed the amount or extent of take specified in the incidental take statement or otherwise affect listed species or designated critical habitat in ways not previously considered. Therefore, USFWS, NOAA RC, or any other cooperating party will keep NMFS informed of any such changes to ensure that conclusions drawn during consultation remain valid.

1.4 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For this consultation, the overall program action area consists of the combined action areas for each action to be authorized or carried out under this opinion within the range of ESA-listed salmon or steelhead, green sturgeon, and eulachon designated critical habitat, or designated EFH in Oregon,[23] Washington, and Idaho. Additionally, the action area includes all Puget Sound waters accessible to listed bocaccio, canary rockfish, and yelloweye rockfish. The action area also includes the Hoh-Quillayute sub-basin whose watershed includes habitat for the Lake Ozette sockeye (Table 1). The action area includes all upland, riparian and aquatic areas affected by site preparation, construction, and site restoration design criteria at each action site.

Each individual project authorized under this opinion will have a project-level action area that exists within the program action area. Individual project-level action areas include riparian areas, banks, and the stream channel in an area extending no more than 150 feet upstream (the beneficial effects of the action can extend much further upstream if fish passage is restored) and 300 feet downstream from the action footprint, where aquatic habitat conditions will be temporarily degraded until site restoration is complete. This estimate is based on an analysis of typical turbidity flux downstream from a nonpoint discharge in a stream with a low flow channel that is greater than 200 feet, although the actual turbidity flux at each project site is likely to be proportionately smaller for streams with a smaller low flow channel width (Rosetta 2005), or may be somewhat greater for project areas that are subject to tidal or coastal scour.

2. ENDANGERED SPECIES ACT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the USFWS, NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat.

Section 7(b)(3) requires that at the conclusion of consultation, the Service provide an opinion stating how the agencies' actions will affect listed species or their critical habitat. If incidental take is expected, section 7(b)(4) requires the provision of an incidental take statement specifying the impact of any incidental taking, and including reasonable and prudent measures to minimize such impacts.

[23] The waters that form the Klamath River system do not fall within the action area because the Klamath basin is not within the NMFS West Coast Region's area of responsibility in Oregon and thus no USFWS and NOAA RC projects will be authorized within that basin (nor will USFWS and NOAA RC projects authorized in other areas have effects in that basin).

2.1 Approach to the Analysis

Section 7(a)(2) of the ESA requires Federal agencies to consult with NMFS to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts to the conservation value of the designated critical habitat.

"To jeopardize the continued existence of a listed species" means to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02).

This opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[24]

We will use the following approach to determine whether the proposed action described in Section 1.3 is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.
- Reach jeopardy and adverse modification conclusions.
- If necessary, define a reasonable and prudent alternative to the proposed action.

In this opinion, NMFS concludes that the proposed action is not likely to adversely affect (NLAA) southern DPS green sturgeon or their designated critical habitat, or southern resident killer whales, which do not have designated critical habitat in the action area. See section 2.11 for details.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be affected by the proposed action. The status is the level of risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical

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[24] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large is climate change.

2.2.1 Status of the Species

For Pacific salmon, steelhead, and other relevant species NMFS commonly uses four parameters to assess the viability of the populations that, together, constitute the species: spatial structure, diversity, abundance, and productivity (McElhany *et al.* 2000). These "viable salmonid population" (VSP) criteria therefore encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout a species' entire life cycle, and these characteristics, in turn, are influenced by habitat and other environmental conditions.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends fundamentally on habitat quality and spatial configuration and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation at single genes to complex life history traits (McElhany *et al.* 2000).

"Abundance" generally refers to the number of naturally-produced adults (*i.e.*, the progeny of naturally-spawning parents) in the natural environment (*e.g.*, on spawning grounds).

"Productivity," as applied to viability factors, refers to the entire life cycle; *i.e.*, the number of naturally-spawning adults produced per parent. When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany *et al.* (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, NMFS assesses the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany *et al.* 2000).

The summaries that follow describe the status of the 20 ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion. More detailed information on the status and trends of the species considered in this opinion, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register (Table 1).

Climate change is likely to play an increasingly important role in determining the abundance of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. Areas with elevations high enough to maintain temperatures well below freezing for most of the winter and early-spring will be less affected. Low-elevation areas are likely to be more affected.

During the last century, average regional air temperatures increased by 1.5°F, and increased up to 4°F in some areas. Warming is likely to continue during the next century as average temperatures increase another 3 to 10°F. Overall, about one-third of the current cold-water fish habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (USGCRP 2009).

Precipitation trends during the next century are less certain than for temperature but more precipitation is likely to occur during October through March and less during summer months, and more of the winter precipitation is likely to fall as rain rather than snow (ISAB 2007; USGCRP 2009). Where snow occurs, a warmer climate will cause earlier runoff so stream flows in late spring, summer, and fall will be lower and water temperatures will be warmer (ISAB 2007; USGCRP 2009).

Higher winter stream flows increase the risk that winter floods in sensitive watersheds will damage spawning redds and wash away incubating eggs. Earlier peak stream flows will also flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and the risk of predation. Lower stream flows and warmer water temperatures during summer will degrade summer rearing conditions, in part by increasing the prevalence and virulence of fish diseases and parasites (USGCRP 2009). Other adverse effects are likely to include altered migration patterns, accelerated embryo development, premature emergence of fry, variation in quality and quantity of tributary rearing habitat, and increased competition and predation risk from warm-water, non-native species (ISAB 2007).

The earth's oceans are also warming, with considerable interannual and inter-decadal variability superimposed on the longer-term trend (Bindoff *et al.* 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances (Scheuerell and Williams 2005; USGCRP 2009; Zabel *et al.* 2006). Ocean conditions adverse to salmon and steelhead may be more likely under a warming climate (Zabel *et al.* 2006).

The status of species and critical habitat sections below are organized under four recovery domains (Table 5) to better integrate recovery planning information that NMFS is developing on the conservation status of the species and critical habitats considered in this consultation.

Recovery domains are the geographically-based areas that NMFS is using to prepare multi-species recovery plans.

Table 5. Recovery planning domains identified by NMFS and their ESA-listed salmon and steelhead species.

Recovery Domain	Species
Puget Sound	PS Chinook salmon Hood Canal (HC)HC summer-run chum salmon Lake Ozette sockeye salmon PS steelhead
Willamette-Lower Columbia (WLC)	LCR Chinook salmon UWR Chinook salmon CR chum salmon LCR coho salmon LCR steelhead UWR steelhead
Interior Columbia (IC)	UCR spring-run Chinook salmon SR spring/summer-run Chinook salmon SR fall-run Chinook salmon SR sockeye salmon MCR steelhead UCR steelhead SRB steelhead
Oregon Coast (OC)	OC coho salmon
Southern Oregon/Northern California Coasts (SONCC)	SONCC coho salmon

For each recovery domain, a technical review team (TRT) appointed by NMFS has developed, or is developing, criteria necessary to identify independent populations within each species, recommended viability criteria for those species, and descriptions of factors that limit species survival. Viability criteria are prescriptions of the biological conditions for populations, biogeographic strata, and evolutionarily significant units (ESU) that, if met, would indicate that an ESU will have a negligible risk of extinction over a 100-year time frame.[25]

Although the TRTs operated from the common set of biological principals described in McElhany *et al.* (2000), they worked semi-independently from each other and developed criteria suitable to the species and conditions found in their specific recovery domains. All of the criteria

[25] For Pacific salmon, NMFS uses its 1991 ESU policy, that states that a population or group of populations will be considered a Distinct Population Segment if it is an Evolutionarily Significant Unit. An ESU represents a distinct population segment of Pacific salmon under the Endangered Species Act that 1) is substantially reproductively isolated from conspecific populations and 2) represents an important component of the evolutionary legacy of the species. The species *O. mykiss* is under the joint jurisdiction of NMFS and the Fish and Wildlife Service, so in making its listing January, 2006 determinations NMFS elected to use the 1996 joint FWS-NMFS DPS policy for this species.

have qualitative as well as quantitative aspects. The diversity of salmonid species and populations makes it impossible to set narrow quantitative guidelines that will fit all populations in all situations.

For this and other reasons, viability criteria vary among species, mainly in the number and type of metrics and the scales at which the metrics apply (*i.e.*, population, major population group (MPG), or ESU) (Busch *et al.* 2008).

The abundance and productivity (A&P) score considers the TRT's estimate of a populations' minimum threshold population, natural spawning abundance and the productivity of the population. Productivity over the entire life cycle and factors that affect population growth rate provide information on how well a population is "performing" in the habitats it occupies during the life cycle. Estimates of population growth rate that indicate a population is consistently failing to replace itself are an indicator of increased extinction risk. The four metrics (abundance, productivity, spatial structure, and diversity) are not independent of one another and their relationship to sustainability depends on a variety of interdependent ecological processes (Wainwright *et al.* 2008).

Integrated spatial structure and diversity (SS/D) risk combines risk for likely, future environmental conditions, and diversity (Ford 2011; McElhany *et al.* 2007; McElhany *et al.* 2000). Diversity factors include:

- *Life history traits* include the distribution of major life history strategies within a population, variability of traits, mean value of traits, and loss of traits.
- *Effective population size*: One of the indirect measures of diversity is effective population size. A population at chronic low abundance or experiencing even a single episode of low abundance is at a higher extinction risk because of loss of genetic variability, inbreeding and the expression of inbreeding depression, or the effects of mutation accumulation.
- *Impact of hatchery fish*: Interbreeding of wild populations and hatchery origin fish are a significant risk factor to the diversity of wild populations if the proportion of hatchery fish in the spawning population is high and their genetic similarity to the wild population is low.
- *Anthropogenic mortality:* The susceptibility to mortality from harvest or habitat alterations will differ depending on size, age, run timing, disease resistance or other traits.
- *Habitat diversity:* Habitat characteristics have clear selective effects on populations, and changes in habitat characteristics are likely to eventually lead to genetic changes through selection for locally adapted traits. In assessing risk associated with altered habitat diversity, historical diversity is used as a reference point.

Overall viability risk scores (high to low) and population persistence scores are based on combined ratings for the A&P and SS/D [26] metrics (Table 6) (McElhany *et al.* 2006). Persistence probabilities, which are provided here for Lower Columbia River salmon and steelhead, are the complement of a population's extinction risk (*i.e.*, persistence probability = 1 – extinction risk) (NMFS 2013a). The IC-TRT has provided viability criteria that are based on McElhany (2000)

[26] The WLC-TRT provided ratings for diversity and spatial structure risks. The IC-TRT provided spatial structure and diversity ratings combined as an integrated SS/D risk.

and McElhany (2006), as well as the results of previous applications in other TRTs and a review of specific information available relative to listed IC ESU populations (Ford 2011; IC-TRT 2007).

Table 6. Population persistence categories from McElhany *et al.* (2006). A low or negligible risk of extinction is considered "viable" (Ford 2011). Population persistence categories correspond to: 4 = very low (VL), 3 = low (L), 2 = moderate (M), 1 = high (H), and 0 = very high (VH) in Oregon populations, which corresponds to "extirpated or nearly so" (E) in Washington populations (Ford 2011).

Population Persistence Category	Probability of population persistence in 100 years	Probability of population extinction in 100 years	Description
0	0-40%	60-100%	Either extinct or "high" risk of extinction
1	40-75%	25-60%	Relatively "high" risk of extinction in 100 years
2	75-95%	5-25%	"Moderate" risk of extinction in 100 years
3	95-99%	1-5%	"Low" (negligible) risk of extinction in 100 years
4	>99%	<1%	"Very low" risk of extinction in 100 years

The boundaries of each population were defined using a combination of genetic information, geography, life-history traits, morphological traits, and population dynamics that indicate the extent of reproductive isolation among spawning groups. To date, the TRTs have divided the 19 species of salmon and steelhead considered in this opinion into a total of 304 populations, although the population structure of Puget Sound (PS) steelhead has yet to be resolved. The overall viability of a species is a function of the VSP attributes of its constituent populations. Until a viability analysis of a species is completed, the VSP guidelines recommend that all populations should be managed to retain the potential to achieve viable status to ensure a rapid start along the road to recovery, and that no significant parts of the species are lost before a full recovery plan is implemented (McElhany *et al.* 2000).

The size and distribution of the populations considered in this opinion generally have declined over the last few decades due to natural phenomena and human activity, including climate change (as described in section 2.2), the operation of hydropower systems, over-harvest, effects of hatcheries, and habitat degradation.

Enlarged populations of terns, seals, California sea lions, and other aquatic predators in the Pacific Northwest may be limiting the productivity of some Pacific salmon and steelhead populations (Ford 2011).

Viability status or probability or population persistence is described below for each of the populations considered in this opinion. Although eulachon are part of more than one recovery domain structure, they are presented below for convenience as part of the PS recovery domain.

<u>Puget Sound Recovery Domain.</u> Species considered in the PS recovery domain include PS Chinook salmon, Hood Canal (HC) summer-run chum salmon, Lake Ozette (LO) sockeye salmon, PS steelhead, and southern DPS eulachon. The PS TRT has identified 22 extant demographically-independent populations of Chinook salmon and two of summer-run chum salmon,[27] (Ford 2011)(Table 7). These populations were further aggregated into strata, groupings above the population level that are connected by some degree of migration, based on ecological subregions. The PS steelhead TRT has not yet finalized its viability criteria for the PS steelhead DPS and is still conducting analyses to identify populations and MPGs within the DPS.

Table 7. Numbers of historical and extant populations for ESA-listed salmon and steelhead in the PS recovery domain (Ford 2011).

Species	Historical Populations	Extant Populations
PS Chinook salmon	31	22
HC summer-run chum salmon	18	2
LO sockeye salmon	1	1
PS steelhead	Not available	

<u>Status of PS Chinook Salmon</u>

<u>Spatial Structure and Diversity</u>. This species includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington, and progeny of 26 artificial propagation programs. The PS-TRT identified 22 historical populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity (Table 8). The NMFS adopted the Shared Strategy for Puget Sound's locally-developed listed species recovery plan for PS Chinook salmon in 2007 (Shared Strategy for Puget Sound 2007).

[27] One HC chum salmon population has four extant spawning aggregations and one has 10 extant spawning aggregations; some of these are recently reintroduced. Spawning aggregations are also referred to as subpopulations.

Table 8. Extant PS Chinook salmon populations in each geographic region (Ford 2011).

Geographic Region	Population (Watershed)
Strait of Georgia	North Fork Nooksack River
	South Fork Nooksack River
Strait of Juan de Fuca	Elwha River
	Dungeness River
Hood Canal	Skokomish River
	Mid Hood Canal River
Whidbey Basin	Skykomish River
	Snoqualmie River
	North Fork Stillaguamish River
	South Fork Stillaguamish River
	Upper Skagit River
	Lower Skagit River
	Upper Sauk River
	Lower Sauk River
	Suiattle River
	Upper Cascade River
Central/South Puget Sound Basin	Cedar River
	North Lake Washington/ Sammamish River
	Green/Duwamish River
	Puyallup River
	White River
	Nisqually River

Indices of spatial distribution and diversity have not been developed at the population level. Based on a Shannon Diversity Index at the ESU level, diversity is declining (due primarily to the increased abundance of returns to the Whidbey Basin region) for both distribution among populations and among regions (Ford 2011). Overall, the new information on abundance, productivity, spatial structure and diversity since the 2005 status review does not indicate a change in the biological risk category (Ford 2011).

Abundance and Productivity. No trend was notable for the total ESU escapements; while trends vary from decreasing to increasing among populations. Natural-origin pre-harvest recruit escapements remained fairly constant from 1985-2009. Returns (pre-harvest run size) from the natural spawners were highest in 1985, declined through 1994, remained low through 1999, increased in 2000 and again in 2001, and have declined through 2009, with 2009 having the lowest returns since 1997. Median recruits per spawner for the last 5-year period (brood years 2002-2006) is the lowest over any of the 5-year intervals. Many of the habitat and hatchery actions identified in the Puget Sound Chinook salmon recovery plan are likely to take years or decades to be implemented and to produce significant improvements in natural population attributes, and these trends are consistent with these expectations (Ford 2011).

Limiting Factors include (NOAA Fisheries 2011; Shared Strategy for Puget Sound 2007; SSPS 2007):

- Degraded nearshore and estuarine habitat: Residential and commercial development has reduced the amount of functioning nearshore and estuarine habitat available for salmon rearing and migration. The loss of mudflats, eelgrass meadows, and macroalgae further limits salmon foraging and rearing opportunities in nearshore and estuarine areas.
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, stream substrate, and water quality have been degraded for adult spawning, embryo incubation, and rearing as a result of cumulative impacts of agriculture, forestry, and development.
- Anadromous salmonid hatchery programs: Salmon and steelhead released from Puget Sound hatcheries operated for harvest augmentation purposes pose ecological, genetic, and demographic risks to natural-origin Chinook salmon populations.
- Salmon harvest management: Total fishery exploitation rates have decreased 14 to 63% from rates in the 1980s, but weak natural-origin Chinook salmon populations in Puget Sound still require enhanced protective measures to reduce the risk of overharvest in Chinook salmon-directed fisheries.

Status of HC Summer-run Chum Salmon

Spatial Structure and Diversity. This species includes all naturally spawned populations of summer-run chum salmon in Hood Canal and its tributaries; populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington; and progeny of eight artificial propagation programs. The Strait of Juan de Fuca population spawns in rivers and streams entering the eastern Strait and Admiralty Inlet. The Hood Canal population includes all spawning aggregations within the Hood Canal area (Hood Canal Coordinating Council 2005; NMFS 2007b). The PS-TRT identified two independent populations of Hood Canal summer chum salmon (NMFS 2007a), which include 16 historical stocks or spawning aggregations (including eight that are extant), based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity (Table 9). The historical populations included at least those 16 spawning aggregation units and likely some additional undocumented and less-persistent aggregations (NMFS 2007a). Programs are underway to reintroduce summer-run chum salmon to several of the watersheds where stocks were lost.

Table 9. HC summer-run chum salmon populations (geographic regions), population aggregations, and their status (Ford 2011).

Geographic Region (Population)	Stock (Watershed)	Status
Strait of Juan de Fuca	Dungeness River	Unknown <5 adult returns annually recently
	Jimmycomelately Creek	Extant
	Salmon River	Extant
	Snow River	Extant
	Chimacum Creek	Extinct but reintroduced with natural spawning reported starting in 1999
Hood Canal	Big Quilcene River	Extant
	Little Quilcene River	Extant
	Dosewallips River	Extant
	Duckabush River	Extant
	Hamma Hamma River	Extant
	Lilliwaup Creek	Extant
	Big Beef Creek	Extinct but reintroduced with adult returns reported starting in 2001
	Anderson Creek	Extinct
	Dewatto Creek	Extinct, no returns mid 1990's, some natural recolonization apparent but numbers remain low (<70 annually)
	Tahuya River	Extinct but reintroduced with increased adult returns reported starting 2006
	Union River	Extant
	Skokomish River	Extinct; no spawning reported prior to 2001; very low numbers of adult returns (<40 annually) reported in recent years
	Finch Creek	Extinct

Diversity is increasing from the low values seen in the 1990s, due both to the reintroduction of spawning aggregates and the more uniform relative abundance between populations; this is a good sign for viability in terms of spatial structure and diversity. Spawning survey data shows that the spawning distribution within most streams has been extended farther upstream as abundance has increased (WDFW and Point No Point Treaty Tribes 2007). Estimates of population viability from three time periods (brood years 1971-2006, 1985-2006, and 1990-2006) all indicate that Hood Canal and Strait of Juan de Fuca populations of summer-run chum salmon are not currently viable (Ford 2011).

Abundance and Productivity. Overall, the new information considered does not indicate a change in the biological risk category since the last status review in 2005 (Ford 2011). The spawning abundance of this species has clearly increased since the time of listing, although the recent abundance is down from the previous 5 years. However, productivity in the last 5-year period (2002-2006) has been very low, especially compared to the relatively high productivity in the 5-10 previous years (WDFW and Point No Point Treaty Tribes 2007). This is a concern for viability. Since abundance is increasing and productivity is decreasing, improvements in habitat and ecosystem function likely are needed.

Limiting factors include (Hood Canal Coordinating Council 2005; NMFS 2007b; NOAA Fisheries 2011):

- Nearshore and estuarine habitat throughout the range of the species has been altered by human activities. Nutrient loading has lowered dissolved oxygen concentrations, which can kill or stress marine organisms, including salmon. Residential and commercial development has reduced the amount of functioning habitat available for salmon rearing and migration. The loss of mudflats, eelgrass meadows, and macroalgae further limits salmon foraging and rearing opportunities in nearshore and estuarine areas.
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, stream substrate, and stream flow have been degraded as a result of cumulative impacts of agriculture, forestry, and development.

Status of LO Sockeye Salmon

Spatial Structure and Diversity. This species includes all naturally spawned populations of sockeye salmon in Ozette Lake and streams and tributaries flowing into Ozette Lake, Washington, and progeny of two artificial propagation programs. The LO Technical Recovery Team concluded that five extant spawning aggregations in Ozette Lake are different subpopulations within a single population (Currens *et al.* 2009; NMFS 2009a). The subpopulations can be grouped according to whether they spawn in tributaries or near lake beaches (NMFS 2009a).

Abundance and Productivity. LO sockeye salmon population sizes remain very small compared to historical sizes. Additionally, population estimates remain highly variable and uncertain, making it impossible to detect changes in abundance trends or in productivity in recent years. The most recent brood years (1999-2003) have had the lowest average recruits per spawner. Spatial structure and diversity are also difficult to appraise; there is currently no successfully quantitative program to monitor beach spawning or spawning at other tributaries. Assessment methods must improve to evaluate the status of this species and its responses to recovery actions. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting factors include (NMFS 2009a; NOAA Fisheries 2011; USDC 2009a):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, lake beach spawning habitat, and stream substrate have been degraded as a result of cumulative impacts of forest practices, agriculture, and development.
- Predation: Harbor seals and river otters, and predaceous non-native and native fish species, are reducing the abundance of adult fish that successfully spawn, and the abundance of sockeye smolts escaping seaward from the watershed each year.

Status of PS Steelhead

Spatial Structure and Diversity. Steelhead populations can be divided into two basic reproductive ecotypes, based on the state of sexual maturity at the time of river entry (summer or winter) and duration of spawning migration (Burgner *et al.* 1992)(Table 10).

The PS DPS includes all naturally spawned anadromous winter-run and summer-run steelhead populations in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks. Non-anadromous ''resident'' *O. mykiss* occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard *et al.* 2007; USDC 2007).

Table 10. PS steelhead populations and risk of extinction (Ford 2011).

Geographic Region (MPGs)	Population (Watershed)	Extinction Risk (probability of decline to 10% of its current estimated abundance)
Northern Cascades	Samish River (winter)	High—about 80% within 25 years
	Skagit River (winter)	High—about 80% within 75 years.
	Snohomish River (winter)	Moderately High—about 50% within 100 years
	Stillaguamish River (winter)	High—about 90% within 60 years
	Tolt River summer	High—nearly 80% within 100 years
	Nooksack River (winter)	Unable to calculate
South Puget Sound	Lake Washington (winter)	High—~ 90% within 40 years
	Green River (winter)r	High—about 90% within 80 years
	Nisqually River (winter)	High—about 80% within 40 years
	Puyallup River (winter)	High—about 90% within 25-30 years
	White River (winter)	High—about 90% within 50 years
	South Sound Tributaries (winter)	Unable to calculate
Olympic	Elwha River (winter)	Fairly High— ~ 90% within 40 years
	Dungeness River (winter)	High—within 100 years (population too low to calculate %)
	Port Angeles (winter)	High—nearly 80% within 100 years
	West Hood Canal (winter)	Low—near zero within 100 years
	East Hood Canal (winter)	Low—about 30% within 100 years
	Skokomish River (winter)	High—about 80% within 80 years

The Puget Sound Steelhead TRT has completed a set of simple population viability analyses (PVAs) for these draft populations and MPGs within the DPS. No new estimates of productivity, spatial structure and diversity of PS steelhead have been made available since the 2007 review, when the BRT concluded that low and declining abundance and low and declining productivity were substantial risk factors for the species (USDC 2007). Loss of diversity and spatial structure were judged to be "moderate" risk factors. Since the listing of this species, this threat has not changed appreciably (Ford 2011).

Abundance and Productivity. The BRT considered the major risk factors facing Puget Sound steelhead to be: widespread declines in abundance and productivity for most natural steelhead populations in the ESU, including those in Skagit and Snohomish rivers (previously considered to be strongholds); the low abundance of several summer-run populations; and the sharply diminishing abundance of some steelhead populations, especially in south Puget Sound, Hood Canal, and the Strait of Juan de Fuca (Hard *et al.* 2007).

For all but a few putative PS steelhead populations, estimates of mean population growth rates obtained from observed spawner or redd counts are declining—typically 3 to 10% annually—and extinction risk within 100 years for most populations in the DPS is estimated to be moderate to high, especially for draft populations in the putative South Sound and Olympic MPGs. Most populations within the DPS continue downward trends in estimated abundance, a few sharply so. Extinction risk within 100 years for most populations in the DPS is estimated to be moderate to high, especially for populations in the South Sound and Olympic MPGs.

Limiting factors include (NOAA Fisheries 2011):

- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years.
- Threats to diversity posed by use of two hatchery steelhead stocks (Chambers Creek and Skamania) inconsistent with wild stock diversity throughout the DPS.
- Declining diversity in the DPS, including the uncertain but weak status of summer-run fish in the DPS.
- A reduction in spatial structure for steelhead in the DPS.
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of LW.
- Increased flood frequency and peak flows during storms, reduced groundwater-driven summer flows in the lower reaches of many rivers and their tributaries in Puget Sound where urban development has occurred, has resulted in gravel scour, streambank erosion, and sediment deposition.
- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, have increased the likelihood of gravel scour and dislocation of rearing juveniles.

Status of Southern DPS Eulachon

Spatial Structure and Diversity. The southern DPS of eulachon occur in four salmon recovery domains: Puget Sound, the Willamette and Lower Columbia, Oregon Coast, and Southern Oregon/Northern California Coasts. The ESA-listed population of eulachon includes all naturally-spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Core populations for this species include the Fraser River, Columbia River and (historically) the Klamath River. Eulachon leave saltwater to spawn in their natal streams late winter through early summer, and typically spawn at night in the lower reaches of larger rivers fed by snowmelt. After hatching, larvae are carried downstream and widely dispersed by estuarine and ocean currents. Eulachon movements in the ocean are poorly known although the amount of eulachon bycatch in the pink shrimp fishery seems to indicate that the distribution of these organisms overlap in the ocean.

Abundance and Productivity. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River with no evidence of returning to their former population levels since then (Drake *et al.* 2008).

Persistent low returns and landings of eulachon in the Columbia River from 1993 to 2000 prompted the states of Oregon and Washington to adopt a Joint State Eulachon Management Plan in 2001 that provides for restricted harvest management when parental run strength, juvenile production, and ocean productivity forecast a poor return (WDFW and ODFW 2001). Despite a brief period of improved returns in 2001–2003, the returns and associated commercial landings have again declined to the very low levels observed in the mid-1990s (Joint Columbia River Management Staff 2009), and since 2005, the fishery has operated at the most conservative level allowed in the management plan (Joint Columbia River Management Staff 2009). Large commercial and recreational fisheries have occurred in the Sandy River in the past. The most recent commercial harvest in the Sandy River was in 2003. No commercial harvest has been recorded for the Grays River from 1990 to the present, but larval sampling has confirmed successful spawning in recent years (USDC 2011).

Limiting Factors include (Gustafson *et al.* 2011; Gustafson *et al.* 2010; NOAA Fisheries 2011):

- Changes in ocean conditions due to climate change, particularly in the southern portion of its range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success.
- Climate-induced change to freshwater habitats, dams and water diversions (particularly in the Columbia and Klamath Rivers where hydropower generation and flood control are major activities)
- Bycatch of eulachon in commercial fisheries
- Adverse effects related to dams and water diversions
- Artificial fish passage barriers
- Increased water temperatures, insufficient streamflow
- Altered sediment balances
- Water pollution
- Over-harvest
- Predation

Willamette-Lower Columbia Recovery Domain. Species considered in the Willamette-Lower Columbia (WLC) Recovery Domain include LCR Chinook salmon, UWR Chinook salmon, CR chum salmon, LCR coho salmon, LCR steelhead, UWR steelhead, and southern DPS eulachon. The WLC-TRT has identified 107 demographically independent populations of Pacific salmon and steelhead (Table 11). These populations were further aggregated into strata, groupings above the population level that are connected by some degree of migration, based on ecological subregions. All 107 populations use parts of the mainstem of the Columbia River and the Columbia River estuary for migration, rearing, and smoltification.

Table 11. Populations of ESA-listed salmon and steelhead in the WLC recovery domain.

Species	Populations
LCR Chinook salmon	32
UWR Chinook salmon	7
CR chum salmon	17
LCR coho salmon	24
LCR steelhead	23
UWR steelhead	4

Status of LCR Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of Chinook salmon in the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River; the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River; and progeny of seventeen artificial propagation programs.[28] LCR Chinook populations exhibit three different life history types base on return timing and other features: fall-run (a.k.a. "tules"), late-fall-run (a.k.a. "brights"), and spring-run. The WLC-TRT identified 32 historical populations of LCR Chinook salmon— seven in the coastal subregion, six in the Columbia Gorge, and 19 in the Cascade Range (Table 12). Spatial structure has been substantially reduced in several populations. Low abundance, past broodstock transfers and other legacy hatchery effects, and ongoing hatchery straying may have reduced genetic diversity within and among LCR Chinook salmon populations. Hatchery-origin fish spawning naturally may also have reduced population productivity (Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010). Out of the 32 populations that make up this ESU, only the two late-fall runs, the North Fork Lewis and Sandy, are considered viable. Most populations (26 out of 32) have a very low probability of persistence over the next 100 years (and some are extirpated or nearly so) (Ford 2011; Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010). Five of the six strata fall significantly short of the WLC-TRT criteria for viability; one stratum, Cascade late-fall, meets the WLC TRT criteria (NMFS 2013a).

[28] In 2009, the Elochoman tule fall Chinook salmon program was discontinued and four new fall Chinook salmon programs have been initiated. In 2011, NMFS recommended removing the Elochoman program from the ESU and adding the new programs to the ESU (NMFS 2011b).

Table 12. LCR Chinook salmon strata, ecological subregions, run timing, populations, and scores for the key elements (A&P, spatial structure, and diversity) used to determine overall net persistence probability of the population (NMFS 2013a). Persistence probability ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Stratum		Spawning Population (Watershed)	A&P	Spatial Structure	Diversity	Overall Persistence Probability
Ecological Subregion	Run Timing					
Cascade Range	Spring	Upper Cowlitz River (WA)	VL	L	M	VL
		Cispus River (WA)	VL	L	M	VL
		Tilton River (WA)	VL	VL	VL	VL
		Toutle River (WA)	VL	H	L	VL
		Kalama River (WA)	VL	H	L	VL
		North Fork Lewis (WA)	VL	L	M	VL
		Sandy River (OR)	M	M	M	M
	Fall	Lower Cowlitz River (WA)	VL	H	M	VL
		Upper Cowlitz River (WA)	VL	VL	M	VL
		Toutle River (WA)	VL	H	M	VL
		Coweeman River (WA)	L	H	H	L
		Kalama River (WA)	VL	H	M	VL
		Lewis River (WA)	VL	H	H	VL
		Salmon Creek (WA)	VL	H	M	VL
		Clackamas River (OR)	VL	VH	L	VL
		Sandy River (OR)	VL	M	L	VL
		Washougal River (WA)	VL	H	M	VL
	Late Fall	North Fork Lewis (WA)	VH	H	H	VH
		Sandy River (OR)	VH	M	M	H
Columbia Gorge	Spring	White Salmon River (WA)	VL	VL	VL	VL
		Hood River (OR)	VL	VH	VL	VL
	Fall	Lower Gorge (WA & OR)	VL	M	L	VL
		Upper Gorge (WA & OR)	VL	M	L	VL
		White Salmon River (WA)	VL	L	L	VL
		Hood River (OR)	VL	VH	L	VL
Coast Range	Fall	Young Bay (OR)	L	VH	L	L
		Grays/Chinook rivers (WA)	VL	H	VL	VL
		Big Creek (OR)	VL	H	L	VL
		Elochoman/Skamokawa creeks (WA)	VL	H	L	VL
		Clatskanie River (OR)	VL	VH	L	VL
		Mill, Germany, and Abernathy creeks (WA)	VL	H	L	VL
		Scappoose River (OR)	L	H	L	L

<u>Abundance and Productivity</u>. A&P ratings for LCR Chinook salmon populations are currently "low" to "very low" for most populations, except for spring Chinook salmon in the Sandy River, which are "moderate" and late-fall Chinook salmon in North Fork Lewis River and Sandy River, which are "very high" (NMFS 2013a). Low abundance of natural-origin spawners (100 fish or fewer) has increased genetic and demographic risks. Other LCR Chinook populations have higher total abundance, but several of these also have high proportions of hatchery-origin spawners.

Particularly for tule fall Chinook salmon populations, poor data quality prevents precise quantification of population abundance and productivity; data quality has been poor because of inadequate spawning surveys and the presence of unmarked hatchery-origin spawners (Ford 2011).

Limiting Factors include (NMFS 2013a; NOAA Fisheries 2011):

- Degraded estuarine and near-shore marine habitat resulting from cumulative impacts of land use and flow management by the Columbia River hydropower system
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development.
- Reduced access to spawning and rearing habitat mainly as a result of tributary hydropower projects
- Hatchery-related effects
- Harvest-related effects on fall Chinook salmon
- An altered flow regime and Columbia River plume has altered the temperature regime and estuarine food web, and has reduced ocean productivity
- Reduced access to off-channel rearing habitat in the lower Columbia River
- Reduced productivity resulting from sediment and nutrient-related changes in the estuary
- Juvenile fish strandings that result from ship wakes
- Contaminants affecting fish health and reproduction

Status of UWR Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River; in the Willamette River and its tributaries above Willamette Falls, Oregon; and progeny of seven artificial propagation programs. All seven historical populations of UWR Chinook salmon identified by the WLC-TRT occur within the action area and are contained within a single ecological subregion, the western Cascade Range (Table 13). The McKenzie River population currently characterized as at a "low" risk of extinction and the Clackamas population has a "moderate" risk. (Ford 2011). Consideration of data collected since the last status review in 2005 has confirmed the high fraction of hatchery origin fish in all of the populations of this species (even the Clackamas and McKenzie rivers have hatchery fractions above WLC-TRT viability thresholds). All of the UWR Chinook salmon populations have "moderate" or "high" risk ratings for diversity. Clackamas River Chinook salmon have a "low" risk rating for spatial structure (Ford 2011).

Table 13. Scores for the key elements (A&P, diversity, and spatial structure) used to determine current overall viability risk for UWR Chinook salmon (ODFW and NMFS 2011). All populations are in the Western Cascade Range ecological subregion. Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Population (Watershed)	A&P	Diversity	Spatial Structure	Overall Extinction Risk
Clackamas River	M	M	L	M
Molalla River	VH	H	H	VH
North Santiam River	VH	H	H	VH
South Santiam River	VH	M	M	VH
Calapooia River	VH	H	VH	VH
McKenzie River	VL	M	M	L
Middle Fork Willamette River	VH	H	H	VH

Abundance and Productivity. The Clackamas and McKenzie river populations currently have the best risk ratings for A&P, spatial structure, and diversity. Data collected since the BRT status update in 2005 highlighted the substantial risks associated with pre-spawning mortality. Although recovery plans are targeting key limiting factors for future actions, there have been no significant on-the-ground-actions since the last status review to resolve the lack of access to historical habitat above dams nor have there been substantial actions removing hatchery fish from the spawning grounds. Overall, the new information does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors include (NOAA Fisheries 2011; ODFW and NMFS 2011):

- Significantly reduced access to spawning and rearing habitat because of tributary dams
- Degraded freshwater habitat, especially floodplain connectivity and function, channel structure and complexity, and riparian areas and LW recruitment as a result of cumulative impacts of agriculture, forestry, and development
- Degraded water quality and altered temperature as a result of both tributary dams and the cumulative impacts of agriculture, forestry, and urban development
- Hatchery-related effects
- Anthropogenic introductions of non-native species and out-of-ESU races of salmon or steelhead have increased predation on, and competition with, native UWR Chinook salmon
- Ocean harvest rates of approximately 30%

Status of CR Chum Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon, and progeny of three artificial propagation programs. The WLC-TRT identified 17 historical populations of CR chum salmon and aggregated these into four strata (Myers *et al.* 2006)(Table 14). CR chum salmon spawning aggregations identified in the mainstem Columbia River were included in the population associated with the nearest river basin.

Table 14. CR chum salmon strata, ecological subregions, run timing, populations, and scores for the key elements (A&P, spatial structure, and diversity) used to determine current overall net persistence probability of the population (NMFS 2013a). Persistence probability ratings are very low (VL), low (L), moderate (M), high (H), to very high (VH).

Stratum		Spawning Population (Watershed)	A&P	Diversity	Spatial Structure	Overall Persistence Probability
Ecological Subregion	**Run Timing**					
Coast Range	Fall	Young's Bay (OR)	*	*	*	VL
		Grays/Chinook rivers (WA)	VH	M	H	M
		Big Creek (OR)	*	*	*	VL
		Elochoman/Skamakowa rivers (WA)	VL	H	L	VL
		Clatskanie River (OR)	*	*	*	VL
		Mill, Abernathy and Germany creeks (WA)	VL	H	L	VL
		Scappoose Creek (OR)	*	*	*	VL
Cascade Range	Summer	Cowlitz River (WA)	VL	L	L	VL
	Fall	Cowlitz River (WA)	VL	H	L	VL
		Kalama River (WA)	VL	H	L	VL
		Lewis River (WA)	VL	H	L	VL
		Salmon Creek (WA)	VL	L	L	VL
		Clackamas River (OR)	*	*	*	VL
		Sandy River (OR)	*	*	*	VL
		Washougal River (WA)	VL	H	L	VL
Columbia Gorge	Fall	Lower Gorge (WA & OR)	VH	H	VH	H
		Upper Gorge (WA & OR)	VL	L	L	VL

* No data are available to make a quantitative assessment.

The very low persistence probabilities or possible extirpations of most chum salmon populations are due to low abundance, productivity, spatial structure, and diversity. Although, hatchery production of chum salmon has been limited and hatchery effects on diversity are thought to have been relatively small, diversity has been greatly reduced at the ESU level because of presumed extirpations and the low abundance in the remaining populations (fewer than 100 spawners per year for most populations) (Lower Columbia Fish Recovery Board 2010; NMFS 2013a). The Lower Gorge population meets abundance and productivity criteria for very high levels of viability, but the distribution of spawning habitat (*i.e.*, spatial structure) for the population has been significantly reduced (Lower Columbia Fish Recovery Board 2010); spatial structure may need to be improved, at least in part, through better performance from the Oregon portion of the population (NMFS 2013a).

Abundance and Productivity. Of the 17 populations that historically made up this ESU, 15 of them (six in Oregon and nine in Washington) are so depleted that either their baseline probability of persistence is very low or they are extirpated or nearly so (Ford 2011; Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010). All three strata in the ESU fall significantly short of the WLC-TRT criteria for viability. Currently almost all natural production occurs in just two populations: the Grays/Chinook and the Lower Gorge.

The Grays/Chinook population has a moderate persistence probability, and the Lower Gorge population has a high probability of persistence (Lower Columbia Fish Recovery Board 2010; NMFS 2013a).

Limiting Factors include (NMFS 2013a; NOAA Fisheries 2011):

- Degraded estuarine and nearshore marine habitat resulting from cumulative impacts of land use and flow management by the Columbia River hydropower system
- Degraded freshwater habitat, in particular of floodplain connectivity and function, channel structure and complexity, stream substrate, and riparian areas and LW recruitment as a result of cumulative impacts of agriculture, forestry, and development
- Degraded stream flow as a result of hydropower and water supply operations
- Loss of access and loss of some habitat types as a result of passage barriers such as roads and railroads
- Reduced water quality
- Current or potential predation from hatchery-origin salmonids, including coho salmon
- An altered flow regime and Columbia River plume has altered the temperature regime and estuarine food web, and has reduced ocean productivity
- Reduced access to off-channel rearing habitat in the lower Columbia River
- Reduced productivity resulting from sediment and nutrient-related changes in the estuary
- Juvenile fish strandings that result from ship wakes
- Contaminants affecting fish health and reproduction

Status of LCR Coho Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of coho salmon in the Columbia River and its tributaries in Washington and Oregon, from the mouth of the Columbia up to and including the Big White Salmon and Hood rivers; in the Willamette River to Willamette Falls, Oregon; and progeny of 25 artificial propagation programs.[29] Spatial diversity is rated "moderate" to "very high" for all the populations, except the North Fork Lewis River, which has a "low" rating for spatial structure.

Three status evaluations of LCR coho salmon status, all based on WLC-TRT criteria, have been conducted since the last NMFS status review in 2005 (McElhany *et al.* 2007; NMFS 2013a). Out of the 24 populations that make up this ESU (Table 15), 21 are considered to have a very low probability of persisting for the next 100 years, and none is considered viable (Ford 2011; Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010).

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[29] The Elochoman Hatchery Type-S and Type-N coho salmon programs were eliminated in 2008. The last adults from these two programs returned to the Elochoman in 2010. NMFS has recommended that these two programs be removed from the ESU (NMFS 2011b).

Table 15. LCR coho salmon strata, ecological subregions, run timing, populations, and scores for the key elements (A&P, spatial structure, and diversity) used to determine current overall net persistence probability of the population (NMFS 2013a). Persistence probability ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Ecological Subregions	Population (Watershed)	A&P	Spatial Structure	Diversity	Overall Persistence Probability
Coast Range	Young's Bay (OR)	VL	VH	VL	VL
	Grays/Chinook rivers (WA)	VL	H	VL	VL
	Big Creek (OR)	VL	H	L	VL
	Elochoman/Skamokawa creeks (WA)	VL	H	VL	VL
	Clatskanie River (OR)	L	VH	M	L
	Mill, Germany, and Abernathy creeks (WA)	VL	H	L	VL
	Scappoose River (OR)	M	H	M	M
Cascade Range	Lower Cowlitz River (WA)	VL	M	M	VL
	Upper Cowlitz River (WA)	VL	M	L	VL
	Cispus River (WA)	VL	M	L	VL
	Tilton River (WA)	VL	M	L	VL
	South Fork Toutle River (WA)	VL	H	M	VL
	North Fork Toutle River (WA)	VL	M	L	VL
	Coweeman River (WA)	VL	H	M	VL
	Kalama River (WA)	VL	H	L	VL
	North Fork Lewis River (WA)	VL	L	L	VL
	East Fork Lewis River (WA)	VL	H	M	VL
	Salmon Creek (WA)	VL	M	VL	VL
	Clackamas River (OR)	M	VH	H	M
	Sandy River (OR)	VL	H	M	VL
	Washougal River (WA)	VL	H	L	VL
Columbia Gorge	Lower Gorge Tributaries (WA & OR)	VL	M	VL	VL
	Upper Gorge/White Salmon (WA)	VL	M	VL	VL
	Upper Gorge Tributaries/Hood (OR)	VL	VH	L	VL

Abundance and Productivity. In Oregon, the Clatskanie Creek and Clackamas River populations have "low" and "moderate" persistence probability ratings for A&P, while the rest are rated "very low." All of the Washington populations have "very low" A&P ratings. The persistence probability for diversity is "high" in the Clackamas population, "moderate" in the Clatskanie, Scappoose, Lower Cowlitz, South Fork Toutle, Coweeman, East Fork Lewis, and Sandy populations, and "low" to "very low" in the rest (NMFS 2013a). Uncertainty is high because of a lack of adult spawner surveys. Smolt traps indicate some natural production in Washington populations, though given the high fraction of hatchery origin spawners suspected to occur in these populations it is not clear that any are self-sustaining. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011; NMFS 2011b; NMFS 2013a).

Limiting Factors include (NMFS 2013a; NOAA Fisheries 2011):

- Degraded estuarine and near-shore marine habitat resulting from cumulative impacts of land use and flow management by the Columbia River hydropower system
- Fish passage barriers that limit access to spawning and rearing habitats
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Hatchery-related effects
- Harvest-related effects
- An altered flow regime and Columbia River plume has altered the temperature regime and estuarine food web, and has reduced ocean productivity
- Reduced access to off-channel rearing habitat in the lower Columbia River
- Reduced productivity resulting from sediment and nutrient-related changes in the estuary
- Juvenile fish strandings that result from ship wakes
- Contaminants affecting fish health and reproduction

Status of LCR Steelhead

Spatial Structure and Diversity. Four strata and 23 historical populations of LCR steelhead occur within the DPS: 17 winter-run populations and six summer-run populations, within the Cascade and Gorge ecological subregions (Table 16).[30] The DPS also includes the progeny of ten artificial propagation programs.[31] Summer steelhead return to freshwater long before spawning. Winter steelhead, in contrast, return from the ocean much closer to maturity and spawn within a few weeks. Summer steelhead spawning areas in the Lower Columbia River are found above waterfalls and other features that create seasonal barriers to migration. Where no temporal barriers exist, the winter-run life history dominates.

[30] The White Salmon and Little White Salmon steelhead populations are part of the Middle Columbia steelhead DPS and are addressed in a separate species-level recovery plan, the Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan (NMFS 2009b).

[31] In 2007, the release of Cowlitz Hatchery winter steelhead into the Tilton River was discontinued; in 2009, the Hood River winter steelhead program was discontinued; and in 2010, the release of hatchery winter steelhead into the Upper Cowlitz and Cispus rivers was discontinued. In 2011, NMFS recommended removing these programs from the DPS. A Lewis River winter steelhead program was initiated in 2009, and in 2011, NMFS proposed that it be included in the DPS (NMFS 2011b).

Table 16. LCR steelhead strata, ecological subregions, run timing, populations, and scores for the key elements (A&P, spatial structure, and diversity) used to determine current overall net persistence probability of the population (NMFS 2013a). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Stratum		Population (Watershed)	A&P	Spatial Structure	Diversity	Overall Persistence Probability
Ecological Subregion	**Run Timing**					
Cascade Range	Summer	Kalama River (WA)	H	VH	M	M
		North Fork Lewis River (WA)	VL	VL	VL	VL
		East Fork Lewis River (WA)	VL	VH	M	VL
		Washougal River (WA)	M	VH	M	M
	Winter	Lower Cowlitz River (WA)	L	M	M	L
		Upper Cowlitz River (WA)	VL	M	M	VL
		Cispus River (WA)	VL	M	M	VL
		Tilton river (WA)	VL	M	M	VL
		South Fork Toutle River (WA)	M	VH	H	M
		North Fork Toutle River (WA)	VL	H	H	VL
		Coweeman River (WA)	L	VH	VH	L
		Kalama River (WA)	L	VH	H	L
		North Fork Lewis River (WA)	VL	M	M	VL
		East Fork Lewis River (WA)	M	VH	M	M
		Salmon Creek (WA)	VL	H	M	VL
		Clackamas River (OR)	M	VH	M	M
		Sandy River (OR)	L	M	M	L
		Washougal River (WA)	L	VH	M	L
Columbia Gorge	Summer	Wind River (WA)	VH	VH	H	H
		Hood River (OR)	VL	VH	L	VL
	Winter	Lower Gorge (WA & OR)	L	VH	M	L
		Upper Gorge (OR & WA)	L	M	M	L
		Hood River (OR)	M	VH	M	M

It is likely that genetic and life history diversity has been reduced as a result of pervasive hatchery effects and population bottlenecks. Spatial structure remains relatively high for most populations Out of the 23 populations, 16 are considered to have a "low" or "very low" probability of persisting over the next 100 years, and six populations have a "moderate" probability of persistence (Ford 2011; Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010). All four strata in the DPS fall short of the WLC-TRT criteria for viability (NMFS 2013a).

Baseline persistence probabilities were estimated to be "low" or "very low" for three out of the six summer steelhead populations that are part of the LCR DPS, moderate for two, and high for one, the Wind, which is considered viable. Thirteen of the 17 LCR winter steelhead populations have "low" or "very low" baseline probabilities of persistence, and the remaining four are at "moderate" probability of persistence (Table 16) (Lower Columbia Fish Recovery Board 2010; NMFS 2013a; ODFW 2010).

Abundance and Productivity. The "low" to "very low" baseline persistence probabilities of most Lower Columbia River steelhead populations reflects low abundance and productivity (NMFS 2013a). All of the populations increased in abundance during the early 2000s, generally peaking in 2004. Most populations have since declined back to levels within one standard deviation of the long term mean. Exceptions are the Washougal summer-run and North Fork Toutle winter-run, which are still higher than the long term average, and the Sandy, which is lower. In general, the populations do not show any sustained dramatic changes in abundance or fraction of hatchery origin spawners since the 2005 status review (Ford 2011). Although current LCR steelhead populations are depressed compared to historical levels and long-term trends show declines, many populations are substantially healthier than their salmon counterparts, typically because of better habitat conditions in core steelhead production areas (Lower Columbia Fish Recovery Board 2010; NMFS 2013a).

Limiting Factors include (NMFS 2013a; NOAA Fisheries 2011):

- Degraded estuarine and nearshore marine habitat resulting from cumulative impacts of land use and flow management by the Columbia River hydropower system
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and recruitment of LW, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Reduced access to spawning and rearing habitat mainly as a result of tributary hydropower projects and lowland development
- Avian and marine mammal predation in the lower mainstem Columbia River and estuary.
- Hatchery-related effects
- An altered flow regime and Columbia River plume has altered the temperature regime and estuarine food web, and has reduced ocean productivity
- Reduced access to off-channel rearing habitat in the lower Columbia River
- Reduced productivity resulting from sediment and nutrient-related changes in the estuary
- Juvenile fish strandings that result from ship wakes
- Contaminants affecting fish health and reproduction

Status of UWR Steelhead.

Spatial Structure and Diversity. This species includes all naturally-spawned steelhead populations below natural and manmade impassable barriers in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River. One stratum and four extant populations of UWR steelhead occur within the DPS (Table 17). Historical observations, hatchery records, and genetics suggest that the presence of UWR steelhead in many tributaries on the west side of the upper basin is the result of recent introductions. Nevertheless, the WLC-TRT recognized that although west side UWR steelhead does not represent a historical population, those tributaries may provide juvenile rearing habitat or may be temporarily (for one or more generations) colonized during periods of high abundance. Hatchery summer-run steelhead that are released in the subbasins are from an out-of-basin stock, not from the DPS. Additionally, stocked summer steelhead that have become established in the McKenzie River were not considered in the identification of historical populations (ODFW and NMFS 2011).

Table 17. Scores for the key elements (A&P, diversity, and spatial structure) used to determine current overall viability risk for UWR steelhead (ODFW and NMFS 2011). All populations are in the Western Cascade Range ecological subregion. Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Population (Watershed)	A&P	Diversity	Spatial Structure	Overall Extinction Risk
Molalla River	VL	M	M	L
North Santiam River	VL	M	H	L
South Santiam River	VL	M	M	L
Calapooia River	M	M	VH	M

Abundance and Productivity. Since the last status review in 2005, UWR steelhead initially increased in abundance but subsequently declines and current abundance is at the levels observed in the mid-1990s when the DPS was first listed. The DPS appears to be at lower risk than the UWR Chinook salmon ESU, but continues to demonstrate the overall low abundance pattern that was of concern during the last status review. The elimination of winter-run hatchery release in the basin reduces hatchery threats, but non-native summer steelhead hatchery releases are still a concern for species diversity. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors include (NOAA Fisheries 2011; ODFW and NMFS 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW recruitment, and stream flow have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Degraded water quality and altered temperature as a result of both tributary dams and the cumulative impacts of agriculture, forestry, and urban development
- Reduced access to spawning and rearing habitats mainly as a result of artificial barriers in spawning tributaries
- Hatchery-related effects: impacts from the non-native summer steelhead hatchery program
- Anthropogenic introductions of non-native species and out-of-ESU races of salmon or steelhead have increased predation and competition on native UWR steelhead

Interior Columbia Recovery Domain. Species in the Interior Columbia (IC) recovery domain include UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, UCR steelhead, Mid-Columbia River (MCR) steelhead, and SRB steelhead. The IC-TRT identified 82 populations of those species based on genetic, geographic (hydrographic), and habitat characteristics (Table 18). In some cases, the IC-TRT further aggregated populations into "major groupings" based on dispersal distance and rate, and drainage structure, primarily the location and distribution of large tributaries (IC-TRT 2003). All 82 populations identified use the lower mainstem of the Snake River, the mainstem of the Columbia River, and the Columbia River estuary, or part thereof, for migration, rearing, and smoltification.

Table 18. Populations of ESA-listed salmon and steelhead in the IC recovery domain.

Species	Populations
UCR spring-run Chinook salmon	3
SR spring/summer-run Chinook salmon	28
SR fall-run Chinook salmon	1
SR sockeye salmon	1
MCR steelhead	17
UCR steelhead	4
SRB steelhead	24

The IC-TRT also recommended viability criteria that follow the VSP framework (McElhany *et al.* 2006) and described biological or physical performance conditions that, when met, indicate a population or species has a 5% or less risk of extinction over a 100-year period (IC-TRT 2007; see also NRC 1995).

Status of UCR Spring-run Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam (excluding the Okanogan River), the Columbia River upstream to Chief Joseph Dam, and progeny of six artificial propagation programs. The IC-TRT identified four independent populations of UCR spring-run Chinook salmon in the upriver tributaries of Wenatchee, Entiat, Methow, and Okanogan (extirpated), but no major groups due to the relatively small geographic area affected (Ford 2011; IC-TRT 2003)(Table 19).

Table 19. Scores for the key elements (A&P, diversity, and SS/D) used to determine current overall viability risk for spring-run UCR Chinook salmon (Ford 2011). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH), and extirpated (E).

Population	A&P	Diversity	Integrated SS/D	Overall Viability Risk
Wenatchee River	H	H	H	H
Entiat River	H	H	H	H
Methow River	H	H	H	H
Okanogan River				E

The composite SS/D risks for all three of the extant populations in this MPG are at "high" risk. The spatial processes component of the SS/D risk is "low" for the Wenatchee River and Methow River populations and "moderate" for the Entiat River (loss of production in lower section increases effective distance to other populations). All three of the extant populations in this MPG are at "high" risk for diversity, driven primarily by chronically high proportions of hatchery-origin spawners in natural spawning areas and lack of genetic diversity among the natural-origin spawners (Ford 2011).

Increases in natural origin abundance relative to the extremely low spawning levels observed in the mid-1990s are encouraging; however, average productivity levels remain extremely low. Overall, the viability of Upper Columbia Spring Chinook salmon ESU has likely improved somewhat since the last status review, but the ESU is still clearly at "moderate-to-high" risk of extinction (Ford 2011).

Abundance and Productivity. UCR spring-run Chinook salmon is not currently meeting the viability criteria (adapted from the IC-TRT) in the Upper Columbia Recovery Plan. A&P remains at "high" risk for each of the three extant populations in this MPG/ESU (Table 19). The 10-year geometric mean abundance of adult natural origin spawners has increased for each population relative to the levels for the 1981-2003 series, but the estimates remain below the corresponding IC-TRT thresholds. Estimated productivity (spawner to spawner return rate at low to moderate escapements) was on average lower over the years 1987-2009 than for the previous period. The combinations of current abundance and productivity for each population result in a "high" risk rating.

Limiting Factors include (NOAA Fisheries 2011; Upper Columbia Salmon Recovery Board 2007):

- Mainstem Columbia River hydropower–related adverse effects: upstream and downstream fish passage, ecosystem structure and function, flows, and water quality
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW recruitment, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Degraded estuarine and nearshore marine habitat
- Hatchery related effects: including past introductions and persistence of non-native (exotic) fish species continues to affect habitat conditions for listed species
- Harvest in Columbia River fisheries

Status of SR Spring/summer-run Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins; and progeny of fifteen artificial propagation programs. The IC-TRT currently believes there are 27 extant and 4 extirpated populations of SR spring/summer-run Chinook salmon, and aggregated these into major population groups (Ford 2011; IC-TRT 2007). Each of these populations faces a "high" risk of extinction (Ford 2011) (Table 20).

Table 20. SR spring/summer-run Chinook salmon ecological subregions, populations, and scores for the key elements (A&P, diversity, and SS/D) used to determine current overall viability risk for SR spring/summer-run Chinook salmon (Ford 2011). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH), and extirpated (E).

Ecological Subregions	Spawning Populations (Watershed)	A&P	Diversity	Integrated SS/D	Overall Viability Risk
Lower Snake River	Tucannon River	H	M	M	H
	Asotin River				E
Grande Ronde and Imnaha rivers	Wenaha River	H	M	M	H
	Lostine/Wallowa River	H	M	M	H
	Minam River	H	M	M	H
	Catherine Creek	H	M	M	H
	Upper Grande Ronde R.	H	M	H	H
	Imnaha River	H	M	M	H
	Big Sheep Creek				E
	Lookingglass Creek				E
South Fork Salmon River	Little Salmon River	*	*	*	H
	South Fork mainstem	H	M	M	H
	Secesh River	H	L	L	H
	EF/Johnson Creek	H	L	L	H
Middle Fork Salmon River	Chamberlin Creek	H	L	L	H
	Big Creek	H	M	M	H
	Lower MF Salmon	H	M	M	H
	Camas Creek	H	M	M	H
	Loon Creek	H	M	M	H
	Upper MF Salmon	H	M	M	H
	Sulphur Creek	H	M	M	H
	Bear Valley Creek	H	L	L	H
	Marsh Creek	H	L	L	H
Upper Mainstem Salmon	N. Fork Salmon River	H	L	L	H
	Lemhi River	H	H	H	H
	Pahsimeroi River	H	H	H	H
	Upper Salmon-lower mainstem	H	L	L	H
	East Fork Salmon River	H	H	H	H
	Yankee Fork	H	H	H	H
	Valley Creek	H	M	M	H
	Upper Salmon main	H	M	M	H
	Panther Creek				E

* Insufficient data.

Abundance and Productivity. Population level status ratings remain at "high" risk across all MPGs within the ESU, although recent natural spawning abundance estimates have increased, all populations remain below minimum natural origin abundance thresholds (Table 20). Spawning escapements in the most recent years in each series are generally well below the peak returns but above the extreme low levels in the mid-1990s.

Relatively low natural production rates and spawning levels below minimum abundance thresholds remain a major concern across the ESU.

The ability of SR spring/summer-run Chinook salmon populations to be self-sustaining through normal periods of relatively low ocean survival remains uncertain. Factors cited by Good (2005) remain as concerns or key uncertainties for several populations. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors include (NOAA Fisheries 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, stream substrate, elevated water temperature, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Mainstem Columbia River and Snake River hydropower impacts
- Harvest-related effects
- Predation

Status of SR Fall-run Chinook Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam, and in the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River, and progeny of four artificial propagation programs. The IC-TRT identified three populations of this species, although only the lower mainstem population exists at present, and it spawns in the lower main stem of the Clearwater, Imnaha, Grande Ronde, Salmon and Tucannon rivers. The extant population of Snake River fall-run Chinook salmon is the only remaining population from an historical ESU that also included large mainstem populations upstream of the current location of the Hells Canyon Dam complex (Ford 2011; IC-TRT 2003). The population is at moderate risk for diversity and spatial structure. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Abundance and Productivity. The recent increases in natural origin abundance are encouraging. However, hatchery origin spawner proportions have increased dramatically in recent years. On average, 78% of the estimated adult spawners have been hatchery origin over the most recent brood cycle. The apparent leveling off of natural returns in spite of the increases in total brood year spawners may indicate that density dependent habitat effects are influencing production or that high hatchery proportions may be influencing natural production rates. The A&P risk rating for the population is "moderate." Given the combination of current A&P and SS/D ratings summarized above, the overall viability rating for Lower SR fall Chinook salmon would be rated as "maintained."[32]

[32] "Maintained" population status is for populations that do not meet the criteria for a viable population but do support ecological functions and preserve options for ESU/DPS recovery.

Limiting Factors include (NOAA Fisheries 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, and channel structure and complexity have been degraded as a result of cumulative impacts of agriculture, forestry, and development.
- Harvest-related effects
- Loss of access to historic habitat above Hells Canyon and other Snake River dams
- Mainstem Columbia River and Snake River hydropower impacts
- Hatchery-related effects
- Degraded estuarine and nearshore habitat

Status of SR Sockeye Salmon

Spatial Structure and Diversity. This species includes all anadromous and residual sockeye salmon from the Snake River basin, Idaho, and artificially-propagated sockeye salmon from the Redfish Lake captive propagation program. The IC-TRT identified historical sockeye salmon production in at least five Stanley Basin and Sawtooth Valley lakes and in lake systems associated with Snake River tributaries currently cut off to anadromous access (*e.g.*, Wallowa and Payette Lakes), although current returns of SR sockeye salmon are extremely low and limited to Redfish Lake (IC-TRT 2007).

Abundance and Productivity. This species is still at extremely high risk across all four basic risk measures (abundance, productivity, spatial structure and diversity. Although the captive brood program has been successful in providing substantial numbers of hatchery produced *O. nerka* for use in supplementation efforts, substantial increases in survival rates across life history stages must occur to re-establish sustainable natural production (Hebdon *et al.* 2004; Keefer *et al.* 2008). Overall, although the risk status of the Snake River sockeye salmon ESU appears to be on an improving trend, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors. The key factor limiting recovery of SR sockeye salmon ESU is survival outside of the Stanley Basin. Portions of the migration corridor in the Salmon River are impeded by water quality and temperature (Idaho Department of Environmental Quality 2011). Increased temperatures likely reduce the survival of adult sockeye returning to the Stanley Basin. The natural hydrological regime in the upper mainstem Salmon River Basin has been altered by water withdrawals. In most years, sockeye adult returns to Lower Granite suffer catastrophic losses (Reed *et al.* 2003) (*e.g.*, greater than 50% mortality in one year) before reaching the Stanley Basin, although the factors causing these losses have not been identified. In the Columbia and lower Snake River migration corridor, predation rates on juvenile sockeye salmon are unknown, but terns and cormorants consume 12% of all salmon smolts reaching the estuary, and piscivorous fish consume an estimated 8% of migrating juvenile salmon (NOAA Fisheries 2011).

Status of MCR Steelhead

Spatial Structure and Diversity. This species includes all naturally-spawned steelhead populations below natural and artificial impassable barriers in streams from above the Wind

River, Washington, and the Hood River, Oregon (exclusive), upstream to, and including, the Yakima River, Washington, excluding steelhead from the Snake River basin; and progeny of seven artificial propagation programs. The IC-TRT identified 17 extant populations in this DPS (IC-TRT 2003). The populations fall into four major population groups: the Yakima River Basin (four extant populations), the Umatilla/Walla-Walla drainages (three extant and one extirpated populations); the John Day River drainage (five extant populations) and the Eastern Cascades group (five extant and two extirpated populations) (Table 21) (Ford 2011; NMFS 2009b).

Table 21. Ecological subregions, populations, and scores for the key elements (A&P, diversity, and SS/D) used to determine current overall viability risk for MCR steelhead (Ford 2011; NMFS 2009b). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH), and extirpated (E). Maintained (MT) population status indicates that the population does not meet the criteria for a viable population but does support ecological functions and preserve options for recovery of the DPS.

Ecological Subregions	Population (Watershed)	A&P	Diversity	Integrated SS/D	Overall Viability Risk
Cascade Eastern Slope Tributaries	Fifteenmile Creek	L	L	L	Viable
	Klickitat River	M	M	M	MT?
	Eastside Deschutes River	L	M	M	Viable
	Westside Deschutes River	H	M	M	H*
	Rock Creek	H	M	M	H?
	White Salmon				E*
	Crooked River				E*
John Day River	Upper Mainstem	M	M	M	MT
	North Fork	VL	L	L	Highly Viable
	Middle Fork	M	M	M	MT
	South Fork	M	M	M	MT
	Lower Mainstem	M	M	M	MT
Walla Walla and Umatilla rivers	Umatilla River	M	M	M	MT
	Touchet River	M	M	M	H
	Walla Walla River	M	M	M	MT
Yakima River	Satus Creek	M	M	M	Viable (MT)
	Toppenish Creek	M	M	M	Viable (MT)
	Naches River	H	M	M	H
	Upper Yakima	H	H	H	H

* Re-introduction efforts underway (NMFS 2009b).

Straying frequencies into at least the Lower John Day River population are high. Out-of-basin hatchery stray proportions, although reduced, remain very high in the Deschutes River basin.

Abundance and Productivity. Returns to the Yakima River basin and to the Umatilla and Walla Walla Rivers have been higher over the most recent brood cycle, while natural origin returns to the John Day River have decreased.

There have been improvements in the viability ratings for some of the component populations, but the MCR steelhead DPS is not currently meeting the viability criteria (adopted from the IC-TRT) in the MCR steelhead recovery plan (NMFS 2009b). In addition, several of the factors cited by Good (2005) remain as concerns or key uncertainties. Natural origin spawning estimates of populations have been highly variable with respect to meeting minimum abundance thresholds. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Limiting Factors include (NMFS 2009b; NOAA Fisheries 2011):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas, fish passage, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, tributary hydro system activities, and development
- Mainstem Columbia River hydropower–related impacts
- Degraded estuarine and nearshore marine habitat
- Hatchery-related effects
- Harvest-related effects
- Effects of predation, competition, and disease

Status of UCR Steelhead

Spatial Structure and Diversity. This species includes all naturally-spawned steelhead populations below natural and manmade impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S.-Canada border, and progeny of six artificial propagation programs. Four independent populations of UCR steelhead were identified by the IC-TRT in the same upriver tributaries as for UC spring-run Chinook salmon (*i.e.*, Wenatchee, Entiat, Methow, and Okanogan; Table 22) and, similarly, no major population groupings were identified due to the relatively small geographic area involved (Ford 2011; IC-TRT 2003). All extant populations are considered to be at high risk of extinction (Table 22)(Ford 2011). With the exception of the Okanogan population, the Upper Columbia populations rated as "low" risk for spatial structure. The "high" risk ratings for SS/D are largely driven by chronic high levels of hatchery spawners within natural spawning areas and lack of genetic diversity among the populations. The proportions of hatchery origin returns in natural spawning areas remain extremely high across the DPS, especially in the Methow and Okanogan River populations. Overall, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Table 22. Summary of the key elements (A&P, diversity, and SS/D) and scores used to determine current overall viability risk for UCR steelhead populations (Ford 2011). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH).

Population (Watershed)	A&P	Diversity	Integrated SS/D	Overall Viability Risk
Wenatchee River	H	H	H	H
Entiat River	H	H	H	H
Methow River	H	H	H	H
Okanogan River	H	H	H	H

Abundance and Productivity. Upper Columbia steelhead populations have increased in natural origin abundance in recent years, but productivity levels remain low. The modest improvements in natural returns in recent years are probably primarily the result of several years of relatively good natural survival in the ocean and tributary habitats.

Limiting Factors include (NOAA Fisheries 2011; Upper Columbia Salmon Recovery Board 2007):

- Mainstem Columbia River hydropower–related adverse effects
- Impaired tributary fish passage
- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW recruitment, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development.
- Effects of predation, competition, and disease mortality: Fish management, including past introductions and persistence of non-native (exotic) fish species continues to affect habitat conditions for listed species.
- Hatchery-related effects
- Harvest-related effects

Status of SRB Steelhead

Spatial Structure and Diversity. This species includes all naturally-spawned steelhead populations below natural and manmade impassable barriers in streams in the Snake River Basin of southeast Washington, northeast Oregon, and Idaho, and progeny of six artificial propagation programs. The IC-TRT identified 24 populations in five major groups (Table 23) (Ford 2011; IC-TRT 2010). The IC-TRT has not assessed the viability of this species. The relative proportion of hatchery fish in natural spawning areas near major hatchery release sites is highly uncertain. There is little evidence for substantial change in ESU viability relative to the previous BRT and IC-TRT reviews. Overall, therefore, the new information considered does not indicate a change in the biological risk category since the last status review (Ford 2011).

Table 23. Ecological subregions, populations, and scores for the key elements (A&P, diversity, and SS/D) used to determine current overall viability risk for SRB steelhead (Ford 2011; NMFS 2011c). Risk ratings range from very low (VL), low (L), moderate (M), high (H), to very high (VH). Maintained (MT) population status indicates that the population does not meet the criteria for a viable population but does support ecological functions and preserve options for recovery of the DPS.

Ecological subregions	Spawning Populations (Watershed)	A&P	Diversity	Integrated SS/D	Overall Viability Risk*
Lower Snake River	Tucannon River	**	M	M	H
	Asotin Creek	**	M	M	MT
Grande Ronde River	Lower Grande Ronde	**	M	M	Not rated
	Joseph Creek	VL	L	L	Highly viable
	Upper Grande Ronde	M	M	M	MT
	Wallowa River	**	L	L	H
Clearwater River	Lower Clearwater	M	L	L	MT
	South Fork Clearwater	H	M	M	H
	Lolo Creek	H	M	M	H
	Selway River	H	L	L	H
	Lochsa River	H	L	L	H
Salmon River	Little Salmon River	**	M	M	MT
	South Fork Salmon	**	L	L	H
	Secesh River	**	L	L	H
	Chamberlain Creek	**	L	L	H
	Lower MF Salmon	**	L	L	H
	Upper MF Salmon	**	L	L	H
	Panther Creek	**	M	H	H
	North Fork Salmon	**	M	M	MT
	Lemhi River	**	M	M	MT
	Pahsimeroi River	**	M	M	MT
	East Fork Salmon	**	M	M	MT
	Upper Main Salmon	**	M	M	MT
Imnaha	Imnaha River	M	M	M	MT

* There is uncertainty in these ratings due to a lack of population-specific data.
** Insufficient data.

Abundance and Productivity. The level of natural production in the two populations with full data series and the Asotin Creek index reaches is encouraging, but the status of most populations in this DPS remains highly uncertain. Population-level natural origin abundance and productivity inferred from aggregate data and juvenile indices indicate that many populations are likely below the minimum combinations defined by the IC-TRT viability criteria.

Limiting Factors include (IC-TRT 2010; NMFS 2011c):

- Mainstem Columbia River hydropower–related adverse effects
- Impaired tributary fish passage

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW recruitment, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, and development
- Impaired water quality and increased water temperature
- Related harvest effects, particularly for B-run steelhead
- Predation
- Genetic diversity effects from out-of-population hatchery releases

Oregon Coast Recovery Domain. The OC recovery domain includes OC coho salmon and southern DPS eulachon, on the Oregon coast and streams south of the Columbia River and north of Cape Blanco. Streams and rivers in this area drain west into the Pacific Ocean, and vary in length from less than a mile to more than 210 miles in length.

Status of OC Coho Salmon

Spatial Structure and Diversity. This species includes populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco. The Cow Creek stock (South Umpqua population) is included as part of the ESU because the original brood stock was founded from the local, natural origin population and natural origin coho salmon have been incorporated into the brood stock on a regular basis.

The OC-TRT identified 56 populations; 21 independent and 35 dependent. The dependent populations were dependent on strays from other populations to maintain them over long time periods. The TRT also identified 5 biogeographic strata (Table 24)(Lawson *et al.* 2007).

Table 24. OC coho salmon populations. Dependent populations (D) are populations that historically would not have had a high likelihood of persisting in isolation for 100 years. These populations relied upon periodic immigration from other populations to maintain their abundance. Independent populations are populations that historically would have had a high likelihood of persisting in isolation from neighboring populations for 100 years and are rated as functionally independent (FI) and potentially independent (PI) (Lawson *et al.* 2007; McElhany *et al.* 2000).

Stratum	Population	Type	Stratum	Population	Type
North Coast	Necanicum River	PI	Mid-Coast (cont.)	Alsea River	FI
	Ecola Creek	D		Big Creek (Alsea)	D
	Arch Cape Creek	D		Vingie Creek	D
	Short Sands Creek	D		Yachats River	D
	Nehalem River	FI		Cummins Creek	D
	Spring Creek	D		Bob Creek	D
	Watseco Creek	D		Tenmile Creek	D
	Tillamook Bay	FI		Rock Creek	D
	Netarts Bay	D		Big Creek (Siuslaw)	D
	Rover Creek	D		China Creek	D
	Sand Creek	D		Cape Creek	D
	Nestucca River	FI		Berry Creek	D
	Neskowin Creek	D		Sutton Creek	D
Mid-Coast	Salmon River	PI	Lakes	Siuslaw River	FI
	Devils Lake	D		Siltcoos Lake	PI
	Siletz River	FI		Tahkenitch Lake	PI
	Schoolhouse Creek	D		Tenmile Lakes	PI
	Fogarty Creek	D	Umpqua	Lower Umpqua River	FI
	Depoe Bay	D		Middle Umpqua River	FI
	Rocky Creek	D		North Umpqua River	FI
	Spencer Creek	D		South Umpqua River	FI
	Wade Creek	D	Mid-South Coast	Threemile Creek	D
	Coal Creek	D		Coos River	FI
	Moolack Creek	D		Coquille River	FI
	Big Creek (Yaquina)	D		Johnson Creek	D
	Yaquina River	FI		Twomile Creek	D
	Theil Creek	D		Floras Creek	PI
	Beaver Creek	PI		Sixes River	PI

A 2010 BRT noted significant improvements in hatchery and harvest practices have been made (Stout *et al.* 2012). However, harvest and hatchery reductions have changed the population dynamics of the ESU. Current concerns for spatial structure focus on the Umpqua River. Of the four populations in the Umpqua stratum, the North Umpqua and South Umpqua, were of particular concern. The North Umpqua is controlled by Winchester Dam and has historically been dominated by hatchery fish. Hatchery influence has recently been reduced, but the natural productivity of this population remains to be demonstrated. The South Umpqua is a large, warm system with degraded habitat. Spawner distribution appears to be seriously restricted in this population, and it is probably the most vulnerable of any population in this ESU to increased temperatures.

Current status of diversity shows improvement through the waning effects of hatchery fish on populations of OC coho salmon. In addition, recent efforts in several coastal estuaries to restore lost wetlands should be beneficial. However, diversity is lower than it was historically because of the loss of both freshwater and tidal habitat loss coupled with the restriction of diversity from very low returns over the past 20 years.

Abundance and Productivity. It has not been demonstrated that productivity during periods of poor marine survival is now adequate to sustain the ESU. Recent increases in adult escapement do not provide strong evidence that the century-long downward trend has changed. The ability of the OC coho salmon ESU to survive another prolonged period of poor marine survival remains in question. Wainwright (2008) determined that the weakest strata of OC coho salmon were in the North Coast and Mid-Coast of Oregon, which had only "low" certainty of being persistent. The strongest strata were the Lakes and Mid-South Coast, which had "high" certainty of being persistent. To increase certainty that the ESU as a whole is persistent, they recommended that restoration work should focus on those populations with low persistence, particularly those in the North Coast, Mid-Coast, and Umpqua strata.

Limiting Factors include (NOAA Fisheries 2011; Stout *et al.* 2012):

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and LW supply, stream substrate, stream flow, and water quality have been degraded as a result of cumulative impacts of agriculture, forestry, instream mining, dams, road crossings, dikes, levees, *etc.*
- Fish passage barriers that limit access to spawning and rearing habitats
- Adverse climate, altered past ocean/marine productivity, and current ocean ecosystem conditions have favored competitors and predators and reduced salmon survival rates in freshwater rivers and lakes, estuaries, and marine environments

Southern Oregon and Northern California Coasts Recovery Domain. The SONCC recovery domain includes coho salmon and southern DPS eulachon. The SONCC recovery domain extends from Cape Blanco, Oregon, to Punta Gorda, California. This area includes many small-to-moderate-sized coastal basins, where high quality habitat occurs in the lower reaches of each basin, and three large basins (Rogue, Klamath and Eel) where high quality habitat is in the lower reaches, little habitat is provided by the middle reaches, and the largest amount of habitat is in the upper reaches.

Status of SONCC Coho Salmon

Spatial Structure and Diversity. This species includes all naturally-spawned populations of coho salmon in coastal streams from the Elk River near Cape Blanco, Oregon, through and including the Mattole River near Punta Gorda, California, and progeny of three artificial propagation programs (NMFS 2012b). Williams *et al.* (2006) designated 45 populations of coho salmon in the SONCC coho salmon ESU. These populations were further grouped into seven diversity strata based on the geographical arrangement of the populations and basin-scale genetic, environmental, and ecological characteristics (Table 25).

Table 25. SONCC coho salmon populations in Oregon. Williams *et al.* (2006) classified populations as dependent or independent based on their historical population size. Independent populations are populations that historically would have had a high likelihood of persisting in isolation from neighboring populations for 100 years and are rated as functionally independent (FI) and potentially independent (PI). Core population types are independent populations judged most likely to become viable most quickly. Non-core 1 population types are independent populations judged to have lesser potential for rapid recovery than the core populations. Dependent populations (D) are populations that historically would not have had a high likelihood of persisting in isolation for 100 years. These populations relied upon periodic immigration from other populations to maintain their abundance. Two ephemeral populations (E) are defined as populations both small enough and isolated enough that they are only intermittently present (McElhany *et al.* 2000; NMFS 2012b; Williams *et al.* 2006).

Stratum	Population	Population Type
Northern Coastal	Elk River	FI Core
	Hubbard Creek	E
	Brush Creek	D
	Mussel Creek	D
	Euchre Creek	E
	Lower Rogue River	PI Non-Core 1
	Hunter Creek	D
	Pistol River	D
	Chetco River	FI Core
	Winchuck River*	PI Non-Core 1
Interior Rogue	Upper Rogue River	FI Core
	Middle Rogue/Applegate*	FI Non-Core 1
	Illinois River*	FI Core
Interior Klamath	Upper Klamath River*	FI Core
Central Coastal	Smith River*	FI core

* Populations that also occur partly in California.

NMFS considered the role each population is expected to play in a recovered ESU to determine population abundance and juvenile occupancy targets for all the populations in the SONCC coho salmon ESU. Independent populations are evaluated using a modified Bradbury (1995) framework. This model uses three groupings of criteria for ranking watersheds for Pacific salmon restoration prioritization: 1) biological and ecological resources (Biological Importance); 2) watershed integrity and salmonid extinction risk (Integrity and Risk); and 3) potential for restoration (Optimism and Potential). Scores for Biological Importance are based on the concept of VSPs (McElhany *et al.* 2000), and are used to describe the current status of the population (population size, productivity, spatial structure, and diversity). "Core" populations were designated based on current condition, geographic location in the ESU, low risk threshold compared to the number of spawners needed for the entire stratum, and other factors. "Non-core 1" populations are in the moderate risk threshold, which is the depensation threshold[33]

[33] Williams (2008) defines the depensation threshold as one spawner per km of stream with estimated rearing potential or Intrinsic Potential.

multiplied by four. NMFS chooses this target if the population is likely to ultimately produce considerably more than the depensation threshold, but less than the low risk threshold.

The draft recovery plan establishes the following criteria at the ESU, diversity strata, and population scales to measure whether the recovery objectives are met (NMFS 2012b).

VSP Parameter	Population Type	Recovery Objective	Recovery Criteria
Abundance	Core	Low risk of extinction.	The geometric mean of wild spawners over 12 years at least meets the "low risk threshold" of spawners for each core population
	Non-Core 1	Moderate or low risk of extinction.	The annual number of wild spawners meets or exceeds the moderate risk threshold for each non-core population
Productivity	Core and Non-Core 1	Population growth rate is not negative.	Slope of regression of the geometric mean of wild spawners over the time series ≥ zero
Spatial Structure	Core and Non-Core 1	Ensure populations are widely distributed.	Annual within-population distribution ≥ 80% of habitat (outside of a temperature mask)
	Non-Core 2 and Dependent	Achieve inter- and intra-stratum connectivity.	20% of accessible habitat is occupied in years following spawning of cohorts that experienced good marine survival
Diversity	Core and Non-Core 1	Achieve low or moderate hatchery impacts on wild fish.	Proportion of hatchery-origin spawners (pHOS) ≤ 0.10
	Core and Non-Core 1	Achieve life history diversity.	Variation is present in migration timing, age structure, size and behavior. Variation in these parameters is retained.

Abundance and Productivity. Although long-term data on abundance of SONCC coho salmon are scarce, available evidence from shorter-term research and monitoring efforts indicate that conditions have worsened for populations since the last formal status review was published (Good *et al.* 2005; NMFS 2012b). Because the extinction risk of an ESU depends upon the extinction risk of its constituent independent populations and the population abundance of most independent populations are below their depensation threshold, the SONCC coho salmon ESU is at high risk of extinction and is not viable (NMFS 2012b).

Limiting Factors. Threats from natural or man-made factors have worsened in the past 5 years, primarily due to four factors: small population dynamics, climate change, multi-year drought, and poor ocean survival conditions (NMFS 2012b; NOAA Fisheries 2011). Limiting factors include:

- Lack of floodplain and channel structure
- Impaired water quality
- Altered hydrologic function (timing of volume of water flow)
- Impaired estuary/mainstem function
- Degraded riparian forest conditions
- Altered sediment supply
- Increased disease/predation/competition
- Barriers to migration

- Adverse fishery-related effects
- Adverse hatchery-related effects

2.2.2 Status of the Critical Habitats

This section examines the status of designated critical habitat affected by the proposed action by examining the condition and trends of essential physical and biological features throughout the designated areas. These features are essential to the conservation of the listed species because they support one or more of the species' life stages (*e.g.*, sites with conditions that support spawning, rearing, migration and foraging).

For salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC_5) in terms of the conservation value they provide to each listed species they support.[34] The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS' critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water condition, side channels), the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area (NOAA Fisheries 2005). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential due to factors such as limited availability (*e.g.*, one of a very few spawning areas), a unique contribution of the population it served (*e.g.*, a population at the extreme end of geographic distribution), or the fact that it serves another important role (*e.g.*, obligate area for migration to upstream spawning areas).

The physical or biological features of freshwater spawning and incubation sites, include water flow, quality and temperature conditions and suitable substrate for spawning and incubation, as well as migratory access for adults and juveniles (Table 26-27). These features are essential to conservation because without them the species cannot successfully spawn and produce offspring. The physical or biological features of freshwater migration corridors associated with spawning and incubation sites include water flow, quality and temperature conditions supporting larval and adult mobility, abundant prey items supporting larval feeding after yolk sac depletion, and free passage (no obstructions) for adults and juveniles. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

[34] The conservation value of a site depends upon "(1) the importance of the populations associated with a site to the ESU [or DPS] conservation, and (2) the contribution of that site to the conservation of the population through demonstrated or potential productivity of the area" (NOAA Fisheries 2005).

Table 26. Primary constituent elements (PCEs) of critical habitats designated for ESA-listed salmon and steelhead species considered in the opinion (except SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, and SONCC coho salmon), and corresponding species life history events.

Primary Constituent Elements		Species Life History Event
Site Type	**Site Attribute**	
Freshwater spawning	Substrate Water quality Water quantity	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Floodplain connectivity Forage Natural cover Water quality Water quantity	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation and "reverse smoltification" Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine areas	Forage Free of artificial obstruction Natural cover Water quantity Water quality	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing
Offshore marine areas	Forage Water quality	Adult growth and sexual maturation Adult spawning migration Subadult rearing

Table 27. PCEs of critical habitats designated for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, SONCC coho salmon, and corresponding species life history events.

Primary Constituent Elements		Species Life History Event
Site	**Site Attribute**	
Spawning and juvenile rearing areas	Access (sockeye) Cover/shelter Food (juvenile rearing) Riparian vegetation Space (Chinook, coho) Spawning gravel Water quality Water temp (sockeye) Water quantity	Adult spawning Embryo incubation Alevin growth and development Fry emergence from gravel Fry/parr/smolt growth and development
Adult and juvenile migration corridors	Cover/shelter Food (juvenile) Riparian vegetation Safe passage Space Substrate Water quality Water quantity Water temperature Water velocity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Areas for growth and development to adulthood	Ocean areas – not identified	Nearshore juvenile rearing Subadult rearing Adult growth and sexual maturation Adult spawning migration

CHART Salmon and Steelhead Critical Habitat Assessments. The CHART for each recovery domain assessed biological information pertaining to areas under consideration for designation as critical habitat to identify the areas occupied by listed salmon and steelhead, determine whether those areas contained PCEs essential for the conservation of those species and whether unoccupied areas existed within the historical range of the listed salmon and steelhead that are also essential for conservation. The CHARTs assigned a 0 to 3 point score for the PCEs in each HUC_5 watershed for:

Factor 1. Quantity,
Factor 2. Quality – Current Condition,
Factor 3. Quality – Potential Condition,
Factor 4. Support of Rarity Importance,
Factor 5. Support of Abundant Populations, and
Factor 6. Support of Spawning/Rearing.

Thus, the quality of habitat in a given watershed was characterized by the scores for Factor 2 (quality - current condition), which considers the existing condition of the quality of PCEs in the HUC_5 watershed; and Factor 3 (quality – potential condition), which considers the likelihood of achieving PCE potential in the HUC_5 watershed, either naturally or through active conservation/restoration, given known limiting factors, likely biophysical responses, and feasibility.

Southern DPS Eulachon. Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington (USDC 2011). All of these areas are designated as migration and spawning habitat for this species. In Oregon, 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek have been designated. The mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles is also designated as critical habitat. Table 28 delineates the designated physical or biological features for eulachon.

Table 28. Physical or biological features of critical habitats designated for eulachon and corresponding species life history events.

Physical or biological features		Species Life History Event
Site Type	**Site Attribute**	
Freshwater spawning and incubation	Flow Water quality Water temperature Substrate	Adult spawning Incubation
Freshwater migration	Flow Water quality Water temperature Food	Adult and larval mobility Larval feeding

The range of eulachon in the Pacific Northwest completely overlaps with the range of several ESA-listed stocks of salmon and steelhead. Although the habitat requirements of these fishes differ somewhat from eulachon, efforts to protect habitat generally focus on the maintenance of watershed processes that will be expected to benefit eulachon. The BRT identified dams and water diversions as moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and Klamath systems, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods (Gustafson *et al.* 2010). Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown (Gustafson *et al.* 2010). The BRT identified dredging as a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental.

The lower Columbia River mainstem provides spawning and incubation sites, and a large migratory corridor to spawning areas in the tributaries. Prior to the construction of Bonneville Dam, eulachon ascended the Columbia River as far as Hood River, Oregon. Major tributaries that support spawning runs include the Grays, Skamokawa, Elochoman, Kalama, Lewis and Sandy rivers.

The number of eulachon returning to the Umpqua River seems to have declined in the 1980s, and does not appear to have rebounded to previous levels. Additionally, eulachon are regularly caught in salmonid smolt traps operated in the lower reaches of Tenmile Creek by ODFW.

Puget Sound Recovery Domain. Critical habitat has been designated in Puget Sound for PS Chinook salmon, HC summer-run chum salmon, LO sockeye salmon, and southern DPS eulachon, and proposed for PS steelhead. Major tributary river basins in the Puget Sound basin include the Nooksack, Samish, Skagit, Sauk, Stillaguamish, Snohomish, Lake Washington, Cedar, Sammamish, Green, Duwamish, Puyallup, White, Carbon, Nisqually, Deschutes, Skokomish, Duckabush, Dosewallips, Big Quilcene, Elwha, and Dungeness rivers and Soos Creek.

Landslides can occur naturally in steep, forested lands, but inappropriate land use practices likely have accelerated their frequency and the amount of sediment delivered to streams. Fine sediment from unpaved roads has also contributed to stream sedimentation. Unpaved roads are widespread on forested lands in the Puget Sound basin, and to a lesser extent, in rural residential areas. Historical logging removed most of the riparian trees near stream channels. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced stream shade and LW recruitment (Shared Strategy for Puget Sound 2007).

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and LW. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat. When the water level of Lake Washington was lowered 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses. Wetlands play an important role in hydrologic processes, as they store water which ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Forest wetlands are estimated to have diminished by one-third in Washington State (FEMAT 1993; Shared Strategy for Puget Sound 2007; Spence *et al.* 1996).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of suspended sediment, presumably from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture or livestock impacts, have been documented in many Puget Sound tributaries (Shared Strategy for Puget Sound 2007).

Peak stream flows have increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clear cuts (Shared Strategy for Puget Sound 2007). In urbanized Puget Sound, there is a strong association between land use and land cover attributes and rates of coho spawner mortality likely due to runoff containing contaminants emitted from motor vehicles (Feist *et al.* 2011).

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook salmon populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat (*e.g.*, Elwha River dams block anadromous fish access to 70 miles of potential habitat) changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants, and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and LW to downstream areas (Shared Strategy for Puget Sound 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion headgates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system (WDFW 2009). Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins (Shared Strategy for Puget Sound 2007).

The nearshore marine habitat has been extensively altered and armored by industrial and residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand (Shared Strategy for Puget Sound 2007).

Degradation of the near-shore environment has occurred in the southeastern areas of Hood Canal in recent years, resulting in late summer marine oxygen depletion and significant fish kills. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has degraded certain physical and chemical characteristics of the near-shore environment (Hood Canal Coordinating Council 2005; Shared Strategy for Puget Sound 2007).

In summary, critical habitat throughout the Puget Sound basin has been degraded by numerous management activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of LW, intense urbanization, agriculture, alteration of floodplain and stream morphology (*i.e.*, channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors in areas of critical habitat.

The PS recovery domain CHART determined that only a few watersheds with PCEs for Chinook salmon in the Whidbey Basin (Skagit River/Gorge Lake, Cascade River, Upper Sauk River, and the Tye and Beckler rivers) are in good to excellent condition with no potential for improvement. Most HUC_5 watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or a high potential for improvement (Table 29).

Table 29. **Puget Sound Recovery Domain:** Current and potential quality of HUC5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK) and chum salmon (CM) (NOAA Fisheries 2005).[35] Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = reduced, with high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC_5 Code(s)	Listed Species	Current Quality	Potential Quality
Strait of Georgia and Whidbey Basin #1711000xxx			
Skagit River/Gorge Lake (504), Cascade (506) & Upper Sauk (601) rivers, Tye & Beckler rivers (901)	CK	3	3
Skykomish River Forks (902)	CK	3	1
Skagit River/Diobsud (505), Illabot (507), & Middle Skagit/Finney Creek (701) creeks; & Sultan River (904)	CK	2	3
Skykomish River/Wallace River (903) & Skykomish River/Woods Creek (905)	CK	2	2
Upper (602) & Lower (603) Suiattle rivers, Lower Sauk (604), & South Fork Stillaguamish (802) rivers	CK	2	1
Samish River (202), Upper North (401), Middle (402), South (403), Lower North (404), Nooksack River; Nooksack River (405), Lower Skagit/Nookachamps Creek (702) & North Fork (801) & Lower (803) Stillaguamish River	CK	1	2
Bellingham (201) & Birch (204) bays & Baker River (508)	CK	1	1
Whidbey Basin and Central/South Basin #1711001xxx			

[35] On January 14, 2013, NMFS published a proposed rule for the designation of critical habitat for LCR coho salmon and PS steelhead (USDC 2013). A draft biological report, which includes a CHART assessment for PS salmon, was also completed (NMFS 2012c). Habitat quality assessments for PS steelhead are out for review; therefore, they are not included on this table.

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = reduced, with high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC_5 Code(s)	Listed Species	Current Quality	Potential Quality
Lower Snoqualmie River (004), Snohomish (102), Upper White (401) & Carbon (403) rivers	CK	2	2
Middle Fork Snoqualmie (003) & Cedar rivers (201), Lake Sammamish (202), Middle Green River (302) & Lowland Nisqually (503)	CK	2	1
Pilchuck (101), Upper Green (301), Lower White (402), & Upper Puyallup River (404) rivers, & Mashel/Ohop(502)	CK	1	2
Lake Washington (203), Sammamish (204) & Lower Green (303) rivers	CK	1	1
Puyallup River (405)	CK	0	2
Hood Canal #1711001xxx			
Dosewallips River (805)	CK/CM	2	1/2
Kitsap – Kennedy/Goldsborough (900)	CK	2	1
Hamma Hamma River (803)	CK/CM	1/2	1/2
Lower West Hood Canal Frontal (802)	CK/CM	0/2	0/1
Skokomish River (701)	CK/CM	1/0	2/1
Duckabush River (804)	CK/CM	1	2
Upper West Hood Canal Frontal (807)	CM	1	2
Big Quilcene River (806)	CK/CM	1	1/2
Deschutes Prairie-1 (601) & Prairie-2 (602)	CK	1	1
West Kitsap (808)	CK/CM	1	1
Kitsap – Prairie-3 (902)	CK	1	1
Port Ludlow/Chimacum Creek (908)	CM	1	1
Kitsap – Puget (901)	CK	0	1
Kitsap – Puget Sound/East Passage (904)	CK	0	0
Strait of Juan de Fuca Olympic #1711002xxx			
Dungeness River (003)	CK/CM	2/1	1/2
Discovery Bay (001) & Sequim Bay (002)	CM	1	2
Elwha River (007)	CK	1	2
Port Angeles Harbor (004)	CK	1	1

Willamette-Lower Columbia Recovery Domain. Critical habitat was designated in the WLC recovery domain for UWR spring-run Chinook salmon, LCR Chinook salmon, LCR steelhead, UWR steelhead, CR chum salmon, southern DPS eulachon, and proposed for LCR coho salmon. In addition to the Willamette and Columbia River mainstems, important tributaries on the Oregon side of the WLC include Youngs Bay, Big Creek, Clatskanie River, and Scappoose River in the Oregon Coast subbasin; Hood River in the Gorge; and the Sandy, Clackamas, Molalla, North and South Santiam, Calapooia, McKenzie, and Middle Fork Willamette rivers in the West Cascades subbasin.

Land management activities have severely degraded stream habitat conditions in the Willamette River mainstem above Willamette Falls and associated subbasins. In the Willamette River mainstem and lower sub-basin mainstem reaches, high density urban development and widespread agricultural effects have reduced aquatic and riparian habitat quality and complexity, and altered sediment and water quality and quantity, and watershed processes. The Willamette River, once a highly braided river system, has been dramatically simplified through channelization, dredging, and other activities that have reduced rearing habitat by as much as 75%. In addition, the construction of 37 dams in the basin blocked access to more than 435 miles of stream and river spawning habitat. The dams alter the temperature regime of the Willamette River and its tributaries, affecting the timing and development of naturally-spawned eggs and fry. Logging in the Cascade and Coast Ranges, and agriculture, urbanization, and gravel mining on valley floors have contributed to increased erosion and sediment loads throughout the WLC domain.

The mainstem Willamette River has been channelized and stripped of LW. Development began to encroach on the riparian forest beginning in the 1870s (Sedell and Froggatt 1984). Gregory (2002a) calculated that the total mainstem Willamette River channel area decreased from 41,000 to 23,000 acres between 1895 and 1995. They noted that the lower reach, from the mouth of the river to Newberg (RM 50), is confined within a basaltic trench, and that due to this geomorphic constraint, less channel area has been lost than in upstream areas. The middle reach from Newberg to Albany (RM 50 to 120) incurred losses of 12% primary channel area, 16% side channels, 33% alcoves, and 9% islands. Even greater changes occurred in the upper reach, from Albany to Eugene (RM 187). There, approximately 40% of both channel length and channel area were lost, along with 21% of the primary channel, 41% of side channels, 74% of alcoves, and 80% of island areas.

The banks of the Willamette River have more than 96 miles of revetments; approximately half were constructed by the ACOE. Generally, the revetments were placed in the vicinity of roads or on the outside bank of river bends, so that while only 26% of the total length is revetted, 65% of the meander bends are revetted (Gregory *et al.* 2002b). The majority of dynamic sections have been armored, reducing adjustments in channel bed and sediment storage by the river, and thereby diminishing both the complexity and productivity of aquatic habitats (Gregory *et al.* 2002b).

Riparian forests have diminished considerably in the lower reaches of the Willamette River (Gregory *et al.* 2002c). Sedell and Froggatt (1984) noted that agriculture and cutting of streamside trees were major agents of change for riparian vegetation, along with snagging of LW in the channel. The reduced shoreline, fewer and smaller snags, and reduced riparian forest comprise large functional losses to the river, reducing structural features, organic inputs from litter fall, entrained allochthonous materials, and flood flow filtering capacity. Extensive changes began before the major dams were built, with navigational and agricultural demands dominating the early use of the river. The once expansive forests of the Willamette River floodplain provided valuable nutrients and organic matter during flood pulses, food sources for macroinvertebrates, and slow-water refugia for fish during flood events. These forests also cooled river temperatures as the river flowed through its many channels.

Gregory *et al.* (2002c) described the changes in riparian vegetation in river reaches from the mouth to Newberg, from Newberg to Albany, and from Albany to Eugene. They noted that the riparian forests were formerly a mosaic of brush, marsh, and ash tree openings maintained by annual flood inundation. Below the City of Newberg, the most noticeable change was that conifers were almost eliminated. Above Newberg, the formerly hardwood-dominated riparian forests along with mixed forest made up less than half of the riparian vegetation by 1990, while agriculture dominated. This conversion has reduced river shading and the potential for recruitment of wood to the river, reducing channel complexity and the quality of rearing, migration and spawning habitats.

Hyporheic flow in the Willamette River has been examined through discharge measurements and found to be significant in some areas, particularly those with gravel deposits (Fernald *et al.* 2001; Wentz *et al.* 1998). The loss of channel complexity and meandering that fosters creations of gravel deposits decreases the potential for hyporheic flows, as does gravel mining. Hyporheic flow processes water and affects its quality on reemerging into the main channel, stabilizing variations in physical and chemical water characteristics. Hyporheic flow is important for ecological functions, some aspects of water quality (such as temperature and dissolved oxygen), and some benthic invertebrate life stages. Alcove habitat, which has been limited by channelization, combines low hydraulic stress and high food availability with the potential for hyporheic flows across the steep hydraulic gradients in the gravel separating them from the main channel (Fernald *et al.* 2001).

On the mainstem of the Columbia River, hydropower projects, including the Federal Columbia River Hydropower System (FCRPS), have significantly degraded salmon and steelhead habitats (Bottom *et al.* 2005; Fresh *et al.* 2005; NMFS 2011d; NMFS 2013a). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts.

Industrial harbor and port development are also significant influences on the Lower Willamette and Lower Columbia rivers (Bottom *et al.* 2005; Fresh *et al.* 2005; NMFS 2011d; NMFS 2013a). Since 1878, 100 miles of river channel within the mainstem Columbia River, its estuary, and Oregon's Willamette River have been dredged as a navigation channel by the ACOE. Originally dredged to a 20-foot minimum depth, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 43 feet and a width of 600 feet. The Lower Columbia River supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, high levels of several sediment chemicals, such as arsenic and polycyclic aromatic hydrocarbons (PAHs), have been identified in Lower Columbia River watersheds in the vicinity of the ports and associated industrial facilities.

The most extensive urban development in the Lower Columbia River subbasin has occurred in the Portland/Vancouver area. Outside of this major urban area, the majority of residences and businesses rely on septic systems.

Common water quality issues with urban development and residential septic systems include higher water temperatures, lowered dissolved oxygen, increased fecal coliform bacteria, and increased chemicals associated with pesticides and urban runoff.

The Columbia River estuary has lost a significant amount of the tidal marsh and tidal swamp habitats that are critical to juvenile salmon and steelhead, particularly small or ocean-type species (Bottom *et al.* 2005; Fresh *et al.* 2005; NMFS 2011d; NMFS 2013a). Edges of marsh areas provide sheltered habitats for juvenile salmon and steelhead where food, in the form of amphipods or other small invertebrates which feed on marsh detritus, is plentiful, and larger predatory fish can be avoided. Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon and steelhead access to a wide expanse of low-velocity marshland and tidal channel habitats. In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming habitat for salmon and steelhead during flooding river discharges or flood tides. Sherwood *et al.* (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. This study further estimated an 80% reduction in emergent vegetation production and a 15% decline in benthic algal production.

Habitat and food-web changes within the estuary, and other factors affecting salmon population structure and life histories, have altered the estuary's capacity to support juvenile salmon (Bottom *et al.* 2005; Fresh *et al.* 2005; NMFS 2011d; NMFS 2013a). Diking and filling activities have reduced the tidal prism and eliminate emergent and forested wetlands and floodplain habitats. These changes have likely reduced the estuary's salmon-rearing capacity. Moreover, water and sediment in the Lower Columbia River and its tributaries have toxic contaminants that are harmful to aquatic resources (Lower Columbia River Estuary Partnership 2007).

Contaminants of concern include dioxins and furans, heavy metals, polychlorinated biphenyls (PCBs) and organochlorine pesticides such as DDT. Simplification of the population structure and life-history diversity of salmon possibly is yet another important factor affecting juvenile salmon viability. Restoration of estuarine habitats, particularly diked emergent and forested wetlands, reduction of avian predation by terns, and flow manipulations to restore historical flow patterns have likely begun to enhance the estuary's productive capacity for salmon, although historical changes in population structure and salmon life histories may prevent salmon from making full use of the productive capacity of estuarine habitats.

The WLC recovery domain CHART determined that most HUC_5 watersheds with PCEs for salmon or steelhead are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or a high potential for improvement. Only watersheds in the upper McKenzie River and its tributaries are in good to excellent condition with no potential for improvement (Table 30).

Table 30. Willamette-Lower Columbia Recovery Domain: Current and potential quality of HUC5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK), chum salmon (CM), and steelhead (ST) (NOAA Fisheries 2005).[36] Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC$_5$ Code(s)	Listed Species	Current Quality	Restoration Potential
Columbia Gorge #1707010xxx			
Wind River (511)	CK/ST	2/2	2/2
East Fork Hood (506), & Upper (404) & Lower Cispus (405) rivers	CK/ST	2/2	2/2
Plympton Creek (306)	CK	2	2
Little White Salmon River (510)	CK	2	0
Grays Creek (512) & Eagle Creek (513)	CK/CM/ST	2/1/2	1/1/2
White Salmon River (509)	CK/CM	2/1	1/2
West Fork Hood River (507)	CK/ST	1/2	2/2
Hood River (508)	CK/ST	1/1	2/2
Unoccupied habitat: Wind River (511)	Chum conservation value "Possibly High"		
Cascade and Coast Range #1708000xxx			
Lower Gorge Tributaries (107)	CK/CM/ST	2/2/2	2/3/2
Lower Lewis (206) & North Fork Toutle (504) rivers	CK/CM/ST	1/3/1	2/1/2
Salmon (101), Zigzag (102), & Upper Sandy (103) rivers	CK/ST	2/2	2/2
Big Creek (602)	CK/CM	2/2	2/2
Coweeman River (508)	CK/CM/ST	2/2/1	2/1/2
Kalama River (301)	CK/CM/ST	1/2/2	2/1/2
Cowlitz Headwaters (401)	CK/ST	2/2	1/1
Skamokawa/Elochoman (305)	CK/CM	2/1	2
Salmon Creek (109)	CK/CM/ST	1/2/1	2/3/2
Green (505) & South Fork Toutle (506) rivers	CK/CM/ST	1/1/2	2/1/2
Jackson Prairie (503) & East Willapa (507)	CK/CM/ST	1/2/1	1/1/2
Grays Bay (603)	CK/CM	1/2	2/3
Upper Middle Fork Willamette River (101)	CK	2	1
Germany/Abernathy creeks (304)	CK/CM	1/2	2
Mid-Sandy (104), Bull Run (105), & Lower Sandy (108) rivers	CK/ST	1/1	2/2
Washougal (106) & East Fork Lewis (205) rivers	CK/CM/ST	1/1/1	2/1/2
Upper Cowlitz (402) & Tilton rivers (501) & Cowlitz Valley Frontal (403)	CK/ST	1/1	2/1

[36] On January 14, 2013, NMFS published a proposed rule for the designation of critical habitat for LCR coho salmon and PS steelhead (USDC 2013). A draft biological report, which includes a CHART assessment for PS steelhead, was also completed (NMFS 2012c). Habitat quality assessments for LCR coho salmon are out for review; therefore, they are not included on this table.

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC_5 Code(s)	**Listed Species**	**Current Quality**	**Restoration Potential**
Clatskanie (303) & Young rivers (601)	CK	1	2
Rifle Reservoir (502)	CK/ST	1	1
Beaver Creek (302)	CK	0	1
Unoccupied Habitat: Upper Lewis (201) & Muddy (202) rivers; Swift (203) & Yale (204) reservoirs	CK & ST Conservation Value "Possibly High"		
Willamette River #1709000xxx			
Upper (401) & South Fork (403) McKenzie rivers; Horse Creek (402); & McKenzie River/Quartz Creek (405)	CK	3	3
Lower McKenzie River (407)	CK	2	3
South Santiam River (606)	CK/ST	2/2	1/3
South Santiam River/Foster Reservoir (607)	CK/ST	2/2	1/2
North Fork of Middle Fork Willamette (106) & Blue (404) rivers	CK	2	1
Upper South Yamhill River (801)	ST	2	1
Little North Santiam River (505)	CK/ST	1/2	3/3
Upper Molalla River (905)	CK/ST	1/2	1/1
Abernethy Creek (704)	CK/ST	1/1	1/2
Luckiamute River (306) & Yamhill (807) Lower Molalla (906) rivers; Middle (504) & Lower (506) North Santiam rivers; Hamilton Creek/South Santiam River (601); Wiley Creek (608); Mill Creek/Willamette River (701); & Willamette River/Chehalem Creek (703); Lower South (804) & North (806) Yamhill rivers; & Salt Creek/South Yamhill River (805)	CK/ST	1	1
Hills (102) & Salmon (104) creeks; Salt Creek/Willamette River (103), Hills Creek Reservoir (105), Middle Fork Willamette/Lookout Point (107); Little Fall (108) & Fall (109) creeks; Lower Middle Fork of Willamette (110), Long Tom (301), Marys (305) & Mohawk (406) rivers	CK	1	1
Willamina Creek (802) & Mill Creek/South Yamhill River (803)	ST	1	1
Calapooia River (303); Oak (304) Crabtree (602), Thomas (603) & Rickreall (702) creeks; Abiqua (901), Butte (902) & Rock (903) creeks/Pudding River; & Senecal Creek/Mill Creek (904)	CK/ST	1/1	0/1
Row River (201), Mosby (202) & Muddy (302) creeks, Upper (203) & Lower (205) Coast Fork Willamette River	CK	1	0
Unoccupied habitat in North Santiam (501) & North Fork Breitenbush (502) rivers; Quartzville Creek (604) and Middle Santiam River (605)	CK & ST Conservation Value "Possibly High"		
Unoccupied habitat in Detroit Reservoir/Blowout Divide Creek (503)	Conservation Value: CK "Possibly Medium"; ST Possibly High"		
Lower Willamette #1709001xxx			

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC$_5$ Code(s)	Listed Species	Current Quality	Restoration Potential
Collawash (101), Upper Clackamas (102), & Oak Grove Fork (103) Clackamas rivers	CK/ST	2/2	3/2
Middle Clackamas River (104)	CK/ST	2/1	3/2
Eagle Creek (105)	CK/ST	2/2	1/2
Gales Creek (002)	ST	2	1
Lower Clackamas River (106) & Scappoose Creek (202)	CK/ST	1	2
Dairy (001) & Scoggins (003) creeks; Rock Creek/Tualatin River (004); & Tualatin River (005)	ST	1	1
Johnson Creek (201)	CK/ST	0/1	2/2
Lower Willamette/Columbia Slough (203)	CK/ST	0	2

Interior Columbia Recovery Domain. Critical habitat has been designated in the IC recovery domain, which includes the Snake River Basin, for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, UCR spring-run Chinook salmon, SR sockeye salmon, MCR steelhead, UCR steelhead, and SRB steelhead.

Habitat quality in tributary streams in the IC recovery domain varies from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development (NMFS 2009b; Wissmar *et al.* 1994). Critical habitat throughout much of the IC recovery domain has been degraded by intense agriculture, alteration of stream morphology (*i.e.*, channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer stream flows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in developed areas.

Migratory habitat quality in this area has been severely affected by the development and operation of the FCRPS dams and reservoirs in the mainstem Columbia River, Bureau of Reclamation tributary projects, and privately owned dams in the Snake and Upper Columbia river basins. For example, construction of Hells Canyon Dam eliminated access to several likely production areas in Oregon and Idaho, including the Burnt, Powder, Weiser, Payette, Malheur, Owyhee, and Boise river basins (Good *et al.* 2005), and Grand Coulee and Chief Joseph dams completely block anadromous fish passage on the upper mainstem Columbia River.

Hydroelectric development modified natural flow regimes, resulting in higher water temperatures, changes in fish community structure leading to increased rates of piscivorous and avian predation on juvenile salmon and steelhead, and delayed migration for both adult and juveniles. Physical features of dams such as turbines also kill migrating fish. In-river survival is inversely related to the number of hydropower projects encountered by emigrating juveniles.

Similarly, development and operation of extensive irrigation systems and dams for water withdrawal and storage in tributaries have altered hydrological cycles. A series of large regulating dams on the middle and upper Deschutes River affect flow and block access to upstream habitat, and have extirpated one or more populations from the Cascades Eastern Slope major population (IC-TRT 2003). Similarly, operation and maintenance of large water reclamation systems such as the Umatilla Basin and Yakima Projects have significantly reduced flows and degraded water quality and physical habitat in this domain.

Many stream reaches designated as critical habitat in the IC recovery domain are over-allocated under state water law, with more allocated water rights than existing streamflow. Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence *et al.* 1996). Reduced tributary stream flow has been identified as a major limiting factor for all listed salmon and steelhead species in this recovery domain except SR fall-run Chinook salmon and SR sockeye salmon (NMFS 2007c; NOAA Fisheries 2011).

Many stream reaches designated as critical habitat are listed on the state of Oregon's Clean Water Act section 303(d) list for water temperature. Many areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water for agricultural or municipal use all contribute to elevated stream temperatures. Contaminants such as insecticides and herbicides from agricultural runoff and heavy metals from mine waste are common in some areas of critical habitat.

The IC recovery domain is a very large and diverse area. The CHART determined that few watersheds with PCEs for Chinook salmon or steelhead are in good to excellent condition with no potential for improvement. Overall, most IC recovery domain watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or high potential for improvement. In Washington, the Upper Methow, Lost, White, and Chiwawa watersheds are in good-to-excellent condition with no potential for improvement. In Oregon, only the Lower Deschutes, Minam, Wenaha, and Upper and Lower Imnaha Rivers HUC_5 watersheds are in good-to-excellent condition with no potential for improvement. In Idaho, a number of watersheds with PCEs for steelhead (Upper Middle Salmon, Upper Salmon/Pahsimeroi, Middle Fork Salmon, Little Salmon, Selway, and Lochsa rivers) are in good-to-excellent condition with no potential for improvement. Additionally, several Lower Snake River HUC_5watersheds in the Hells Canyon area, straddling Oregon and Idaho, are in good-to-excellent condition with no potential for improvement (Table 31).

Table 31. Interior Columbia Recovery Domain: Current and potential quality of Oregon and Washington HUC_5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK) and steelhead (ST) (NOAA Fisheries 2005). Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC_5 Code(s)	Listed Species	Current Quality	Restoration Potential
Upper Columbia # 1702000xxx			
White (101), Chiwawa (102), Lost (801) & Upper Methow (802) rivers	CK/ST	3	3
Upper Chewuch (803) & Twisp rivers (805)	CK/ST	3	2
Lower Chewuch River (804); Middle (806) & Lower (807) Methow rivers	CK/ST	2	2
Salmon Creek (603) & Okanogan River/Omak Creek (604)	ST	2	2
Upper Columbia/Swamp Creek (505)	CK/ST	2	1
Foster Creek (503) & Jordan/Tumwater (504)	CK/ST	1	1
Upper (601) & Lower (602) Okanogan River; Okanogan River/Bonaparte Creek (605); Lower Similkameen River (704); & Lower Lake Chelan (903)	ST	1	1
Unoccupied habitat in Sinlahekin Creek (703)	ST Conservation Value "Possibly High"		
Upper Columbia #1702001xxx			
Entiat River (001); Nason/Tumwater (103); & Lower Wenatchee River (105)	CK/ST	2	2
Lake Entiat (002)	CK/ST	2	1
Columbia River/Lynch Coulee (003); Sand Hollow (004); Yakima/Hansen Creek (604), Middle Columbia/Priest Rapids (605), & Columbia River/Zintel Canyon (606)	ST	2	1
Icicle/Chumstick (104)	CK/ST	1	2
Lower Crab Creek (509)	ST	1	2
Rattlesnake Creek (204)	ST	0	1
Yakima #1703000xxx			
Upper (101) & Middle (102) Yakima rivers; Teanaway (103) & Little Naches (201) rivers; Naches River/Rattlesnake Creek (202); & Ahtanum (301) & Upper Toppenish (303) & Satus (305) creeks	ST	2	2
Umtanum/Wenas (104); Naches River/Tieton River (203); Upper Lower Yakima River (302); & Lower Toppenish Creek (304)	ST	1	2
Yakima River/Spring Creek (306)	ST	1	1
Lower Snake River #1706010xxx			
Snake River/Granite (101), Getta (102), & Divide (104) creeks; Upper (201) & Lower (205) Imnaha River; Snake River/Rogersburg (301);	ST	3	3

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Minam (505) & Wenaha (603) rivers			
Grande Ronde River/Rondowa (601)	ST	3	2
Big (203) & Little (204) Sheep creeks; Asotin River (302); Catherine Creek (405); Lostine River (502); Bear Creek (504); & Upper (706) & Lower (707) Tucannon River	ST	2	3
Middle Imnaha River (202); Snake River/Captain John Creek (303); Upper Grande Ronde River (401); Meadow (402); Beaver (403); Indian (409), Lookingglass (410) & Cabin (411) creeks; Lower Wallowa River (506); Mud (602), Chesnimnus (604) & Upper Joseph (605) creeks	ST	2	2
Ladd Creek (406); Phillips/Willow Creek (408); Upper (501) & Middle (503) Wallowa rivers; & Lower Grande Ronde River/Menatche Creek (607)	ST	1	3
Five Points (404); Lower Joseph (606) & Deadman (703) creeks	ST	1	2
Tucannon/Alpowa Creek (701)	ST	1	1
Mill Creek (407)	ST	0	3
Pataha Creek (705)	ST	0	2
Snake River/Steptoe Canyon (702) & Penawawa Creek (708)	ST	0	1
Flat Creek (704) & Lower Palouse River (808)	ST	0	0
Mid-Columbia #1707010xxx			
Wood Gulch (112); Rock Creek (113); Upper Walla Walla (201), Upper Touchet (203), & Upper Umatilla (301) rivers; Meacham (302) & Birch (306) creeks; Upper (601) & Middle (602) Klickitat River	ST	2	2
Glade (105) & Mill (202) creeks; Lower Klickitat River (604); Mosier Creek (505); White Salmon River (509); Middle Columbia/Grays Creek (512)	ST	2	1
Little White Salmon River (510)	ST	2	0
Middle Touchet River (204); McKay Creek (305); Little Klickitat River (603);Fifteenmile (502) & Fivemile (503) creeks	ST	1	2
Alder (110) & Pine (111) creeks; Lower Touchet River (207), Cottonwood (208), Pine (209) & Dry (210) creeks; Lower Walla Walla River (211); Umatilla River/Mission Creek (303) Wildhorse Creek (304); Umatilla River/Alkali Canyon (307); Lower Butter Creek (310); Upper Middle Columbia/Hood (501); Middle Columbia/Mill Creek (504)	ST	1	1
Stage Gulch (308) & Lower Umatilla River (313)	ST	0	1
John Day #170702xxx			
Middle (103) & Lower (105) South Fork John Day rivers; Murderers (104) & Canyon (107) creeks; Upper John Day (106) & Upper North	ST	2	2

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name and HUC5 Code(s)	Listed Species	Current Quality	Restoration Potential
Fork John Day (201) rivers; & Desolation Creek (204)			
North Fork John Day/Big Creek (203); Cottonwood Creek (209) & Lower NF John Day River (210)	ST	2	1
Strawberry (108), Beech (109), Laycock (110), Fields (111), Mountain (113) & Rock (114) creeks; Upper Middle John Day River (112); Granite (202) & Wall (208) creeks; Upper (205) & Lower (206) Camas creeks; North Fork John Day/Potamus Creek (207); Upper Middle Fork John Day River (301) & Camp (302), Big (303) & Long (304) creeks; Bridge (403) & Upper Rock (411) creeks; & Pine Hollow (407)	ST	1	2
John Day/Johnson Creek (115); Lower Middle Fork John Day River (305); Lower John Day River/Kahler Creek (401), Service (402) & Muddy (404) creeks; Lower John Day River/Clarno (405); Butte (406), Thirtymile (408) & Lower Rock (412) creeks; Lower John Day River/Ferry (409) & Scott (410) canyons; & Lower John Day River/McDonald Ferry (414)	ST	1	1
Deschutes #1707030xxx			
Lower Deschutes River (612)	ST	3	3
Middle Deschutes River (607)	ST	3	2
Upper Deschutes River (603)	ST	2	1
Mill Creek (605) & Warm Springs River (606)	ST	2	1
Bakeoven (608) & Buck Hollow (611) creeks; Upper (701) & Lower (705) Trout Creek	ST	1	2
Beaver (605) & Antelope (702) creeks	ST	1	1
White River (610) & Mud Springs Creek (704)	ST	1	0
Unoccupied habitat in Deschutes River/McKenzie Canyon (107) & Haystack (311); Squaw Creek (108); Lower Metolius River (110), Headwaters Deschutes River (601)	ST Conservation Value "Possibly High"		

<u>Oregon Coast Recovery Domain</u>. In this recovery domain, critical habitat has been designated for OC coho salmon, and southern DPS eulachon. Many large and small rivers supporting significant populations of coho salmon flow through this domain, including the Nehalem, Nestucca, Siletz, Yaquina, Alsea, Siuslaw, Umpqua, Coos, and Coquille.
The historical disturbance regime in the central Oregon Coast Range was dominated by a mixture of high and low-severity fires, with a natural rotation of approximately 271 years. Old-growth forest coverage in the Oregon Coast Range varied from 25 to 75% during the past 3,000 years, with a mean of 47%, and never fell below 5% (Wimberly *et al.* 2000).

Currently, the Coast Range has approximately 5% old-growth, almost all of it on Federal lands. The dominant disturbance now is logging on a cycle of approximately 30 to 100 years, with fires suppressed.

Oregon's assessment of OC coho salmon (Nicholas *et al.* 2005) mapped how streams with high intrinsic potential for rearing are distributed by land ownership categories. Agricultural lands and private industrial forests have by far the highest percentage of land ownership in high intrinsic potential areas and along all coho salmon stream miles. Federal lands have only about 20% of coho salmon stream miles and 10% of high intrinsic potential stream reaches. Because of this distribution, activities in lowland agricultural areas are particularly important to the conservation of OC coho salmon.

The OC coho salmon assessment concluded that at the scale of the entire domain, pools are generally abundant, although slow-water and off-channel habitat (which are important refugia for coho salmon during high winter flows) are limited in the majority of streams when compared to reference streams in minimally-disturbed areas. Amounts of LW in streams are low in all four ODFW monitoring areas and land-use types relative to reference conditions. Amounts of fine sediment are high in three of the four monitoring areas, and were comparable to reference conditions only on public lands. Approximately 62 to 91% of tidal wetland acres (depending on estimation procedures) have been lost for functionally and potentially independent populations of coho salmon.

As part of the coastal coho salmon assessment, the Oregon Department of Environmental Quality analyzed the status and trends of water quality in the range of OC coho salmon using the Oregon water quality index, which is based on a combination of temperature, dissolved oxygen, biological oxygen demand, pH, total solids, nitrogen, total phosphates, and bacteria. Using the index at the species scale, 42% of monitored sites had excellent to good water quality, and 29% show poor to very poor water quality (ODEQ 2005). Within the four monitoring areas, the North Coast had the best overall conditions (six sites in excellent or good condition out of nine sites), and the Mid-South coast had the poorest conditions (no excellent condition sites, and only two out of eight sites in good condition). For the 10-year period monitored between 1992 and 2002, no sites showed a declining trend in water quality. The area with the most improving trends was the North Coast, where 66% of the sites (six out of nine) had a significant improvement in index scores. The Umpqua River basin, with one out of nine sites (11%) showing an improving trend, had the lowest number of improving sites.

Southern Oregon/Northern California Coasts Recovery Domain. In this recovery domain critical habitat has been designated for SONCC coho salmon, and southern DPS eulachon. Many large and small rivers supporting significant populations of coho salmon flow through this area, including the Elk, Rogue, Chetco, Smith and Klamath. The following summary of critical habitat information in the Elk, Rogue, and Chetco rivers is also applicable to habitat characteristics and limiting factors in other basins in this area.

The Elk River flows through Curry County, and drains approximately 92 square miles (or 58,678 acres)(Maguire 2001). Historical logging, mining, and road building have degraded stream and riparian habitats in the Elk River basin.

Limiting factors identified for salmon and steelhead production in this basin include sparse riparian cover, especially in the lower reaches, excessive fine sediment, high water temperatures, and noxious weed invasions (Maguire 2001).

The Rogue River drains approximately 5,160 square miles within Curry, Jackson and Josephine counties in southwest Oregon. The mainstem is about 200 miles long and traverses the coastal mountain range into the Cascades. The Rogue River estuary has been modified from its historical condition. Jetties were built by the ACOE in 1960, which stabilized and deepened the mouth of the river. A dike that extends from the south shore near Highway 101 to the south jetty was completed in 1973. This dike created a backwater for the large shallow area that existed here, which has been developed into a boat basin and marina, eliminating most of the tidal marsh.

The quantity of estuary habitat is naturally limited in the Rogue River. The Rogue River has a drainage area of 5,160 square miles, but the estuary at 1,880 acres is one of the smallest in Oregon. Between 1960 and 1972, approximately 13 acres of intertidal and 14 acres of subtidal land were filled in to build the boat basin dike, the marina, north shore riprap and the other north shore developments (Hicks 2005). Jetties constructed in 1960 to stabilize the mouth of the river and prevent shoaling have altered the Rogue River, which historically formed a sill during summer months (Hicks 2005).

The Lower Rogue Watershed Council's watershed analysis (Hicks 2005). lists factors limiting fish production in tributaries to Lower Rogue River watershed. The list includes water temperatures, low stream flows, riparian forest conditions, fish passage and over-wintering habitat. Limiting factors identified for the Upper Rogue River basin include fish passage barriers, high water temperatures, insufficient water quantity, lack of LW, low habitat complexity, and excessive fine sediment (Rogue Basin Coordinating Council 2006).

The Chetco River estuary has been significantly modified from its historical condition. Jetties were erected by the ACOE in 1957, which stabilized and deepened the mouth of the river. These jetties have greatly altered the mouth of the Chetco River and how the estuary functions as habitat for salmon migrating to the ocean. A boat basin and marina were built in the late 1950s and eliminated most of the functional tidal marsh. The structures eliminated shallow water habitats and vegetation in favor of banks stabilized with riprap. Since then, nearly all remaining streambank habitat in the estuary has been stabilized with riprap. The factors limiting fish production in the Chetco River appear to be high water temperature caused by lack of shade, especially in tributaries, high rates of sedimentation due to roads, poor over-wintering habitat due to a lack of LW in tributaries and the mainstem, and poor quality estuary habitat (Maguire 2001).

2.3 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

As described above in the Status of the Species and Critical Habitat sections, factors that limit the recovery of species considered in this opinion vary with the overall condition of aquatic habitats on private, state, and Federal lands. Within the program-level action area, many stream and riparian areas have been degraded by the effects of land and water use, including road construction, forest management, agriculture, mining, transportation, urbanization, and water development. Each of these economic activities has contributed to myriad interrelated factors resulting in the decline of species considered in this opinion. Among the most important of these are changes in stream channel morphology, degradation of spawning substrates, reduced instream roughness and cover, loss and degradation of estuarine rearing habitats, loss of wetlands, loss and degradation of riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants) degradation, blocked fish passage, direct take, and loss of habitat refugia. Climate change is likely to play an increasingly important role in determining the abundance of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest.

Anadromous salmonids have been affected by the development and operation of dams. Dams, without adequate fish passage systems, have extirpated anadromous fish from their pre-development spawning and rearing habitats. Dams and reservoirs, within the currently accessible migratory corridor, have greatly altered the river environment and have affected fish passage. The operation of water storage projects has altered the natural hydrograph of many rivers. Water impoundment and dam operations also affect downstream water quality characteristics, a vital component of anadromous fish survival. In recent years, high quality fish passage is being restored where it did not previously exist, either through improvements to existing fish passage facilities or through dam removal (*e.g.*, Elwha Dams, Marmot Dam on the Sandy River, and Powerdale Dam on the Hood River).

Within the habitat currently accessible by species considered in this opinion, dams have negatively affected spawning and rearing habitat. Floodplains have been reduced, off-channel habitat features have been eliminated or disconnected from the main channel, and the amount of LW debris in mainstem rivers has been greatly reduced. Remaining habitats are often affected by flow fluctuations associated with reservoir water management for power peaking, flood control, and other operations.

The development of hydropower and water storage projects within the Columbia River Basin has resulted in the inundation of many mainstem spawning and shallow-water rearing areas (loss of spawning gravels and access to spawning and rearing areas). It has also altered water quality (reduced spring turbidity levels), water quantity (seasonal changes in flows and consumptive losses resulting from use of stored water for agricultural, industrial, or municipal purposes), water temperature (including generally warmer minimum winter temperatures and cooler maximum summer temperatures), water velocity (reduced spring flows and increased cross-sectional areas of the river channel), food (alteration of food webs, including the type and availability of prey species), and safe passage (increased mortality rates of migrating juveniles) (Ferguson *et al.* 2005; Williams *et al.* 2005).

Fish considered in this opinion are exposed to high rates of predation during all life stages.

Fish, birds, and marine mammals, including harbor seals, sea lions, and killer whales all prey on juvenile and adult salmon. The Columbia River Basin has a diverse assemblage of native and introduced fish species, some of which prey on salmon, steelhead, and eulachon. The primary resident fish predators of salmonids in many areas of Oregon are northern pikeminnow (native), smallmouth bass (introduced), and walleye (introduced). Other predatory resident fish include channel catfish (introduced), Pacific lamprey (native), yellow perch (introduced), largemouth bass (introduced), and bull trout (native). Increased predation by non-native predators has and continues to decrease salmonid population abundance and productivity. Forty species of freshwater fish have been introduced in Washington and are now self-sustaining, making up nearly half of the state's freshwater fish fauna (Wydoski and Whitney 2003). As in Oregon, most of the introduced species are warm-water game fish that are thriving in reservoirs and other areas where stream temperatures are higher than natural conditions because of human-caused changes to the landscape. Introduced species are frequently predators on native species, compete for food resources, alter freshwater habitats, and are displacing native salmonids from areas that historically had colder water temperatures.

Avian predation is another factor limiting salmonid recovery in the Columbia River Basin. Throughout the basin, piscivorous birds congregate near hydroelectric dams and in the estuary near man-made islands and structures. Avian predation has been exacerbated by environmental changes associated with river developments. Water clarity caused by suspended sediments settling in impoundments increases the vulnerability of migrating smolts. Smolt migration is delayed in project reservoirs, particularly immediately upstream from dams, where the juvenile bypass systems concentrate smolts, increasing their exposure to avian predators. Dredge spoil islands, associated with maintaining the Columbia River navigation channel, provide habitat for nesting Caspian terns and other piscivorous birds. Caspian terns, double-crested cormorants, glaucous-winged/western gull hybrids, California gulls, and ring-billed gulls are the principal avian predators in the basin. As with piscivorous predators, predation by birds has and continues to decrease salmonid population abundance and productivity.

The existing highway system contributes to a poor environmental baseline condition in several significant ways. Many miles of highway that parallel streams have degraded streambank conditions by armoring the banks with rip rap, degraded floodplain connectivity by adding fill to floodplains, and degraded water quality by discharging untreated or marginally-treated highway runoff to streams. Culvert and bridge stream crossings have similar effects, and create additional problems for fish when they act as physical or hydraulic barriers that prevent fish access to spawning or rearing habitat, or contribute to adverse stream morphological changes upstream and downstream of the crossing itself.

The environmental baseline includes the anticipated impacts of all Federal actions in the action area that have already undergone formal consultation. For example, from 2007 through 2012, the U.S Army Corps of Engineers (USACE) authorized 280 restoration actions in Oregon under the SLOPES programmatic consultation and another 397 actions for construction, minor discharge, over- and in-water structures, transportation, streambank stabilization, surveys, and utility lines in habitat affecting ESA-listed fish species (NMFS 2008a; NMFS 2008b).

The USACE, BPA, and Bureau of Reclamation have consulted on large water management actions, such as operation of the Federal Columbia River Power System, the Umatilla Basin Project, and the Deschutes Project. The U.S. Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), and the U.S. Forest Service (USFS) have consulted on Federal land management throughout the Northwest, including restoration actions, forest management, livestock grazing, and special use permits. The BPA has also consulted on large restoration programs that consist of actions designed to address species limiting factors or make contributions that would aid in species recovery. After going through consultation, many ongoing actions, such as water management, have less impact on listed salmon and steelhead. Restoration actions may have short-term adverse effects, but generally result in long-term improvements to habitat condition and population abundance, productivity, and spatial structure.

The precise project-level action area for each restoration project is not yet known, so the current condition of fish or critical habitats in each project area, the factors responsible for that condition, and the conservation value of each site can only be partially described. Therefore, to complete the jeopardy and destruction or adverse modification of critical habitat analyses in this consultation, NMFS made the following assumptions regarding the environmental baseline in each area that will eventually be chosen to support an action:

1. The purpose of the proposed program is to implement habitat restoration and fish passage improvements for the benefit of populations of ESA-listed species.
2. Each individual action area will be occupied by one or more populations of ESA-listed species.
3. Restoration projects will occur at sites where the biological requirements of individual fish of ESA-listed species are not being fully met due, in part, to the presence of impaired fish passage, floodplain fill, streambank degradation, or degraded channel or riparian conditions.
4. Restoration projects will occur at sites where the biological requirements of individual fish of ESA-listed species are not being met due to one or more impaired aquatic habitat functions related to any of the habitat factors limiting the recovery of the species in that area.

It is very likely that a few action areas for some of these previously consulted upon actions will overlap with action areas for restoration actions covered under this new iteration of USFWS/NOAA RC programmatic consultation. Impacts to the environmental baseline from these previous actions vary from short-term adverse effects to long-term beneficial effects.

2.4 Effects of the Action on Species and Designated Critical Habitat

"Effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

This analysis begins with an overview of the scope of the USFWS/NOAA RC aquatic restoration program, deconstructs the program and individual types of actions, then examines the general environmental impacts of each of those elements in detail before analyzing their combined impact on species and designated critical habitats. Under the administrative portion of this action, the USFWS or NOAA RC will evaluate each individual action to ensure that the following conditions are true: (a) The requirements of this opinion are only applied where ESA-listed salmon, steelhead, or eulachon, or their designated critical habitats, or both, are present; (b) the anticipated range of effects is within the range considered in this opinion; (c) the action is carried out consistent with the PDC; and (d) action and program level monitoring and reporting requirements are met. Although that process will not, by itself, affect a listed species or critical habitat, it determines which factors must be considered to analyze the effects of each individual action that will be authorized or completed under this opinion.

A central part of the USFWS/NOAA RC program includes processes for program administration to ensure that individual projects covered by this analysis remain within the scope of effects considered here, and to ensure that the aggregate or program-level effects of those individual projects are also accounted for.

The discussion of the direct physical and chemical effects of the action on the environment will vary depending on the type of restoration or fish passage action being performed, but will all be based on a common set of effects related to construction. Actions involving fish passage restoration, off- or side channel reconstruction, set-back of an existing berm, dike or levee, or removal of a water control structure are likely to have all of the following effects; actions that only involve placement of boulders, gravel or wood will only have a subset of those effects, or will express those effects to a lesser degree.

Construction will have direct physical and chemical effects on the environment that commonly begin with pre-construction activity, such as surveying, minor vegetation clearing, and placement of stakes and flagging guides. This requires movement of personnel and sometimes machines over the action area. The next stage, site preparation, may require development of access roads, construction staging areas, and materials storage areas that affect more of the action area. If additional earthwork is necessary to clear, excavate, fill, or shape the site, more vegetation and topsoil may be removed, deeper soil layers exposed, and operations extended into the active channel. The final stage of construction is site restoration. This stage consists of any action necessary to undo disturbance caused by the action, and may include replacement of LW, native vegetation, topsoil, and native channel material displaced by construction, and otherwise restoring ecosystem processes that form and maintain productive fish habitats.

The physical, chemical, and biotic effects of each individual project the USFWS and NOAA RC propose under this opinion will vary according to the number and type of elements present, although each element will share, in relevant part, a common set of effects related to pre-construction and construction (Darnell 1976; Spence *et al.* 1996), site restoration (Cramer *et al.* 2003; Cramer 2012), and operation and maintenance. NMFS assumes that every individual project will share some of the effects described here in proportion to the project's complexity, footprint, and proximity to species and critical habitat, but that no action will have effects that are greater than the full range of effects described here, because every action is based on the same set of underlying construction activities or elements, and each element is limited by the same design criteria. The duration of construction required to complete most projects will normally be less than one year, although significant fish passage projects may require additional in-water work or upland work to complete. Projects requiring an EIS pursuant to NEPA are ineligible for coverage under this consultation if the EIS evaluates alternatives affecting listed species.

Program administration. The USFWS and NOAA RC will notify the appropriate NMFS office with information to review each proposed project to ensure that the opinion is being used as intended no later than 30-days before beginning in-water work. Before actions are funded or carried out, USFWS and NOAA RC will obtain an additional approval from NMFS for projects that involve: (a) Diversion of surface water using gravity or by pumping at a rate that exceeds 3 cubic feet per second (cfs), (b) a boulder structure or fish ladder for fish passage restoration, (c) channel reconstruction/relocation, and (d) dam removals. Large projects, such as channel reconstruction, dam removal, tide/flood gate replacement, and precedent and/or policy setting actions, such as the application of new technology, will be reviewed by a regional team of experts that includes NMFS and USFWS. Monitoring and reporting data will be entered into our Public Consultation Tracking System (PCTS) consultation initiation and reporting system. Shortly (within 60 days) after inwater work for a project is completed, USFWS or NOAA RC will submit the completion report portion of the implementation form, along with any pertinent information needed, to ensure that a completed project matches its proposed design.

As an additional program-level check on the continuing effects of the action, the USFWS and NOAA RC will report and meet with NMFS at least annually to review implementation of this opinion and opportunities to improve conservation, or make the program overall more effective or efficient. Application of consistent design criteria and engineering improvements to the maximum extent feasible in each recovery domain is likely to gradually reduce the total adverse impacts, improve ecosystem resilience, and contribute to management actions necessary for the recovery of ESA-listed species and critical habitats in the Northwest.

Preconstruction. Some restoration projects have little or even no construction footprint in the riparian zone, riparian area, or in the active channel. For example, piling removal and invasive or nonnative plant control have little ground disturbance. Other project footprints extend far into the active channel, such as fish passage restoration and water control structure removal, and may require activities like work area isolation, fish capture, and relocation.

Each construction footprint that extends into a riparian or instream area is likely to have short-term adverse effects due to the physical and chemical consequences of altering those environments, and to have long-term adverse effects due to the impact of maintaining the built environment's encroachment on aquatic habitats. Under the action as proposed, each project is also likely to have long-term positive effects through application of design criteria that reduce pre-existing impacts by, for example, improving floodplain connectivity, streambank function, water quality, or fish passage.

Surveying, mapping. Preconstruction activities for restoration projects typically include surveying, mapping, placement of stakes and flagging guides, exploratory drilling, minor vegetation clearing, opening access roads, and establishing vehicle and material staging areas. These activities entail minor movements of machines and personnel over the action area with minimal direct effects but important indirect effects by establishing geographic boundaries that will limit the environmental impact of subsequent activities. The USFWS and NOAA RC will ensure that work area limits are marked to preserve vegetation and reduce soil disturbance as a fundamental and effective management practice that will avoid and reduce the impact of all subsequent construction actions.

Habitat or fish surveys. USFWS and NOAA RC often conduct habitat or fish surveys as part of a restoration project. For instance, presence/absence fish surveys are often carried out prior to construction activities to determine if fish relocation will be necessary. NMFS has specified that fish surveys must only include non-lethal techniques, *i.e.,* snorkel, minnow trapping, not hooking or electrofishing. Engineering surveys are almost always necessary for culvert replacements and other construction activities. When these surveys are carried out within or in close proximity to streams, harassment of listed salmon and steelhead can occur. In some instances, fish are flushed from hiding cover and can become more susceptible to predation. The disturbance typically lasts a few hours and will not have population level effects. No measurable habitat effects are expected from this proposed activity category. This activity category does not cover research activities requiring an ESA section 10(a)(1)(A) permit.

Erosion and pollution control measures. The USFWS and NOAA RC will ensure that a suite of erosion and pollution control measures will be applied to any project that involves soil disturbance. Those measures will constrain the use and disposal of all hazardous products, the disposal of construction debris, secure the site against erosion and inundation during high flow events, and ensure that no earthwork will occur at an EPA-designated Superfund Site, a state-designated clean-up area, or in the likely impact zone of a significant contaminant source, as identified by historical information or best professional judgment. Any action involving off- and side-channel habitat restoration or set-back of an existing berm, dike or levee must include the results of a site assessment to identify the type, quantity, and extent of any potential contamination.

Roads and staging areas. Establishing access roads and staging areas requires disturbance of vegetation and soils that support floodplain and riparian function, such as delivery of LW and particulate organic matter, shade, development of root strength for slope and streambank stability, and sediment filtering and nutrient absorption from runoff (Darnell 1976; Spence *et al.* 1996). Although the size of areas likely to be adversely affected by actions proposed to be authorized or carried out under this opinion are small, and the effects are likely to be short-term (weeks or months), even small denuded areas will lose organic matter and dissolved minerals, such as nitrates and phosphates.

The microclimate at each action site where vegetation is removed is likely to become drier and warmer, with a corresponding increase in wind speed, and soil and water temperature. Water tables and spring flow in the immediate area may be temporarily reduced. Loose soil will temporarily accumulate in the construction area. In dry weather, part of this soil is dispersed as dust; in wet weather, part is transported to streams by erosion and runoff, particularly in steep areas. Erosion and runoff increase the supply of sediment to lowland drainage areas and eventually to aquatic habitats, where they increase total suspended solids and sedimentation.

Whenever possible, temporary access roads will not be built on steep slopes, where grade, soil, or other features suggest a likelihood of excessive erosion or failure; will use existing ways whenever possible; and will minimize soil disturbance and compaction within 150 feet of a stream, waterbody, or wetland. All temporary access roads will be obliterated when the action is completed, the soil will be stabilized and the site will be revegetated. Temporary roads in wet or flooded areas will be restored by the end of the applicable in-water work period.

During and after wet weather, increased runoff resulting from soil and vegetation disturbance at a construction site during both preconstruction and construction phases is likely to suspend and transport more sediment to receiving waters as long as construction continues so that multiyear projects are likely to cause more sedimentation. This increases total suspended solids and, in some cases, stream fertility. Increased runoff also increases the frequency and duration of high stream flows and wetland inundation in construction areas. Higher stream flow increases stream energy that scours stream bottoms and transports greater sediment loads farther downstream than would otherwise occur. Sediments in the water column reduce light penetration, increase water temperature, and modify water chemistry. Redeposited sediments partly or completely fill pools, reduce the width to depth ratio of streams, and change the distribution of pools, riffles, and glides. Increased fine sediments in substrate also reduce survival of eggs and fry, reducing spawning success of salmon and steelhead.

The installation and removal of pilings with a vibratory or impact hammer is likely to result in adverse effects to salmon, steelhead, and eulachon due to high levels of underwater sound that will be produced. Although there is little information regarding the effects on fish from underwater sound pressure waves generated during piling installation (Anderson and Reyff 2006; Laughlin 2006), laboratory research on the effects of sound on fish has used a variety of species and sounds (Hastings *et al.* 1996; Popper and Clarke 1976; Scholik and Yan 2002).

Because those data are not reported in a consistent manner and most studies did not examine the type of sound generated by pile driving, it is difficult to directly apply the results of those studies to pile driving effects on salmon, steelhead, and eulachon. However, it is well established that elevated sound can cause injuries to fish swim bladders and internal organs and temporary or permanent hearing damage. The degree to which normal behavior patterns are altered is less known, although it is likely that salmon, steelhead, and eulachon that are resident within the action area are more likely to sustain an injury than fish that are migrating up or downstream.

Removal of pilings within the wetted perimeter that are at the end of their service life will disturb sediments that become suspended in the water, often along with contaminants that may have been pulled up with, or attached to, the pile. A major release of PAHs into the water is likely to occur if creosote-treated pilings are damaged during removal, or if debris is allowed to re-enter or remain in the water.

PDC to minimize exposure of fish to high levels of underwater sound during pile driving and to reduce releases of suspended solids and contaminants during pile removal will minimize impacts to fish. PDC include requirements that pilings will be 24 inches in diameter or smaller, steel H-pile will be designated as HP24 or smaller, a vibratory hammer will be used whenever possible for piling installation, and full or partial (bubble curtain) isolation of the pile while it is being driven will occur. During pile extraction, care will be taken to ensure that sediment disturbance is minimized, including special measures for broken or intractable piles. All adhering sediment and floating debris will be contained and all residues will be properly disposed. Nonetheless, a small contaminant release will occur when a creosote pile is removed, and total suspended sediment will increase with every pile removal. It is still likely that sound energy will radiate directly or indirectly into the water as a result of pile driving, although widespread propagation of sounds injurious to fish is not expected to occur.

Manual, mechanical, biological and herbicidal treatments of invasive and non-native plants are often conducted as part of an action to restore native riparian vegetation on streambank and fish passage restoration projects. NMFS has recently analyzed the effects of these activities using the similar active ingredients and PDC for proposed USFS and BLM invasive plant control programs (NMFS 2010; NMFS 2012a). The types of plant control actions analyzed here are a conservative (*i.e.*, less aggressive) subset of the types of actions considered in those analyses, and the effects presented here are summarized from those analyses. Each type of treatment is likely to affect fish and aquatic macrophytes through a combination of pathways, including disturbance, chemical toxicity, dissolve oxygen and nutrients, water temperature, sediment, instream habitat structure, forage, and riparian and emergent vegetation (Table 32).

Table 32. Potential pathways of effects of invasive and non-native plant control.

	Pathways of Effects							
Treatment Methods	**Disturbance***	**Chemical toxicity**	**Dissolved oxygen and nutrients**	**Water temperature**	**Fine sediment and turbidity**	**Instream habitat structure**	**Forage**	**Riparian and emergent vegetation**
Manual	X					X	X	X
Mechanical	X			X	X		X	X
Biological				X	X			
Herbicides		X	X	X	X	X	X	X

*Stepping on redds, displacing fish, interrupting fish feeding, or disturbing banks.

Short-term displacement or disturbance of threatened and endangered fish are likely to occur from activities in the area that disturb or displace fish that are feeding, resting or moving through the area. The understory of knotweed is usually bare of any other plants and despite a large rhizome mass, it provides poor erosion control on streambanks. Treating streamside knotweed or blackberry (*Rubus armeniacus* and *R. lacinatus*) monocultures, and possibly other streamside woody invasive species (*i.e.*, tree of heaven, scotch broom, *etc.*) will not likely cause significant shade loss. Most invasive plants are understory species of streamside vegetation that do not provide the majority of streamside shade and furthermore will be replaced by planted native vegetation. Loss of shade would persist until native vegetation reaches and surpasses the height of the invasive plants that were removed. Shade recovery may take one to several years, depending on the success of invasive plant treatment, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated. The short-term shade reduction that is likely to occur due to removal of riparian weeds could slightly affect stream temperatures or dissolved oxygen levels, which could cause short-term stress to fish adults, juveniles and eggs. NMFS did not identify adverse effects to macroinvertebrates from herbicide applications that follow these proposed PDC. Effects pathways are described in detail below.

Manual and mechanical treatments are likely to result in mild restoration construction effects (discussed above). Hand pulling of emergent vegetation is likely to result in a localized mobilization of suspended sediments. Treatment of knotweed and other streamside invasive species with herbicides (by stem injection or spot spray) or heavy machinery is likely to result in short-term releases of suspended sediment when treatment of locally extensive streamside monocultures occurs. Thus, these treatments are likely to affect a definite, broad area, and to produce at least minor damage to riparian soil and vegetation. In some cases, this will decrease stream shade, increase suspended sediment and temperature in the water column, reduce organic inputs (*e.g.*, insects, leaves, woody material), and alter streambanks and the composition of stream substrates. However, these circumstances are likely to occur only in rare cases, such as treatment of an invasive plant monoculture that encompasses a small stream channel. This effect would vary depending on site aspect, elevation, and amount of topographic shading, but is likely to decrease over time at all sites as shade from native vegetation is reestablished.

Biological controls work slowly, typically over several years, and are designed to work only on the target species. Thus, biological controls produce a smaller reduction of riparian and instream vegetation over a smaller area than manual and mechanical treatments and are unlikely to lead to bare ground and surface erosion that would release suspended sediment to streams. As treated invasive plants die, native plants are likely to become reestablished at each site; root systems will restore soil and streambank stability and vegetation will provide shade. Therefore, any adverse effects due to biological treatments, by themselves, are likely to be very mild. Biological controls typically work slowly over a period of years, and only on target species, and result in minimal impact to soils and vegetation from the actual release. Over time, successful biological control agents will reduce the size and vigor of host noxious weeds with minimal or no adverse effect to other plant species.

Herbicide applications. Stream margins often provide shallow, low-flow conditions, have a slow mixing rate with mainstem waters, and are the site at which subsurface runoff is introduced. Juvenile salmon and steelhead, particularly recently emerged fry, often use low-flow areas along stream margins. For example, wild Chinook salmon rear near stream margins until they reach about 60 mm in length. As juveniles grow, they migrate away from stream margins and occupy habitats with progressively higher flow velocities. Nonetheless, stream margins continue to be used by larger salmon and steelhead for a variety of reasons, including nocturnal resting, summer and winter thermal refuge, predator avoidance, and flow refuge. NMFS identified three scenarios for the analysis of herbicide application effects: (1) Runoff from riparian application; (2) application within perennial stream channels; and (3) runoff from intermittent stream channels and ditches.

Spray and vapor drift are important pathways for herbicide entry into aquatic habitats. Several factors influence herbicide drift, including spray droplet size, wind and air stability, humidity and temperature, physical properties of herbicides and their formulations, and method of application. For example, the amount of herbicide lost from the target area and the distance the herbicide moves both increase as wind velocity increases. Under inversion conditions, when cool air is near the surface under a layer of warm air, little vertical mixing of air occurs. Spray drift is most severe under these conditions, since small spray droplets will fall slowly and move to adjoining areas even with very little wind. Low relative humidity and high temperature cause more rapid evaporation of spray droplets between sprayer and target. This reduces droplet size, resulting in increased potential for spray drift. Vapor drift can occur when herbicide volatilizes. The formulation and volatility of the compound will determine its vapor drift potential. The potential for vapor drift is greatest under high air temperatures and low humidity and with ester formulations. For example, ester formulations of triclopyr are very susceptible to vapor drift, particularly at temperatures above 80°F (DiTomaso *et al.* 2006). Triclopyr, which is proposed, as well as many other herbicides and pesticides, are detected frequently in freshwater habitats within the four western states where listed Pacific salmonids are distributed (NMFS 2011e).

Several proposed PDC reduce the risk of herbicide drift. Ground equipment reduces the risk of drift, and hand equipment nearly eliminates it. Relatively calm conditions, preferably when humidity is high and temperatures are relatively low, and low sprayer nozzle height will reduce the distance that herbicide droplets will fall before reaching weeds or soil. Less distance means less travel time and less drift. Wind velocity is often greater as height above ground increases, so droplets from nozzles close to the ground would be exposed to lower wind speeds. The higher that an application is made above the ground, the more likely it is to be above an inversion layer that will not allow herbicides to mix with lower air layers and will increase long distance drift.

Surface water contamination with herbicides can occur when herbicides are applied intentionally or accidentally into ditches, irrigation channels or other bodies of water, or when soil-applied herbicides are carried away in runoff to surface waters. Direct application into water sources is generally used for control of aquatic species. Accidental contamination of surface waters can occur when irrigation ditches are sprayed with herbicides or when buffer zones around water sources are not wide enough. In these situations, use of hand application methods will greatly reduce the risk of surface water contamination.

The contribution from runoff will vary depending on site and application variables, although the highest pollutant concentrations generally occur early in the storm runoff period when the greatest amount of herbicide is available for dissolution (Stenstrom and Kayhanian 2005; Wood 2001). Lower exposures are likely when herbicide is applied to smaller areas, when intermittent stream channel or ditches are not completely treated, or when rainfall occurs more than 24 hours after application. Under the proposed action, some formulas of herbicide can be applied within the bankfull elevation of streams, in some cases up to the water's edge. Any juvenile fish in the margins of those streams are more likely to be exposed to herbicides as a result of overspray, inundation of treatment sites, percolation, surface runoff, or a combination of these factors. Overspray and inundation will be minimized through the use of dyes or colorants.

Groundwater contamination is another important pathway. Most herbicide groundwater contamination is caused by "point sources," such as spills or leaks at storage and handling facilities, improperly discarded containers, and rinses of equipment in loading and handling areas, often into adjacent drainage ditches. Point sources are discrete, identifiable locations that discharge relatively high local concentrations. In soil and water, herbicides persist or are decomposed by sunlight, microorganisms, hydrolysis, and other factors. 2,4-D and triclopyr are detected frequently in freshwater habitats within the four western states where listed Pacific salmonids are distributed (NMFS 2011e). Proposed PDC minimize these concerns by ensuing proper calibration, mixing, and cleaning of equipment. Non-point source groundwater contamination of herbicides is relatively uncommon but can occur when a mobile herbicide is applied in areas with a shallow water table. Proposed PDC minimize this danger by restricting the formulas used, and the time, place and manner of their application to minimize offsite movement.

Herbicide toxicity. Herbicides included in this invasive plant programmatic activity were selected due to their low to moderate aquatic toxicity to listed salmonids. The risk of adverse effects from the toxicity of herbicides and other compounds present in formulations to listed aquatic species is mitigated in this programmatic activity by reducing stream delivery potential by restricting application methods. Near wet stream channels, only aquatic labeled herbicides are to be applied. Aquatic glyphosate, aquatic imazapyr, and aquatic triclopyr-TEA can be applied up to the waterline, but only using hand selective techniques. A 15-foot buffer is required to use aquatic imazapyr and aquatic triclopyr-TEA by spot spraying. On dry streams, ditches, and wetlands, no buffers are required use the aquatic herbicides for spot spraying or hand selective application. The associated application methods were selected for their low risk of contaminating soils and subsequently introducing herbicides to streams. However, direct and indirect exposure and toxicity risks are inherent in some application scenarios.

Generally, herbicide active ingredients have been tested on only a limited number of species and mostly under laboratory conditions. While laboratory experiments can be used to determine acute toxicity and effects to reproduction, cancer rates, birth defect rates, and other effects to fish and wildlife, laboratory experiments do not typically account for species in their natural environments and little data is available from studies focused specifically on the listed species in this opinion. This leads to uncertainty in risk assessment analyses. Environmental stressors increase the adverse effects of contaminants, but the degree to which these effects are likely to occur for various herbicides is largely unknown.

The effects of the herbicide applications to various representative groups of species have been evaluated for each proposed herbicide. The effects of herbicide applications using spot spray, hand/select, and broadcast spray methods were evaluated under several exposure scenarios: (1) runoff from riparian (above the OHW mark) application along streams, lakes and ponds, (2) runoff from treated ditches and dry intermittent streams, and (3) application within perennial streams (dry areas within channel and emergent plants). The potential for herbicide movement from broadcast drift was also evaluated. Risks associated with exposure and associated effects were also evaluated for terrestrial species.

Although the PDC would minimize drift and contamination of surface and ground water, herbicides reaching surface waters will likely result in mortality to fish during incubation, or lead to altered development of embryos. Stehr *et al.* (2009) found that the low levels of herbicide delivered to surface waters are unlikely to be toxic to the embryos of ESA-listed salmon, steelhead and trout. However, mortality or sub-lethal effects such as reduced growth and development, decreased predator avoidance, or modified behavior are likely to occur. Herbicides are likely to also adversely affect the food base for listed salmonids and other fish, which includes terrestrial organisms of riparian origin, aquatic macroinvertebrates and forage fish.

Adverse effect threshold values for each species group were defined as either 1/20th of the LC50 value for listed salmonids, 1/10th of the LC50 value for non-listed aquatic species, or the lowest acute or chronic "no observable effect concentration," whichever was lower, found in Syracuse Environmental Research Associates, Inc. (SERA) risk assessments that were completed for the USFS; *i.e.*, sethoxydim (SERA 2001), sulfometuron-methyl (SERA 2004b), imazapic (SERA 2004c), chlorsulfuron (SERA 2004a), imazapyr (SERA 2011a), glyphosate (SERA 2011d), and triclopyr (SERA 2011c). These assessments form the basis of the analysis in this opinion. Generally, effect threshold values for listed salmonids were lower than values for other fish species groups, so values for salmonids were also used to evaluate potential effects to other listed fish. In the case of sulfometuron-methyl, threshold values for fathead minnow were lower than salmonid values, so threshold values for minnow were used to evaluate effects to listed fish.

Data on toxicity to wild fish under natural conditions are limited and most studies are conducted on lab specimens. Adverse effects could be observed in stressed populations of fish, and it is less likely that effects will be noted in otherwise healthy populations of fish. Chronic studies or even long-term studies on fish egg-and-fry are seldom conducted. Risk characterizations for both terrestrial and aquatic species are limited by the relatively few animal and plant species on which data are available, compared to the large number of species that could potentially be exposed. This limitation and consequent uncertainty is common to most if not all ecological risk assessments. Additionally, in laboratory studies, test animals are exposed to only a single chemical. In the environment, humans and wildlife may be exposed to multiple toxicants simultaneously, which can lead to additive or synergistic effects.

The effects of herbicides on salmonids are fully described by NMFS in other recent opinions with the EPA, USFS, BPA, and USACE (NMFS 2010; NMFS 2011e; NMFS 2011f; NMFS 2012a; NMFS 2013b; NMFS 2013d; NMFS 2013c) and in SERA reports. For the 2008 Aquatic Restoration Biological Opinion (ARBO) the USFS, BLM, and BIA evaluated the risk of adverse effects to listed salmonids and their habitat in terms of hazard quotient (HQ) values (NMFS 2008c).

HQ evaluations from the 2008 ARBO (NMFS 2008c) are summarized below for the herbicides (chlorsulfuron, clopyralid, glyphosate, imazapyr, metsulfuron methyl, sethoxydim, and sulfometuron methyl). HQs were calculated by dividing the expected environmental concentration by the effects threshold concentration. Adverse effect threshold concentrations are

1/20th (for ESA listed aquatic species) or 1/10th (all other species) of LC50 values, or "no observable adverse effect" concentrations, whichever concentration was lower. The water contamination rate (WCR) values are categorized by herbicide, annual rainfall level, and soil type. Variation of herbicide delivery to streams among soil types (clay, loam, and sand) is displayed as low and high WCR values. All WCR values are from risk assessments conducted by SERA. When there are HQ values greater than 1, adverse effects are likely to occur. Hazard quotient values were calculated for fish, aquatic invertebrates, algae, and aquatic macrophytes.

For imazapic, picloram, and triclopyr, we referred to NMFS' opinions, SERA reports, various other literature sources, and the 2013 BA for ARBO II (USDA-Forest Service *et al.* 2013) to characterize risk to listed fish species.

Chlorsulfuron. No chlorsulfuron HQ exceedences occur for fish or aquatic invertebrates. HQ exceedences occur for algae at rainfall rates of 50 and 150 inches per year, and for aquatic macrophytes at rainfall rates of 15, 50, and 150 inches per year.

The HQ values predicted for algae at 50 inches per year ranged from 0.002 to 2.8, and the HQ exceedence occurred at the maximum application rate on clay soils. The HQ values predicted for algae at 150 inches per year ranged from 0.02 to 5.0, and HQ exceedances occurred at both the typical (HQ of 1.1) and maximum (HQ of 5.0) application rates on clay soils. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall regimes of 50 to 150 inches per year, is likely adversely affect algal production when occurring on soils with poor infiltration.

The HQ values predicted for aquatic macrophytes at 15 inches per year ranged from 0 to 64, and HQ exceedences occurred at both the typical and maximum application rates on clay soils. The HQ values for aquatic macrophytes at 50 inches per year ranged from 0.5 to 585, and ranged from 4.8 to 1,064 at 150 inches per year. The HQ exceedences at 50 and 150 inches per year occurred at both typical and maximum application rates, with lower HQ values occurring on loam soils, and the highest values on clay soils. Given the wide range of HQ values observed among soil types at a given rainfall rate, soil type is clearly a major driver of exposure risk for chlorsulfuron, with low permeability soils markedly increasing exposure levels. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall regimes of 15 to 150 inches per year, is likely to adversely affect aquatic macrophytes. Application on soils with low infiltration rates will have a substantially higher risk of resulting in adverse effects.

Clopyralid. Application of clopyralid under the modeled scenario did not result in any HQ exceedences for any of the species groups. Clopyralid applications are not likely to adversely affect listed salmonids or their habitat because HQ values are less than 1.

Glyphosate. Glyphosate HQ exceedences occurred for fish and algae at a rainfall rate of 150 inches per year, and no HQ exceedences occurred for aquatic invertebrates or aquatic macrophytes. The HQ exceedences occurred at the maximum application rates only. The HQ values for fish at 150 inches per year ranged from 1.5 to 3.6, and occurred within a narrow range on all soil types. The HQ values for algae at 150 inches per year ranged from 0.8 to 2.0 in sand.

Application of glyphosate adjacent to stream channels at application rates approaching the maximum, in rainfall regimes approaching 150 inches per year, on all soil types is likely to adversely affect listed salmonids. When glyphosate is applied adjacent to stream channels at rates approaching the maximum on sandy soils, in rainfall regimes approaching 150 inches per year, adverse effects to algal production will occur.

Imazapic. Aquatic animals appear to be relatively insensitive to imazapic exposures, with LC50 values of greater than 100 mg/L for both acute toxicity and reproductive effects. Aquatic macrophytes may be much more sensitive, with an acute EC50 of 6.1 µg/L in duck weed (*Lemna gibba*). Aquatic algae appear to be much less sensitive, with EC50 values of greater than 45 µg/L. No toxicity studies have been located on the effects of imazapic on amphibians or microorganisms (SERA 2004c).

Imazapyr. No HQ exceedences occurred for imazapyr for fish or aquatic invertebrates. HQ exceedances occurred for algae and aquatic macrophytes at a rainfall rate of 150 inches per year.

The HQ values for algae at 150 inches per year ranged from 0 to 1.3. The HQ exceedence at 150 inches per year occurred only at the maximum application rate on clay soils. The HQ values for aquatic macrophytes at 150 inches per year ranged from 0 to 2.0. The HQ exceedence at 150 inches per year occurred only at the maximum application rate on clay soils. Given the range of HQ values observed for imazapyr at a rainfall rate of 150 inches per year, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. Application of imazapyr adjacent to stream channels at application rates approaching the maximum on soils with low permeability, in rainfall regimes approaching 150 inches per year, is likely to adversely affect algal production and aquatic macrophytes.

Algae and macrophytes provide food for aquatic macroinvertebrates, particularly those in the scraper feeding guild (Williams and Feltmate 1992). These macroinvertebrates in turn provide food for rearing juvenile salmonids. Consequently, adverse effects on algae and aquatic macrophyte production may cause a reduction in availability of forage for juvenile salmonids. Over time, juvenile salmonids that receive less food have lower body condition and smaller size at smoltification. However, the small amount of imazapyr expected to reach the water should not result in effects this severe.

Metsulfuron methyl. No HQ exceedences occurred for metsulfuron for fish, aquatic invertebrates, or algae. The HQ exceedences for aquatic macrophytes occurred at the maximum application rate on clay soils at rainfall rates of 50 and 150 inches per year. The HQ values ranged from 0.009 to 1.0 at 50 inches, and from 0.02 to 1.9 at 150 inches per year.

Given the range of HQ values observed for metsulfuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with rainfall rates between 50 and 150 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to adversely affect aquatic macrophytes. A slight decrease in forage availability for juvenile salmonids will result from adverse effects to aquatic macrophytes.

Picloram. Based on expected concentrations of picloram in surface water, all central estimates of the HQs are below the level of concern for fish, aquatic invertebrates, and aquatic plants. No risk characterization for aquatic-phase amphibians can be developed because no directly useful data are available. Upper bound HQs exceed the level of concern for longer-term exposures in sensitive species of fish (HQ=3) and peak exposures in sensitive species of algae (HQ=8). It does not seem likely that either of these HQs would be associated with overt or readily observable effects in either fish or algal populations for typical applications. In the event of an accidental spill, substantial mortality will be likely in both sensitive species of fish and sensitive species of algae (SERA 2011b).

Sethoxydim. No HQ exceedences occurred for sethoxydim for aquatic invertebrates, algae, or aquatic macrophytes. The HQ exceedences for fish occurred at rainfall rates of 50 and 150 inches per year, and ranged from 0.3 to 1.0, and from 1.1 to 3.0, respectively. The HQ exceedence at 50 inches per year occurred only at the maximum application rate on loam soils. The HQ exceedences at 150 inches per year occurred at the typical application rate on sand, and at the maximum application rate on loam soil.

The HQ values for sethoxydim were calculated using the toxicity data for the Poast formulation, and incorporates the toxicity of naphtha solvent. The toxicity of sethoxydim alone for fish and aquatic invertebrates is much less than that of the formulated product (about 30 times less toxic for invertebrates, and about 100 times less toxic for fish). Since the naphtha solvent tends to volatilize or adsorb to sediments, using Poast formulation data to predict indirect aquatic effects from runoff leaching is likely to overestimate adverse effects (SERA 2001). Project design criteria sharply reduce the risk of naptha solvent presence in percolation runoff reaching streams. When design criteria to reduce naptha solvent exposure are employed, application of sethoxydim adjacent to stream channels will not adversely affect listed salmonids or their habitat.

Sulfometuron-methyl. No HQ exceedences occurred for sulfometuron-methyl for fish, aquatic invertebrates, or algae. The HQ exceedence for aquatic macrophytes occurred at a rainfall rate of 150 inches per year on clay soils, and HQ values ranged from 0.007 to 3.8. Considering the range of HQ values observed for sulfometuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with a rainfall rate approaching 150 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to adversely affect aquatic macrophytes. A slight decrease in forage availability for juvenile salmonids will result from adverse effects to aquatic macrophytes.

Triclopyr. With the exception of aquatic plants, substantial risks to nontarget species (including humans) associated with the contamination of surface water are low, relative to risks associated with contaminated vegetation. Stehr *et al.*(2009) observed no developmental effects at nominal concentrations of 10 mg/L or less for purified triclopyr alone or for the TEA formulations Garlon 3A and Renovate.

Adjuvants. Washington State Departments of Agriculture and Ecology have the following criteria for the registration of spray adjuvants for aquatic use in Washington:

- The adjuvant must fulfill all requirements for registration of a food / feed use spray adjuvant in Washington.
- The adjuvant must be either slightly toxic or practically non-toxic to freshwater fish. Rainbow trout (*Oncorhynchus mykiss*) is the preferred test species.
- The adjuvant must be moderately toxic, slightly toxic or practically non-toxic to aquatic invertebrates. Either *Daphnia magna* or *Daphnia pulex* are acceptable test species.
- The adjuvant formulation must contain less than 10% alkyl phenol ethoxylates (including alkyl phenol ethoxylate phosphate esters).
- The adjuvant formulation must not contain any alkyl amine ethoxylates (including tallow amine ethoxylates).

NMFS has excluded several of these compounds because they do contain alkyl phenol ethoxylates (APEOs). Alkylphenols, including nonylphenol (NP) and nonylphenol ethoxylates (NPE), have been detected in the natural environment, including ambient air, sewage treatment plant effluent, sediment, soil, and surface waters, in wildlife, household dust, and human tissues. NP and NPE are toxic to aquatic organisms, and the breakdown products of nonylphenol ethoxylates (NP and shorter-chained ethoxylates) are more toxic and more persistent than their parent chemicals. NP has been shown to have estrogenic effects in a number of aquatic organisms (Environment Canada and Health Canada 2001; Lani 2010; Servos 1999). Environment Canada and Health Canada (2001) concluded that nonylphenol and its ethoxylates are entering the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity. Zoller (2006) reported that egg production by zebrafish, exposed to 75, 25 and 10 µg/L of a typical industrial APEO was reduced up to 89.6%, 84.7% and 76.9%, respectively, between the 8th and 28th days of exposure.

Summary. Stehr *et al.* (2009) studied developmental toxicity in zebrafish *(Danio rerio)*, which involved conducting rapid and sensitive phenotypic screens for potential developmental defects resulting from exposure to six herbicides (picloram, clopyralid, imazapic, glyphosate, imazapyr, and triclopyr) and several technical formulations. Available evidence indicates that zebrafish embryos are reasonable and appropriate surrogates for embryos of other fish, including salmonids. The absence of detectable toxicity in zebrafish screens is unlikely to represent a false negative in terms of toxicity to early developmental stages of threatened or endangered salmonids. Their results indicate that low levels of noxious weed control herbicides are unlikely to be toxic to the embryos of ESA-listed salmon, steelhead, and trout. Those findings do not necessarily extend to other life stages or other physiological processes (*e.g.*, smoltification, disease susceptibility, behavior).

The proposed PDC, including limitations on the herbicides, adjuvants, carriers, handling procedures, application methods, drift minimization measures, and riparian buffers, will greatly reduce the likelihood that significant amounts of herbicide will be transported to aquatic habitats, although some herbicides are still likely to enter streams through aerial drift, in association with eroded sediment in runoff, and dissolved in runoff, including runoff from intermittent streams and ditches. The indirect effects or long-term consequences of invasive, non-native plant control will depend on the long-term progression of climatic factors and the success of follow-up management actions to exclude undesirable species from the action area, provide early detection and rapid response before such species establish a secure position in the plant community, eradicate incipient populations, and control existing populations.

Effects of Near and Instream Restoration Construction. Use of heavy equipment for vegetation removal and earthwork compact the soil, thus reducing permeability and infiltration. Use of heavy equipment, including stationary equipment like generators and cranes, also creates a risk that accidental spills of fuel, lubricants, hydraulic fluid, coolants, and other contaminants may occur. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain PAHs, which are acutely toxic to salmon, steelhead, and other fish and aquatic organisms at high levels of exposure and cause sublethal adverse effects on aquatic organisms at lower concentrations (Heintz *et al.* 2000; Heintz *et al.* 1999; Incardona *et al.* 2005; Incardona *et al.* 2004; Incardona *et al.* 2006). It is likely that petroleum-based contaminants have similar effects on eulachon. Therefore, before entering wetlands or within 150 feet of a waterbody, petroleum-based hydraulic fluids will be replaced with biodegradable products. The intent of this PDC is to prevent hydraulic fluid spilling into and polluting natural water bodies in the event of an accidental release due to equipment leakage or hydraulic component failure. Furthermore, the Washington State Department of Transportation (2010) requires that all equipment entering waters containing bull trout use vegetable oil or other biodegradable, acceptable hydraulic fluid substitute.

The USFWS and NOAA RC will require that heavy-duty equipment and vehicles for each project be selected with care and attention to features that minimize adverse environmental effects (*e.g.*, minimal size, temporary mats or plates within wet areas or sensitive soils), use of staging areas at least 150 feet from surface waters, and regular inspection and cleaning before operation to ensure that vehicles remain free of external oil, grease, mud, and other visible contaminants. Also, as noted above, to reduce the likelihood that sediment or pollutants will be carried away from project construction sites, the USFWS and NOAA RC will ensure that clearing areas are limited and that a suite of erosion and pollution control measures will be applied to any project that involves the likelihood of soil and vegetation disturbance that can increase runoff and erosion, including securing the site against erosion, inundation, or contamination by hazardous or toxic materials.

Work involving the presence of equipment or vehicles in the active channel when ESA-listed fish are present is likely to result in injury or death of some individuals. The USFWS and NOAA RC will avoid or reduce that risk by having mechanized equipment work from the top of the streambank, unless work from another location will result in less habitat disturbance, and limiting the timing of that work to avoid vulnerable life stages of ESA-listed fish, including migration, spawning and rearing. Further, when work in the active channel involves substantial excavation, backfilling, embankment construction, or similar work below OHW where adult or juvenile fish are reasonably certain to be present, or 300 feet or less upstream from spawning habitats, the USFWS and NOAA RC will require that the work area be effectively isolated from the active channel to reduce the likelihood of direct, mechanical interactions with fish, or indirect interactions through environmental effects. Regardless of whether a work area is isolated or not, and with few exceptions, the USFWS and NOAA RC will require that passage for adult and juvenile fish that meets NMFS' (2011a) criteria, or most recent version, will be provided around the project area during and after construction.

If any juvenile fish are likely to be present in the work isolation area, the USFWS and NOAA RC will require that they be captured and released. However, it is unlikely that any adult fish, including salmon, steelhead, or eulachon will be affected by this procedure because it will occur when adults are unlikely to be present and, if any are present, their size allows them to easily escape from the containment area. Capturing and handling fish causes them stress though they typically recover fairly rapidly from the process and therefore the overall effects of the procedure are generally short-lived (NMFS 2002).

The primary contributing factors to stress and death from handling are differences in water temperature between the river where the fish are captured and wherever the fish are held, dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on fish increases rapidly from handling if the water temperature exceeds 64°F or dissolved oxygen is below saturation. The USFWS and NOAA RC's conservation measures regarding fish capture and release, use of pump screens during the de-watering phase, and fish passage around the isolation area are based on standard NMFS guidance to reduce the adverse effects of these activities (NMFS 2011a).

Direct habitat loss refers to displacement of native streambed material and diversity by the installation of rock or other hard structures within the functional floodplain. The habitat features of concern include water velocity, depth, substrate size, gradient, accessibility and space that are suitable for salmon and steelhead rearing. In spawning areas, rock and other hard structures are often used to replace spawning gravels, and realign channels to eliminate natural meanders, bends, spawning riffles and other habitat elements. Riffles and gravel bars downstream are scoured when flow velocity is increased. For eulachon, the important habitat features are flow, water quality and substrate conditions, primarily in lower Columbia River tributaries.

In this programmatic opinion, rock may not be used for streambank restoration, except as ballast to stabilize LW. Damaged streambanks will be restored to a natural slope, pattern, and profile suitable for establishment of permanent woody vegetation, without changing the location of the streambank toe. Rock and other hard structures within the functional floodplain reduce water quality by reducing or eliminating riparian vegetation that regulates the quantity and quality of runoff and, together with channel complexity, help to maintain and reduce stream temperatures. The benefits of using rock or other hard structures for this purpose are often speculative or minimal, at best, particularly in contrast to the multiple habitat benefits provided by other erosion control methods that do not require hardening of the streambank or bed (Cramer *et al.* 2003; Cramer 2012).

Treated wood as a construction material is not allowed for bridge projects under this consultation. Copper and other toxic chemicals, such as zinc, arsenic, chromium, and PAHs, that leach from pesticide-treated wood used to construct roads, culverts or bridges are likely to adversely affect salmon, steelhead, and eulachon that spawn, rear, or migrate by those structures, and when they ingest contaminated prey (Poston 2001). These effects are unpredictable, with the intensity of effect depending on numerous factors. Effects from the use of treated wood are best addressed in an individual consultation. Copper has been shown to impair the olfactory nervous system and olfactory-mediated behaviors in salmon and steelhead (Baldwin *et al.* 2003; Baldwin and Scholz 2005; Hecht *et al.* 2007; Linbo *et al.* 2006; McIntyre *et al.* 2008). Similarly, PAHs, which leach from wood treated with creosote, may cause cancer, reproductive anomalies, immune dysfunction, growth and development impairment, and other impairments to exposed fish (Carls *et al.* 2008; Collier *et al.* 2002; Incardona *et al.* 2005; Incardona *et al.* 2004; Incardona *et al.* 2006; Johnson 2000; Johnson *et al.* 2002; Johnson *et al.* 1999; Stehr *et al.* 2009). Alternatives to treated wood, such as silica-based wood preservation, improved recycled plastic technology, and environmentally safe wood sealer and stains are allowed.[37]

Any temporary water withdrawal will have a fish screen installed, operated, and maintained as described in NMFS (2011a). The USFWS and NOAA RC will require that all discharge water created by concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids, or other construction work will be treated using the BMPs applicable to site conditions for removal of debris, heat, nutrients, sediment, petroleum products, metals and any other pollutants likely to be present (*e.g.*, green concrete, contaminated water, silt, welding slag, sandblasting abrasive, grout cured less than 24 hours), to ensure that no pollutants are discharged from the construction site. For bridge construction, all concrete will be poured in the dry, or within confined waters not connected to surface waters, and will be allowed to cure a minimum of 7 days before contact with surface water (Washington State Department of Transportation 2010).

Some of these adverse effects will abate almost immediately, such as increased total suspended solids caused by boulder or LW restoration. Others will be long-term conditions that may decline quickly but persist at some level for weeks, months, or years, until riparian and floodplain vegetation are fully reestablished. Failure to complete site restoration, or to prevent disturbance of newly restored areas by livestock or unauthorized persons will delay or prevent recovery of processes that form and maintain productive fish habitats.

All of the activities are designed to have long-term beneficial effects to critical habitat. However, as noted above, the long-term effectiveness of habitat restoration actions, in general, have not been well documented. In part, this is because they often concentrate on instream habitat without addressing the processes that led to the loss of the habitat (Cederholm *et al.* 1997; Doyle and Shields 2012; Fox 1992; Roper *et al.* 1997; Simenstad and Thom 1996; Zedler 1996). Nevertheless, the proposed actions are reasonably certain to lead to some degree of ecological recovery within each action area, including the establishment or restoration of environmental conditions associated with functional habitat and high conservation value. Fish passage improvement actions, in particular, are likely to have long-term beneficial effects at the watershed or designation-wide scale (Roni *et al.* 2002).

Site restoration. After each project is complete, the USFWS and NOAA RC will require any significant disturbance of riparian vegetation, soils, streambanks, or stream channel that was

[37] See, *e.g.*, American Plastic Lumber (Shingle Springs, California) and Resco Plastics (Coos Bay, Oregon) for structural lumber from recycled plastic; Plastic Pilings, Inc. (Rialto, California) for structurally reinforced plastic marine products; Timbersil (Springfield, Virginia) for structural lumber from wood treated with a silica-based fusion technology; and Timber Pro Coatings (Portland, Oregon) for non-petroleum based wood sealer and stains. The use of trade, firm, or corporation names in this opinion is for the information and convenience of the action agency and applicants and does not constitute an official endorsement or approval by the U.S. Department of Commerce or NMFS of any product or service to the exclusion of others that may be suitable.

caused by the construction to be cleaned up and restored to reestablish those features within reasonable limits of natural and management variation.

Thus, each restoration project will typically include replacement of natural materials or other geomorphic characteristics that were previously altered or degraded there in some way, so that ecosystem processes that form and maintain productive fish habitats are replaced and can function at those sites. The project footprint of any restoration project more complicated than simple site stabilization and revegetation will almost always occur in the riparian area or zone, or inside the active channel.

For actions that include a construction phase, the direct physical and chemical effects of site clean-up after construction is complete are essentially the reverse of the previous construction activities. Bare earth will be protected by various methods, including seeding, planting woody shrubs and trees, and mulching. This will immediately dissipate erosive energy associated with precipitation and increase soil infiltration and accelerate vegetative succession that is necessary to restore the delivery of LW to the riparian area and aquatic system, root strength necessary for slope and streambank stability, leaf and other particulate organic matter input, sediment filtering and nutrient absorption from runoff, and shade. Microclimate will become cooler and moister, and wind speed will decrease. Whether recovery occurs over weeks or years, the disturbance frequency, considered as the number of actions funded per year within a given recovery domain is likely to be extremely low, as is the intensity of the disturbance, considered as a function of the total number of miles of critical habitat present within each watershed.

Restoration of aquatic habitats is fundamentally about allowing stream systems to express their capacities, *i.e.*, the relief of human influences that have suppressed the development of desired habitat mosaics (Ebersole *et al.* 2001). Thus, the time necessary for recovery of functional habitat attributes sufficient to support species recovery following any disturbance, including construction necessary to complete a restoration action, will vary by the potential capacity of each habitat attribute. Recovery mechanisms such as soil stability, sediment filtering and nutrient absorption, and vegetation succession may recover quickly (*i.e.*, months to years) after completion of the project. Recovery of functions related to wood recruitment and microclimate may require decades or longer. Functions related to shading of the riparian area and stream, root strength for streambank stabilization, and organic matter input may require intermediate lengths of time. The rate and extent of functional recovery is also controlled in part by watershed context. Proposed actions will occur in areas where productive habitat functions and recovery mechanisms are absent or degraded.

Many authors have discussed the importance of riparian vegetation to stream ecosystems (Dosskey *et al.* 2010; Hicks *et al.* 1991; Murphy and Meehan 1991; Spence *et al.* 1996; Swanston 1991). Streambanks covered with well-rooted woody vegetation have an average critical sheer stress three times that of streambanks weakly vegetated or covered with grass (Millar and Quick 1998). Riparian vegetation also plays an important role in protecting streams from nonpoint source pollutants and in improving the quality of degraded stream water (Dosskey *et al.* 2010).

Planting in riparian areas may result in very minor fine sediment delivery to streams. It could also temporarily flush fish from hiding cover. In the long term, planting of riparian vegetation will increase shade, hiding cover, LW, and streambank stability. This will improve the survival of yearling and other juvenile salmonids by providing appropriate substrate for fry and an increase in cover from predators and high flows.

Beneficial effects to fish also include enhanced fitness through improved conditions for forage species and improved reproductive success for adult salmonids as a result of increased deep water cover and holding areas. As plantings mature, width-to-depth ratios of disturbed channels and fine sediment delivery will decrease.

Activity Category-Specific Effects

1. Fish Passage Restoration. For the USFWS and NOAA RC aquatic restoration programs, fish passage includes a broad range of activities to restore or improve juvenile and adult fish passage as described in the proposed action. Such projects will take place where fish passage has been partially or completely eliminated through road construction, stream degradation, creation of small dams and step structures, and irrigation diversions. Equipment such as excavators, bull dozers, dump trucks, front-end loaders and similar equipment may be used to implement such projects.

These activities usually require isolation of the work area from flowing water, relocation of fish, and significant instream construction. The construction-related effects described in the above section on restoration construction effects will occur at all culvert and bridge project sites. USFWS and NOAA RC propose to replace culverts and bridges using the stream simulation method, in which natural stream substrates will be placed in the bottom of these structures.

Under this activity category, artificial obstructions that block fish passage will be removed or replaced with facilities that restore or improve fish passage. The beneficial effects of this activity category include improved fish passage, restoration of natural bedload movement in streams, and restoration of tidal influence in estuarine areas. Removal of these structures requires instream construction with effects as described earlier. Culverts and bridges, other than stream simulation design crossings that meet the proposed action criteria, will require review and approval by NMFS fish passage engineers.

Culverts and Bridges. Long-term beneficial effects of culvert and bridge replacement or removal projects include restoration of fish passage and restoration of natural stream channel processes through removal of channel constricting structures. Removing fish-passage blockages will restore spatial and temporal connectivity of streams within and between watersheds where fish movement is currently obstructed. This, in turn, will permit fish access to areas critical for fulfilling their life history requirements, especially foraging, spawning, and rearing. At a larger scale this will improve population spatial structure.

However, the removal of fish passage barriers could have short-term (typically lasting less than one week, depending on the duration of instream work) temporary effects to fish and their habitat. Heavy equipment might be used in the stream for unblocking, removing and replacing culverts and bridges. In-water equipment use could temporarily affect salmonids and critical habitat, including impacts on redds, smothered or crushed eggs and alevins, increased suspended sediment and deposition, blocked migration, and disrupted or disturbed overwintering behavior. Salmon are particularly vulnerable during the fall and winter, when adult salmon are migrating and spawning, and the spring, when eggs and fry are still present in the substrate. The activities could move juveniles out of overwintering habitats such as side channels and deep pools, into inferior habitats or high velocity waters. However, because of the seasonal restrictions imposed by in-water work windows, these effects will be avoided.

Treated wood as a construction material is not allowed for bridge projects under this consultation. Copper and other toxic chemicals, such as zinc, arsenic, chromium, and PAHs, that leach from pesticide-treated wood used to construct a road, culvert or bridge are likely to adversely affect salmon, steelhead, and eulachon that spawn, rear, or migrate by those structures, and when they ingest contaminated prey (Poston 2001). These effects are unpredictable, with the intensity of effect depending on numerous factors. Effects from the use of treated wood as a material for structures placed in or over aquatic habitats that support ESA-listed species are best addressed in an individual consultation to consider material selection and site-specific considerations such as background concentrations, density of product installation, location of other treated wood structures, and environmental conditions (NOAA Fisheries - Southwest Region 2009).

Fish passage impediments are common throughout Oregon and Washington and restoration planning efforts have highlighted the need to restore fish passage, particularly when the blockage occurs low in a watershed.

Fish Screen Installation/Replacement. Unscreened or improperly screened irrigation diversion structures can entrain fish into canals where they become trapped and die. If approach velocities are too fast, fish can also be impinged against the screen surface. To avoid any effects from improperly designed screens, all proposed screen installations or replacements will meet NMFS fish passage criteria (NMFS 2011a). No additional water withdrawal points will be established and no greater rate or duty of water withdrawal will be authorized under this consultation.

Replacing, relocating, or construction of fish screens and irrigation diversions activities will require near or instream construction, so related effects as described above will occur. This consultation does not consider the effects of stream flow diminution caused by water withdrawals on listed salmon, steelhead, or their habitat. Installation of screens will occur only on existing diversion.

The primary long-term beneficial effect of properly screening diversions is decreased salmonid mortality. Although it is well accepted that screens prevent fish from dying, NMFS cannot predict exactly how many fish would be saved by installing screens in the Northwest. Despite millions of dollars spent on fish screening of water diversions in the Pacific Northwest and California, there have been few quantitative studies conducted on how screening actually affects fish populations (Moyle and Israel 2005). One recent study (Walters *et al.* 2012), examined potential losses of Chinook salmon juveniles to unscreened diversions and found that about 71%

of out-migrating smolts could be lost each year within a given river basin. The authors also found that screening was an effective mitigation strategy and reduced estimated mortality to less than 2% when all diversions within the basin were screened. Even though the effects of screening have not been well studied, NMFS recognizes the value of screening and supports the USFWS and NOAA RC's precautionary approach to screen diversions that may affect listed salmon and steelhead. The removal of unneeded diversion structures improves fish passage and restores natural bedload movement.

Head-cut and Grade Stabilization. The stabilization of active or potential head-cuts with LW, rock, or step structures primarily takes place in Rosgen (1994) C- and E-type channels in areas east of the Cascade Mountains. In these areas, historical land management such as heavy livestock grazing and road construction has destabilized stream channels and increased the chance of head-cut formation. Stabilization requires instream construction, so short-term construction related adverse effects as described earlier will occur.

The propagation of headcuts in an upstream direction is often arrested by buried wood or rock, a change in stream type, or infrastructure such as culverts. USFWS and NOAA RC propose aggressive treatments to prevent further incision of stream channels including use of rock and log step structures. Grade stabilization is often required for culvert removal projects where channel incision or erosion downstream of the road crossing has created a significant vertical discontinuity through the crossing. Bridge and culvert replacement designs often incorporate grade control components to protect footings and abutments, terminate or abate future channel instability, and protect critical or valuable upstream habitats.

These aggressive restoration techniques are sometimes necessary to stop the ongoing damage caused by migrating head-cuts. USFWS and NOAA RC also propose temporary head-cut stabilization, in which case fish passage may be blocked. In these circumstances, the fish passage will be reestablished during the subsequent in-water work period. This may block fish passage for several months, but without this treatment, head-cut formation might also block fish passage.

The beneficial effects of this proposed activity result primarily from the action's prophylactic nature. Left unchecked, head-cuts lead to channel incision, deposition of fine sediments in downstream substrates, and disconnection of a stream from its floodplain. Stabilizing head-cuts will stop the progression of these adverse effects. No matter where these activities occur, we expect an increase in habitat functions, improvements to VSP parameters, and a reduction in the risk of extinction to listed species.

Fish Ladders. Installation of a fish ladder and its subsequent operation increases the number of individual fish that are able to move upstream. This, in turn, will increase the number of fish that populate areas upstream from a dam, either because the fish continue to reside in the newly available habitat or because they reproduce in formerly unutilized spawning habitat. Short-term construction related adverse effects as described earlier will occur. Restoration of passage through constructing a ladder will improve population spatial structure and possible abundance and productivity if additional spawning habitat is made available.

Replace/Relocate Existing Irrigation Diversions. Under this activity subcategory, USFWS and NOAA RC will fund or implement the replacement of instream irrigation diversion structures with screened pump stations or remove unneeded irrigation diversion structures to benefit fish passage. This activity category requires significant in-water construction, so effects as described earlier will occur.

Beneficial effects of removing irrigation diversion structures such as small concrete dams, rock structures, and gravel push-up berms include improved fish passage and restoration of natural stream bedload movement. Many structures that would be removed provide only marginal fish passage and their removal will improve both adult and juvenile salmonid passage. The removal of unneeded structures also allows for the restoration of natural stream processes such as bedload movement and alleviates upstream and downstream scour that occurs at some diversion structures. Replacing a gravity diversion with a pump can eliminate the need for yearly construction of gravel push-up berms with heavy equipment and reduce water consumption.

Pump stations created under this subcategory will be screened to NMFS fish passage and screening criteria (NMFS 2011a). This will prevent juvenile fish from being entrained into the irrigation system. Actions involving effects to listed salmon, steelhead, or their habitat caused by lack of stream flow are not covered by this consultation.

2. ***Large Wood, Boulder, and Gravel Placement; Engineered Logjams (ELJs); Constructed Riffles; Porous Boulder Step Structures and Vanes; Tree Removal for Large Wood Projects.*** Installation of wood and boulder instream structures is likely to require entry of personnel into the riparian area and channel, and will result in unavoidable short-term construction related effects as described above, but will increase stream habitat complexity, increase overhead cover, increase terrestrial insect drop, and help reestablish natural hydraulic processes in streams over time. LW, in a stream, can accomplish multiple purposes by trapping gravel above the structure, creating pools, and increasing the connection with the floodplain vegetation. Wood placement is likely to cause minor damage to riparian soil and vegetation, and minor disturbance of streambank or channel substrate.

However, the intensity and duration of disturbance is unlikely to increase total suspended solids, or otherwise impair aquatic habitats or freshwater rearing and migration.

No matter where these activities occur, we expect an increase in habitat functions, improvements to VSP parameters, and a reduction in the risk of extinction to listed species. Numerous authors have highlighted the importance of LW to lotic ecosystems (Bilby 1984; Keller *et al.* 1985; Lassettre and Harris 2001; Spence *et al.* 1996). LW influences channel morphology, traps and retains spawning gravels, and provides food for aquatic invertebrates that in turn provide food for juvenile salmonids. LW, boulders, and other structures provide hydraulic complexity and pool habitats that serve as resting and feeding stations for salmonids as they rear or migrate upstream to spawn (Spence *et al.* 1996).

Land management actions such as logging, road building, stream clearing, and splash damming carried out over the last 150 years have greatly reduced the amount of LW and boulders in streams (McIntosh *et al.* 1994; Murphy 1995). USFWS and NOAA RC propose this activity category to return these important elements to stream ecosystems. Addition of LW is a common and effective restoration technique used throughout the Pacific Northwest (Roni *et al.* 2002). Roni and Quinn (2001a) found that LW placement can lead to higher densities of juvenile coho salmon during summer and winter and higher densities of steelhead and cutthroat trout in the winter. These authors also found that addition of LW to streams with low levels of wood can lead to greater fish growth and less frequent and shorter fish movements (Roni and Quinn 2001b).

ELJs, which are constructed either of timber, rock, or a combination that is engineered to create an interlocking composite structure, are an effective tool for restoring physical and biological conditions critical to salmon recovery in large alluvial rivers. Placement of a single log can provide benefits in certain situations but a log jam typically provides more habitat value. The mass of the structures and pilings are designed to provide the needed resistance to the expected forces of the river. These diverse bio-structures provide the base for different aquatic life to find food, shelter, and space to thrive. A log jam also changes water velocity and direction to sort gravels and create pool and riffle habitat. On the Elwha River, ELJs have proved to be stable with little significant change in position or surface area noted despite frequent inundation from floods including two peak floods that rank within the top 10% of floods recorded for over 100 years of record. The ELJs have also helped maximize habitat area by partially balancing flows between two major channels. During flood flows, ELJs have increased exchange of water with floodplain surfaces, primarily through backwatering. This has resulted in the expansion of side-channel habitats, including groundwater fed channels that provide critical habitats for multiple salmonid species. The ELJs developed scour pools, stored gravel, and reduced bed substrate grain size in the vicinity of several ELJs, with the mean particle size changing from large cobble to gravel. ELJs also had a measurable and significant positive effect on primary productivity, secondary productivity and juvenile fish populations (McHenry *et al.* 2007).

ELJs also retard streambank erosion as flow redirection structures that mimic stable log jams or bedrock outcrops that create "hard points" that form pools and cover, and increase overall channel complexity. Flow redirection structures are an effective means to control erosion and restore the quantity and quality of aquatic habitat by increasing channel length, pool frequency, and the amount of cover. Forested riparian buffers can be reestablished by first shifting the areas of high shear stress off the existing streambanks using structures to redirect flow away from streambanks. With properly spaced flow ELJs, sediment storage can be encouraged in between the structures to establish and sustain riparian buffers (Entrix 2009).

Live conifers and other trees can be felled or pulled/pushed over in the riparian zone, and upland areas for in-channel LW placement only when conifers and trees are fully stocked. This action will result in increased LW. If the riparian zone is fully stocked the action will not likely result in increased sedimentation or an increase in stream temperature.

As with LW, the addition of boulders, gravel, and properly designed rock structures can help restore natural stream processes and provide cover for rearing salmonids. Boulders can accomplish the retention of gravel by physically intercepting the bed load or slowing the water, and increase the interaction with the floodplain habitat by increasing the bed elevation and providing pool habitat. Boulders are most effective in high velocity or bedrock dominated streams. Roni *et al.* (2006) found that placement of boulder step structures in highly disturbed streams of Western Oregon led to increased pool area and increased abundance of trout and coho salmon. The addition of gravel in areas where it is lacking, such as below impoundments, will provide substrate for food organisms, fill voids in wood and boulder habitat structures to slow water and create pool habitat and provide spawning substrate for fish. Although little research has been conducted on the effectiveness of gravel augmentation in improving salmonid spawning, Merz and Chan (2005) found that gravel augmentation can result in increased macroinvertebrate densities and biomass, thus leading to more food for juvenile salmonids.

Constructed riffles will be installed in uniform, incised, or bedrock-dominated channels to enhance or provide fish habitat, or activate floodplain flow, in stream reaches where log placements are not practicable due to channel conditions (not feasible to place logs of sufficient length, bedrock dominated channels, deeply incised channels, artificially constrained reaches, *etc.*), where damage to infrastructure on public or private lands is of concern, or where private landowners will not allow log placements due to concerns about damage to their streambanks or property.

The proposed design criteria and conservation measures ensure that USFWS and NOAA RC will place LW, boulders, and gravel in a natural manner to avoid unintended negative consequences. This activity category will result in numerous long-term beneficial effects including increased cover and resting areas for rearing and migrating fish and restoration of natural stream processes.

3. ***Dam, and Legacy Structure Removal.*** This category of actions includes removal of small dams, channel-spanning step structures, legacy aquatic habitat structures, earthen embankments, subsurface drainage features, spillway systems, tide gates, outfalls, pipes, instream flow redirection structures (*e.g.*, drop structure, gabion, groin), or similar devices used to control, discharge, or maintain water levels. Projects will be implemented to reconnect stream corridors, floodplains, and estuaries, reestablish wetlands, improve aquatic organism passage, and restore more natural channel and flow conditions. Any instream water control structures that impound substantial amounts of contaminated sediment are not proposed. Equipment such as excavators, bull dozers, dump trucks, front-end loaders and similar equipment may be used to implement such projects. A NMFS engineer will review design plans for the removal of a dams greater than 10 feet in height. A long-term monitoring and adaptive management plan will be developed between the NMFS and the action agency.

Dam Removal. In addition to the restoration construction effects discussed above, removing a water control structure (*e.g.,* small dam, earthen embankment, subsurface drainage features tide gate, gabion) using the proposed PDC is likely to have significant local and landscape-level effects to processes related to sediment transport, energy flow, stream flow, temperature, and biotic fragmentation (Poff and Hart 2002). The diversity of water control structures distributed on the landscape combined with the relative scarcity of knowledge about the environmental response to their removal makes it difficult to generalize about the ecological harm or benefits of their removal. However, many small water control structures are nearing the end of their useful life, due to sediment accumulation and general deterioration. They can either be removed intentionally by parties concerned about liability, or fail due to lack of maintenance. Thus, it is likely that in some cases the best outcome of these restoration actions will be a minimization of adverse effects that follow unplanned failures, such as reducing the size of a contaminated sediment release, preventing an unplanned sediment pulse, controlling undesirable species, or ensuring fish passage around remnants of the structure.

Removing a water control structure for restoration, safety, or economic reasons is unlikely to entirely restore pristine stream conditions. The legacy of flow control includes altered riparian soils and vegetation, channel morphology, and plant and animal species composition that frequently take many years or decades to fully respond to restoration of a more natural flow regime. The indirect effects or long-term consequences of water control structure removal will depend on the long-term progression of climatic factors and the success of follow-up management actions to manage sediments, exclude undesirable species, revegetate, and ensure that continuing water and land use impacts do not impair ecological recovery.

Removal of Legacy Structures. During the 1980s and early 1990s, many habitat-forming structures such as log, boulder and gabion structures were placed in streams to create pool habitat. Many of these structures were placed perpendicular to stream flow or placed in a manner that interfered with natural stream function. USFWS and NOAA RC propose to remove these structures to restore natural stream function. This activity type requires instream construction causing the short-term effects described earlier. Long-term beneficial effects of removing these structures include decreased streambank erosion, decreased stream width-to-depth ratios, and restoration of natural stream processes. Decreasing erosion will increase the survival of eggs and alevins and reduce interference with feeding, behavioral avoidance and the breakdown of social organization. Decreasing the stream width-to-depth ratios will increase adult holding areas and improve rearing sites for yearling and older juveniles.

4. Channel Reconstruction/Relocation. Channel straightening and dredging were extensively used in the 20th century to enhance agricultural drainage and facilitate crop maintenance and harvest. Channels were also straightened in response to flood events. Forested areas that have a legacy of timber harvest and log drives may also have simplified straightened channels with a scarcity of instream wood. In general, the level of intervention dictates the scale or magnitude of a stream restoration project.

As the streams were channelized or naturally returned to their original bed elevation, streambank heights increased so that greater water depth and discharge became required before the stream could spread onto the floodplain. The increase in streambank heights and bankfull discharge, which results in increased bank erosion, may be responsible for a significant portion of sediment loads in streams. Along many streams, this may cause channel spreading and, over decades, the re-establishment of a new "meander belt" (Knox 2006). The resistance of bed materials to stream incision is one of the major factors that determine how this process manifests itself along each stream course.

Mine tailings produced by placer mining nearly a century ago occupy the majority of the valley floor in some of the USFWS and NOAA RC's prospective project areas. These tailings piles have greatly altered fish and wildlife habitat within the project reach by confining and straightening the stream, creating a nearly continuous riffle with few pools or spawning gravel for fish. These tailings piles essentially function as dikes that cut off flood flows from the original floodplain. Water velocities accelerate as they are compressed through the constricted channel, concentrating the stream's energy on the streambed, simplifying substrate and degrading the channel. Sediment and nutrients are transported through the project area, depriving riparian areas of soil and nutrients, which in turn retard disturbance recovery and natural succession. The tailings piles prevent fine sediment and organics carried by floods from being deposited on the floodplain, preventing natural fertilization and soil augmentation needed to reestablish vigorous riparian communities. Tailings piles within the placer-mined reaches disconnect the stream from the historical floodplain and side channel habitat, which historically provided the flood flow refugia and over-wintering habitat, which were critical to salmonids. Mechanical manipulation and grading of thousands of cubic yards of mine tailings may be required to recover floodplain width and elevations.

Projects which involve significant channel reconfiguration over a considerable stream length or require extensive alteration of land management practices are likely to have more constraints, be more costly, and have a greater level of associated risk. For stream reaches that have evolved to a condition of greater instability, it may be necessary to adjust the channel's geometry. This may involve minor adjustments such as narrowing the channel cross-section and stabilizing the eroding stream banks. At the opposite end of the intervention scale, extremely unstable conditions with poor potential for natural recovery may require complete reconstruction of the stream channel to provide a stable channel pattern, profile, and cross-section; utilization of streambank stabilization techniques; and installation of flow diverting and grade control structures. Therefore, the short-term adverse and long-term beneficial effects of channel reconstruction will vary with the scale of the project. For some stream reaches, restoration may not be a realistic goal without intervention at the watershed level first.

Channel Reconstruction/Relocation will be implemented to improve aquatic and riparian habitat diversity and complexity, reconnect stream channels to floodplains, reduce bed and bank erosion, increase hyporheic exchange, provide long-term nutrient storage, provide substrate for macroinvertebrates, moderate flow disturbance, increase retention of organic material, and provide refuge for fish and other aquatic species. In addition to the restoration construction effects discussed above, channel reconstruction/ relocation projects using the proposed PDC are likely to have significant local and landscape-level effects to processes related to sediment transport, energy flow, stream flow, temperature, and biotic fragmentation.

Some potential negative physical and biological effects of channel modification include undesirable or unintended:

- Incision or aggradation within the project reach or in upstream, downstream or tributary reaches
- Bank erosion due to changes in hydraulic forces or bank stability
- Mid-channel bar formation and widening
- Channel avulsion (sudden shift in channel location across the intervening floodplain)
- Flanking of in-stream structures
- Increased sediment delivered to downstream reaches due to post-project channel adjustments
- Decreased sediment delivered to downstream reaches due to reduction of bank erosion rates to below natural levels

- Altered patterns of flooding
- Creation of fish-stranding hazards
- Shifts in composition and distribution of riparian plant and fish species, including establishment of non-native species (Cramer 2012).

Short-term risks associated with construction may also exist. These risks are increased if at-risk species are present. Construction related risks can be minimized by taking proper precautions and by anticipating potential outcomes. Some of the potential risks during or shortly following construction include:

- Mortality, physiological stress or displacement of aquatic macroinvertebrates, amphibians, and fish due to in-stream activity, increased turbidity, deposition of fine-sediment, and channel abandonment
- Increased sediment input to downstream reaches during construction or during channel re-watering, affecting pools and spawning gravels
- Increased sediment input to downstream reaches during the wet season following construction, affecting spawning gravels
- Loss of riparian vegetation
- Temporary loss or imbalance of nutrients and food supply (Cramer 2012).

Typically stream channel reconstruction /relocation projects are conducted in phases that will end with the full return of river flows to the historical channel and the filling of the old shortened channel. Fish passage is typically blocked until the restored channel can be activated. Mechanical manipulation and grading of thousands of cubic yards of mine tailings may be required to recover floodplain width and elevations. Mercury pollution is also a potential concern in creeks that were mined for gold, therefore a site assessment for contamination is a required PDC before a project is implemented.

Fish evacuation and relocation of juvenile fish from the old channel to the restored channel can be challenging because of the long transport distances required. Some fish mortality will also likely occur from predation, suffocation, or temperature stress in the old channel when it is dewatered, unless fish are relocated upstream or downstream promptly. Fish that are not relocated will also likely be stranded. Indirect mortality of aquatic species would be possible from high turbidities in the lower third of the reach and some distance downstream during channel relocation. In-water work windows, work area isolation, and fish capture and release PDC are intended to minimize handling and mortality.

With in-water work timing during low water periods and isolation of the work area, the release of suspended sediment is expected to be a short-term event. Sediment is likely to be carried by surface runoff when the newly configured channel(s) are reactivated and erosion control structures are removed. Localized suspended sediment increases are likely to cause some juveniles and adults to seek alternative habitat, which could contain suboptimal cover and forage and cause increases in behavioral stress (*e.g.,* avoidance, displacement), and sub-lethal responses (*e.g.,* increased respiration, reduced feeding success, reduced growth rates). Excessive sediment clogs the gills of juvenile fish, reduces prey availability, and reduces juvenile success in catching prey. However, the USFWS and NOAA RC's implementation procedures and pollution and erosion control plans will be designed to minimize suspended sediment. If turbidity is observed in the outflow, turbidity levels should be monitored downstream of the source with a hand-held turbidimeter. If measurements indicate violations of State water quality standards, USFWS and NOAA RC will work with the contractor to take appropriate corrective actions.

Disturbances associated with restoration have the potential to increase non-native plant abundance in the project area through influx of non-native species on equipment and by providing bare soil conditions. However, PDC for revegetation of native species and active removal/treatment of invasive plants will help to establish native species and reduce the overall presence of non-natives plants.

Effectiveness monitoring for channel reconstruction/relocation projects will be designed to measure progress toward achieving the project objectives, inform maintenance needs, and provide input into whether the restoration project is trending towards or away from achieving project goals. USFWS and NOAA RC will complete an existing conditions survey on the existing channel to determine the pre-project conditions and an as-built survey, which follows the same parameters, immediately upon completion of the new channel construction. This survey will compare as-built to proposed design metrics for channel length, substrate size, residual pool depth, pieces of LW, *etc.* Based on the project goals and compliance with this programmatic opinion, physical and biological parameters will be monitored using standard field techniques that will produce data compatible with the various protocols required by the RRT. Monitoring may include evaluation of stream length and channel complexity, riparian and floodplain vegetation, channel-floodplain connectivity, thermal regime, and fish passage.

Generally, post-project monitoring surveys will occur frequently enough to capture change that could result in a significant reduction in the desired habitat conditions. Surveys should occur during a similar timeframe each cycle, and should occur under similar flow conditions. The RRT will approve field methods that will be used to perform the monitoring surveys. Effectiveness of mitigation techniques for the restoration activities will be reviewed at the end of each construction season with NMFS, and any improvements will be incorporated into plans for the next season.

Post-project, hydrologic function of the stream channel will be restored to more natural conditions. Functional floodplains will promote riparian vegetation and stable banks. The restored corridor will provide an adequate riparian buffer zone. Aquatic habitat will be greatly improved in the short term and long term. Under this activity category streams that are made more self-sustaining and resilient to external perturbation will lead to improved aquatic habitat, which will help improve aquatic population abundance and productivity.

Although NMFS can predict the worse-case effects of this activity, with the proposed PDC and RRT review process we believe that the stream ecological condition will be measurably improved. The RRT will help to fine-tune the process to achieve the best possible outcome. However, for this opinion NMFS only analyzed the effects of carrying out projects as described by the proposed activity categories with application of the general and activity-specific conservation measures. We did not assume the RRT review process would result in a further reduction of the short-term adverse effects of any particular project. Our evaluation of the beneficial effects of the proposed actions is based on scientific literature and our past experience with similar types of actions. We also did not assume the RRT review would maximize the beneficial effects of any particular project.

5. ***Off- and Side-Channel Habitat Restoration.*** Many historical off- and side-channels have been blocked from main stream channels for flood control or by other land management activities, or have ceased functioning due to other in-stream sediment imbalances. The proposed action includes reconnecting existing stream channels to historical off- and side-channels, but not the creation of off- and side-channel habitats. These project types will increase habitat diversity and complexity, improve flow heterogeneity, provide long-term nutrient storage and substrate for aquatic macroinvertebrates, moderate flow disturbances, increase retention of leaf litter, and provide refuge for fish during high flows. Side channel wetlands and ponds provide important habitats for juvenile fish. When these areas are more regularly and permanently available, as in larger river basins, they can provide additional benefits such as high quality protected spawning habitat, especially for coho and chum salmon that actively seek these areas, and have high value as summer and winter rearing habitat for coho salmon (Cramer 2012).

The direct effects of reconnecting stream channels with historical river floodplain swales, abandoned side channels, and floodplain channels using the proposed PDC are likely to include relatively intense restoration construction effects, as discussed above. Side channel reconnections that contain more than 20% of the flow will be reviewed as a channel reconstruction/relocation project by the RRT (see PDC 5). Indirect effects are likely to include equally intense beneficial effects to habitat diversity and complexity (Cramer 2012), including increased overbank flow and greater potential for groundwater recharge in the floodplain; attenuation of sediment transport downstream due to increased sediment storage; greater channel complexity or increased shoreline length; increased floodplain functionality; reduction of chronic streambank erosion and channel instability due to sediment deposition; and increased width of riparian corridors. Increased riparian functions are likely to include increased shade and hence moderated water temperatures and microclimate; increased abundance and retention of wood; increased organic material supply; water quality improvement; filtering of sediment and nutrient inputs; more efficient nutrient cycling; and restoration of flood-flow refuge for ESA-listed fish (Cramer 2012). Wetlands, such as those created by off- and side-channel restoration are also cost-effective tools to sequester carbon to mitigate the effect of greenhouse gas emissions (Bernal and Mitsch 2013).

6. ***Streambank Restoration.*** In addition to restoration construction effects discussed above, the proposed streambank restoration action is likely to allow reestablishment of native riparian forests or other appropriate native riparian plant communities, that provide increased cover (LW, boulders, vegetation, and streambank protection structures) and a long-term source of instream wood, reduce fine sediment supply, increase shade, moderate microclimate effects, and provide more normative channel migration over time.

USFWS and NOAA RC propose to stabilize eroding streambanks using bioengineering methods. This requires instream construction with short-term effects as described above. Heavy equipment might be used in the stream for this activity. The use of equipment in-water could temporarily affect salmonids and critical habitat, including increased suspended sediment and deposition, blocked migration, disrupted or disturbed overwintering behavior, and smothered or crushed eggs and alevins in redds. Pacific salmonids are particularly vulnerable during the fall and winter, when adult salmonids are migrating and spawning, and the spring, when eggs and fry are still present in the substrate. However, because of the seasonal restrictions imposed by in-water work windows, these effects will be avoided.

The use of rock groins, weirs, rock toes, and riprap has been excluded by USFWS and NOAA RC to avoid the potential negative effects of using hard structures to stabilize streambanks. Long term beneficial effects of stabilizing eroding streambanks include reductions in fine sediment inputs. Eliminating a sediment source will help to increase the diversity and densities of aquatic macroinvertebrates, which are used as a food source by listed fish species. It will also maintain or increase the amount of interstitial cover available to juveniles and juvenile emergence success. Suffocation of fry and entombment caused by excessive siltation of spawning gravels will also be reduced or eliminated. Light penetration, which, in turn, affects the feeding abilities of covered fish species and juvenile growth rates, will improve.

By limiting streambank restoration to bioengineering methods such as the placement of LW and riparian plantings, overhead cover for fish will be increased and streambank stability will improve.

*7. **Set-back or Removal of Existing Berms, Dikes, and Levees.*** Channelization of streams through levee construction means that the floodplain no longer benefits from floods, producing many of the same changes to living communities and ecosystems as those resulting from dams. Levees, berms, and dikes are commonly found along mid- to large-sized rivers for flood control or infrastructure protection and can severely disrupt ecosystem function (Gergel *et al.* 2002) and fish community structure (Freyer and Healey 2003). Similarly, mine tailings left by dredging for precious metals can have comparable effects on small streams.

Floodplain heterogeneity is associated with the occurrence of a mosaic of food webs, all of which are utilized by anadromous salmonids, and all of which may be important to their recovery and persistence. In the long term, these and other fishes will likely benefit from restoring the processes that maintain floodplain complexity (Bellmore et al. 2013). Set-back or removal of existing berms, dikes, and levees increases habitat diversity and complexity, moderates flow disturbances, and provides refuge for fish during high flows. Other restored ecological functions include overland flow during flood events, dissipation of flood energy, increased water storage to augment low flows, sediment and debris deposition, growth of riparian vegetation, nutrient cycling, and development of side channels and alcoves.

Under this activity category, the USFWS and NOAA RC propose to remove dikes, berms, mine tailings or other floodplain overburden to restore river-floodplain interactions and natural channel-forming processes. This action category may often be combined with the stream channel reconstruction/relocation category above. The direct and indirect effects of this type of proposed action are also very similar to off- and side-channel habitat restoration discussed above, although the effects of this type of action may also include short-term or chronic instability of affected streams and rivers as channels adjust to the new hydrologic conditions. Moreover, this type of action is likely to affect larger areas overall because the area isolated by a berm, dike or levee is likely to be larger than that included in an off- or side-channel feature.

In the long term, removal of floodplain overburden will improve connection between the stream and its floodplain, and allow reestablishment of riparian vegetation. Over time, the removal of overburden will also allow for the restoration of natural channel forming processes. Over the course of many decades, degraded and incised channels will be able to regain meanders, aggrade to the proper elevation, and resume natural formation of habitat features. Ultimately, this will result in more functional fish habitat, *i.e.,* streams with overhead cover and undercut banks to provide protection for juvenile fish, low width-to-depth ratios that provide cool and deep refugia for migrating juveniles, and healthy riparian plant communities that provide allochthonous nutrient inputs that drive the food base that juvenile salmonids consume when rearing and migrating to the ocean. More immediate beneficial effects will result from the restoration of "flood pulses" that periodically deliver water, nutrients, and sediment to floodplains.

*8. **Reduction/Relocation of Recreation Impacts.*** USFWS and NOAA RC propose to close or better control recreational activities occurring along streams or within riparian areas. This activity category includes removal of campgrounds, toilets, and trails. It also includes placement of rocks or other barriers to limit access to streams and gravel surfacing of existing areas prone to erosion. Some construction activities such as removal of floodplain fill in campgrounds may occur, but construction activities within the bankfull stream width will not occur under this category. These actions will eliminate or reduce recreational impacts to restore riparian areas and vegetation, improve streambank stability, and reduce sedimentation into adjacent streams (Eubanks 2004).

Adverse effects of this action include minor riparian disturbance from construction. Long-term beneficial effects result primarily from exclusion of people and vehicles from streams and riparian areas. Reduced streambank damage and reduced chronic disturbance of riparian areas will result from implementation of this activity category.

Soil compaction in riparian areas will be reversed by providing a way for water and air to saturate the soil. Eliminating gravel-clogging sediment sources (*e.g.,* eroding streambanks) will help to increase the diversity and densities of aquatic macroinvertebrates used as a food source by covered fish species. It will also maintain or increase the amount of interstitial cover available to juveniles, and juvenile emergence success. Suffocation of fry and entombment caused by excessive siltation of spawning gravels will also be reduced or eliminated. Light penetration, which, in turn, affects the feeding abilities of fish species and juvenile growth rates, will improve. Graveling of areas inside established recreation sites reduces erosion, but also precludes the growth of riparian vegetation in these areas.

*9. **Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering Facilities.*** Such projects promote a balanced approach to livestock use in riparian areas, reducing livestock impacts to riparian soils and vegetation, streambanks, channel substrates, and water quality. The direct effects of constructing a livestock crossing or off-channel watering facility using the proposed PDC will be similar, though less intense, to the restoration construction effects discussed above. Although the net benefits of fencing streams to exclude livestock or humans are clear, some minor adverse effects can occur at watering or crossing sites. Concentration of livestock or human traffic at these areas can result in streambank damage and add fine sediment to stream substrates. Redds created by salmon or steelhead could be trampled if they are located in crossings. USFWS and NOAA RC propose several conservation measures to reduce the potential for these types of adverse effects from occurring. Crossings will be located in areas where streambanks are naturally low, crossing widths are limited to 15 feet, and areas of sensitive soils and vegetation will be avoided. Although these measures will reduce the potential for adverse effects, some minor streambank damage is likely to occur in these small areas and redds could occasionally be trampled.

Such projects promote a balanced approach to livestock use in riparian areas, reducing livestock impacts to riparian soils and vegetation, streambanks, channel substrates, and water quality. Indirect effects are likely to be beneficial, including reducing the likelihood that livestock, particularly cattle, will have unrestricted access to a riparian area or stream channel for shade, forage, drinking water, or to cross the stream. This, in turn, is likely to reduce the likelihood that livestock will disturb streambeds, spawning areas or redds, or erode streambanks, and will improve water quality by increasing riparian vegetation and reducing sediment and nutrient loading to streams.

10. Piling and Other Structure Removal. This category includes the removal of untreated and chemically treated wood pilings, piers, and boat docks as well as similar structures comprised of plastic, concrete and other material. Piling and other structure removal from waterways will improve water quality by eliminating chronic sources of toxic contamination and associated impacts to riparian dependent species. The proposed PDC mainly focus on the removal of intact and broken piles which are typically treated with a toxic preservative. Removal of piles using the proposed PDC will re-suspend sediments that are inevitably pulled up with, or attached to, the piles. If sediment in the vicinity of a pile is contaminated, or if the pile is creosote treated, those contaminants will be included with the re-suspended sediments, especially if a creosote-treated pile is damaged during removal, or if debris from a broken pile is allowed to re-enter or remain in the water. Due to the relatively small amount of sediment disturbed during pile removal, any effects to fish from the re-suspended sediments will be minor. The indirect effects of structure removal are likely to be beneficial and include reduction of resting areas for piscivorous birds, hiding habitat for aquatic predators such as large and smallmouth bass, and, in the case of creosote piles, a chronic source of PAH pollution.

11. Shellfish Bed/Nearshore Habitat Restoration. Pacific Northwest beaches provide habitat for shellfish (Dethier 2006) and forage fishes such as Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus),* and surf smelt (*Hypomesus pretiosus*), which are important food sources for salmon. Adjacent nearshore habitats are used as nursery grounds by all three species. Each of these species has particular habitat requirements for spawning; *e.g.*, relatively restricted sediment grain size, particular tidal heights, and specific vegetation types. Other forage fish species, *i.e.*, eulachon, Northern anchovy (*Engraulis mordax*), and longfin smelt (*Spirinchus thaleichthys*), do not spawn on Puget Sound beaches, but use nearshore ecosystems in other ways (Penttila 2007).

Five species of Pacific salmon use the nearshore ecosystems of Puget Sound: Chinook, coho, chum, sockeye, and pink (*O. gorbuscha*). Juvenile chum salmon abundance in nearshore areas peaks in May and June. Juvenile Chinook salmon abundance peaks in June and July, although some are present in shoreline habitats through October, but they may occupy nearshore habitat nearly year-round (Fresh 2006). Beaches and shallow waters provide shelter from predators and food for young salmon and trout as their bodies adapt to saltwater. These fish migrate and feed along these nearshore corridors as they move to open water and then as returning adults they use these same areas to re-acclimate to freshwater (Shared Strategy for Puget Sound 2007).

Nearshore habitat forming processes have been interrupted by shoreline armoring, development on top of and below banks, bluffs, and beaches, and changes in flow due to the diversion of rivers or streams. Bluff sediment input, primarily glacially deposited units, is the primary source of beach sediment in Puget Sound. Dams on rivers also hold back sediment important to processes downstream and the nourishment of shoreline beaches. Many beaches, particularly in the Puget Sound region, have been modified with bulkheads, jetties, and armoring to protect industrial or residential development, *i.e.*, roads, railroads, docks, piers, marinas, *etc.*, from erosion. These modifications have disrupted beach forming erosion processes and decreased access to juvenile salmon rearing habitats. Overwater structures and ramps also contribute to this loss of salmon habitat (Shared Strategy for Puget Sound 2007). Sea level is also expected to rise substantially in this century which will affect the amount, structure, and function of nearshore habitat in Puget Sound and elsewhere on the coast. The loss of small parcels of shoreline habitat from hardening may not have a large impact on the ecosystem, but the cumulative impact of the loss of many small parcels will at some point, alter the properties, composition, and values of the ecosystem. Approximately 34% of the Puget Sound and Northern Straits shoreline (more than 805 miles) has been modified (Johannessen and MacLennan 2007) and every year approximately 1.5 miles of new bulkheads are built and about 2.5 miles are replaced (Barnard 2010).

By re-connecting naturally eroding feeder bluffs to the marine environment, beaches will be nourished with a natural source of sediment, and by removing barriers like bulkheads, structures, and piers, wave action will again transport sediment to form beaches. Shoreline restoration measures may include gravel beach nourishment, grade control/slope support with large wood and/or rock, wood revetment or wood/rock revetment, and biotechnical slope support (vegetated geogrids, soil pillows, *etc.*) as described by Barnard (2009). However, removing some bank hardening structures may not be sufficient to create sandy beaches; there may also be a need to augment sediment supplies. Furthermore, beach nourishment has significant impacts on local ecosystems. Nourishment may cause direct mortality to sessile organisms in the target area by burying them in the new sand. Seafloor habitat in both source and target areas are disrupted, *e.g.*, when sand is deposited. Nourishment is also typically a repetitive process, since nourishment does not remove the physical forces that cause erosion; it simply mitigates their effects. Thus, this restoration measure will be accompanied by a monitoring plan and reviewed and approved by NMFS.

The placement of cultch, spat-on-shell, or live shellfish as part of shellfish restoration can negatively impact benthic organisms and submerged aquatic vegetation (SAV) due to burial, excessive turbidity, or space competition. Eelgrass (*Zostera marina*) is a particularly important habitat component of Pacific Northwest estuaries, and is susceptible to decline from physical disturbance. This is especially true if the rhizome matrix is disrupted (Boese *et al.* 2009). However, since shellfish restoration generally will not disturb the substrate, it is likely that shellfish restoration conducted under this Opinion will not disrupt rhizomes, but may reduce shoot density or percent cover.

Introduction of non-native species, predators, and pathogens is a potential mechanism for harmful effects of shellfish restoration. Although many safeguards are now in place to protect against such introductions, shellfish have historically been a vector for a variety of non-indigenous species. The proposed action will minimize this danger by ensuring that shell or other substance used for substrate enhancement will be procured from clean sources that are then steam cleaned, left on dry land for a minimum of 1 month, or both, before placement in the water.

In some cases, the planting of SAV is included as part of a shellfish restoration activity. During revegetation activities, workers may disturb the surrounding sediment locally by compacting sediment due to foot traffic, or may disturb existing vegetation. Harvest of SAV from donor beds may harm the donor SAV bed, and may increase turbidity temporarily. For kelp restoration projects, there is potential for damage from divers or equipment, disruption of bottom sediment from diving finds, and impacts resulting from the transplanting of kelp to restoration sites.

12. In-channel Nutrient Enhancement. USFWS and NOAA RC propose to add salmon carcasses, salmon carcass analogs (SCA), or inorganic fertilizers to replace missing nutrients. Many streams throughout the Pacific Northwest that once had large returns of salmon and steelhead are now lacking the nutrients that decomposing fish carcasses provided. This is especially true for trace marine nutrients (Compton *et al.* 2006; Murota 2003; Nagasaka *et al.* 2006; Thomas *et al.* 2003). SCA, dried, which are made of pasteurized and pelletized marine fishmeal, represent an inanimate nutrient treatment while spawning salmon represent an ecologically important source of bioturbation that physically disrupt the streambed and provide direct sources of metabolic waste products through excretion.

Nevertheless, benefits including trophic transfer pathways that include direct consumption of SCA particulates by stream-dwelling consumers (*i.e.,* macroinvertebrates and salmonids), a pasteurized product that reduces the risk of disease transfer, and the ability to recycle fish products into a usable and widely applicable nutrient amendment tool hold great potential utility (Pearsons *et al.* 2007).

The organisms in the base of the food chain that rely on those inputs are ultimately the food base that juvenile salmonids consume when rearing and migrating to the ocean. Studies conducted in British Columbia have shown that addition of inorganic fertilizers can increase salmonid production in oligotrophic streams (Slaney *et al.* 2003; Ward *et al.* 2003; Wilson *et al.* 2003). Pearsons *et al.* (2007) documented direct consumption of SCA material by rainbow/steelhead trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*) and juvenile Chinook salmon, and increased growth rates of rainbow trout in the Yakima River basin, Washington, and Wipfli *et al.* (2004) documented an increase in stream-resident salmonid condition, lipid level measures and production in the presence of SCA in southeast Alaska, U.S.A. artificial stream channels. Kohler *et al.* (2008) documented no significant change in dissolved nutrient concentrations following the addition of salmon carcass analogs in two Idaho streams. Ebel (2012) found that although biofilm standing crop and nutrient limitation did not respond to SCA, primary productivity and respiration increased in the subset of streams where they were measured.

SCA have only been applied in a research-oriented framework (Kohler *et al.* 2008); the effects of nutrient additions have not been studied in detail (Compton *et al.* 2006). Therefore, the USFWS and NOAA RC propose the above conservation measures (PDC 43) in conjunction with this activity type. In Oregon, fish carcasses will be certified as disease free by an ODFW fish pathologist and in Washington, placement of carcasses will follow WDFW's stream habitat restoration guidelines for distributing salmonid carcasses, salmon carcass analogs, and delayed release fertilizers (Cramer 2012). Following these steps will minimize the chance of introducing disease causing pathogens through carcass supplementation. USFWS and NOAA RC will not attempt nutrient enhancement in naturally oligotrophic systems where nutrient levels will be naturally low, and they will not add nutrients to eutrophic systems where nutrient levels are atypically high. Carcass additions will occur during normal spawning periods, so there is a more than negligible chance that some spawning activities could be temporarily interrupted by the addition activities. These interruptions will last for a maximum of a few hours, will only happen once, and are not likely to cause a measurable decrease in spawning success.

13. Road and Trail Erosion Control and Decommissioning. Road and trail erosion control and decommissioning typically includes one or more of the following actions:

- culvert removal in perennial and intermittent streams;
- removing, installing or upgrading cross-drainage culverts;
- upgrading culverts on non-fish-bearing steams;
- constructing water bars and dips; reshaping road prisms;
- vegetating fill and cut slopes; removing and stabilizing of side-cast materials;
- grading or resurfacing roads that have been improved for aquatic restoration with gravel, bark chips, or other permeable materials;
- contour shaping of the road or trail base;
- removing road fill to native soils; and
- soil stabilization and tilling of compacted surfaces to reestablish native vegetation.

A significant amount of information is available regarding the adverse effects of roads on aquatic habitats (Gucinski *et al.* 2001; Jones *et al.* 2000; Trombulak and Frissell 2000). Roads introduce invasive species and deliver fine sediment, which results in decreased fry emergence, benthic production, winter carrying capacity, and juvenile densities, and increased predation and algal production. Improper culvert placement can limit or eliminate fish passage. Moreover, roads can greatly increase the frequency of landslides, debris flows, and other mass movements.

Unfortunately, much less information is available on the specific effects of road and trail restoration or removal, and its effectiveness for reversing adverse habitat conditions attributed to the presence of road and trail systems. The short-term effects of these actions using the proposed PDC will include the restoration construction effects and, in the case of culvert removal, fish passage restoration, discussed above. The long-term effects of road and trail restoration or removal appear to include mitigation of many of the negative effects to aquatic habitats that have been associated with roads (Madej 2001; McCaffery *et al.* 2007), but the large variance between substrate conditions and other stream habitat characteristics that are important to fish make it difficult to assign measurable effects to road decommissioning (Madej 2001; McCaffery *et al.* 2007). Thus, road and trail erosion control and decommissioning are likely to result in restoration of riparian and stream functions as a result of reduced sediment yield and improved fish passage.

14. Juniper Removal. This action will help restore composition and structure of desired riparian species, thereby improving ground cover and water infiltration into soils. The direct adverse effects of juniper tree removal will include minor restoration construction effects (*i.e.*, soil compaction, erosion, loss of upland vegetation) caused by the movement of personnel over the action area. Moreover, this action will convert living trees to woody debris and slash that will be left within the action area at densities that are likely to range from less than 1 to more than 8 tons per acre (Azuma *et al.* 2005). This increase in fuel loading will increase the likelihood or intensity of fire, especially during the first 2 to 3 years while needles are still attached, although post-settlement reduction in the extent and return interval of fire is considered to be the most important factor allowing western juniper to expand into neighboring plant communities (Miller *et al.* 2005). Beneficial effects of the juniper removal and retention of slash residue will include increased soil cover that will reduce erosion, increased soil nutrients and organic matter content, and increased distribution and abundance of native vegetation than is otherwise typical for sites that have been degraded by increasing dominance of western juniper. The indirect effects of juniper tree removal using these methods will depend on the long-term progression of climatic factors and the success of follow-up management actions to address fire, livestock management, and other site-specific factors driving woodland succession.

15. Bull Trout Protection. This category includes the removal of brook trout or other non-native fish species via electrofishing or other manual means to protect bull trout from competition or hybridization. Brook trout, introduced throughout much of the range of bull trout, easily hybridize with them, producing sterile offspring. Brook trout also reproduce earlier and at a higher rate than bull trout, so bull trout populations are often supplanted by these non-natives. Hybridization with brown trout and lake trout is also a problem in some areas.

Removal methods, such as dip netting, spearing, and traps will be directed at brook trout or other non-native fish species. Minnow traps could capture nontarget ESA-listed salmon and steelhead species, but this capture method allows the capture and release of juvenile salmon and steelhead with very little harm to individuals. USFWS and NOAA RC also propose to electrofish for brook trout or other non-native fish species. Electrofishing can be an effective measure for controlling nonnative brook trout, thus paving the way to native trout recovery (Carmona-Catot *et al.* 2010). Bull trout spawn in headwater areas of streams from late-August to November, generally further upstream than ESA-listed salmon and steelhead species. On the Clackamas River where bull trout were recently reintroduced, the potential impact of bull trout was considered to be very low or moderately low for spring Chinook salmon, coho salmon, and winter steelhead and mostly none to very low for fall Chinook salmon (Marcot *et al.* 2012). Thus far, no bull trout have resided for a significant amount of time in areas where migrating juvenile salmon and steelhead are artificially concentrated and vulnerable to predation (*i.e.*, Clackamas River hydroelectric facilities). In both years, reintroduced bull trout were observed spawning in a headwater tributaries (Allen and Koski 2013). Capture mortality to species other than species targeted for removal by electrofishing will be low. Mortality of fish captured by this method will be less than 2% given that NMFS (2000) electrofishing protocol is required.

Although this category has the potential to harass, kill, or injure listed salmon and steelhead, the overall result will be a reduction of non-native fishes that prey on listed species or compete for habitat and food resources. This type of activity will likely occur very infrequently. Therefore, the overall threat to listed salmon and steelhead will be insignificant.

16. Beaver Habitat Restoration. The long-term goal of this category is to restore linear, entrenched, simplified channels to their previously sinuous, structurally complex channels that were connected to their floodplains. This will result in a substantial expansion of riparian vegetation and improved instream habitat. Beavers, which were historically prevalent in many watersheds, build dams that, if they remain intact, will substantially alter the hydrology, geomorphology, and sediment transport within the riparian corridor. Beaver dams will entrain substrate, aggrade the bottom, and reconnect the stream to the floodplain; raise water tables; increase the extent of riparian vegetation; increase pool frequency and depth; increase stream sinuosity and sediment sorting; and lower water temperatures (Pollock *et al.* 2007; Pollock *et al.* 2012b).

The loss of beaver from small stream networks lowers water tables, hampering recovery of willows. Beschta and Ripple (2010) observed that the reintroduction of apex predators, such as wolves in Yellowstone National Park, helped to discourage browsing, allowing recovery of willows along streambanks. However, long-term experiments conducted in the park have shown that restoring physical structure to streams, as well as restoring the historical disturbance and hydrological regimes, requires beaver damming of stream channels (Marshall *et al.* 2013).

The installation of beaver dam support structures, to encourage dam building, may result in very minor fine sediment delivery to streams. Removal of vegetation mechanically will likely adversely affect stream habitat by removing shade trees, which could increase stream temperature in the short term. However, the streams where this action will occur are for the most part incised, lack adequate riparian vegetation, and contribute little to the conservation of the listed fish populations through demonstrated or potential productivity. Long term, the establishment of beavers in these stream reaches will result in the aforementioned benefits to listed fish habitat. To make habitat more suitable to beavers, USFWS and NOAA RC will also plant riparian hardwoods, protect hardwoods with enclosures until they are established, and control grazing to the extent possible.

17. Wetland Restoration. Wetland restoration projects using the proposed PDC are likely to have effects similar to those of restoration construction; off-and side channel restoration; set-back of existing berms, dikes, and levees; and removal of water control structures, as described above.

18. Tide/Flood Gate Removal, Replacement, or Retrofit. A tide gate is an opening through which water may flow freely when the tide sets in one direction (outgoing tide), but which closes automatically and prevents the water from flowing in the other direction (incoming tide). Flood gates, which are similar devices, consist of a valve or gate that controls the rate of water flow, or prevents water flow from entering behind the gate (WDFW 2009). Floodgate operation is similar to that of tide gates, except that they allow water to flow outward from the drainage system into a freshwater natural watercourse (*i.e.,* Columbia River) while preventing water in a natural watercourse from back-flooding into a drainage system when the water elevation in the natural watercourse is higher than the floodgate. These gates are only needed a few times each year or as little as once every several years, but typically remain closed all the time.

In the Skagit River, fish immigrate from estuaries into the lower reaches of the watercourses via culvert/tidegates to forage on available prey between February and July. The upstream distribution and duration of residence for these immigrating fish are limited by water quality, prey availability and their physiological affinity for salt water. In addition to salmonid species, forage fish species such as surf smelt and sand lance also use the estuary habitats for rearing and could potentially immigrate into the lower reaches of watercourses (Western Washington Agricultural Association *et al.* 2007). When tidegates are partially or completely closed they are barriers to fish migration, because they block adult salmonids from accessing upstream habitat on the incoming tide and limit passage for juvenile and adult salmonids at other times. Most are also a barrier to migration when they are open because they don't open far enough or frequently enough, they may be perched too high, and/or the water velocity is too high.

Flood gates are particularly harmful to fish that are denied access to tributary systems for spawning and rearing. Flood gates have been designed with hydraulic or electric control systems that bring the gate into action only when flood stage reaches a certain critical elevation. While these systems appear to have benefits that outweigh the impacts, there remain some major concerns that include:

- Juvenile fish seek off channel refuge during floods and flood gates exclude them from this type of habitat.
- Adult salmonids often move upstream into tributary systems during flood events. They are motivated to move on these freshets because the extra water depth created by floods allows them to penetrate deeply into a watershed.
- Some rivers flood for sustained periods, precisely at a time when fish are seeking access to off channel areas. If the gate was closed for several weeks during the fish passage season it would have a significant effect on the population.

Removal of Tide and Flood Gates. Removal of dikes and their tide/flood gates, regardless of how fish friendly their design and operation, will improve fish movement and positively alter the quality of their habitats. Even "fish friendly" automatic-type tide gates on tidal sloughs, which remain open for part of the flood tide, negatively affect the abundance and movement of juvenile Chinook salmon when compared to similar but un-gated sloughs.

NOAA Fisheries Science Center and the Skagit River Systems Cooperative (Barnard 2011; Greene *et al.* 2012) found the following preliminary findings:

- Juvenile Chinook salmon are present in lower numbers upstream of automatic tide gated sloughs than in un-gated sloughs
- These fish tended to spend less time behind the tide gate
- Tagged fish were shown to move less frequently across the gate and, in the case of larger fish released above the gate, to move only once downstream and out of the slough

- Indications are that the muted tidal cycle created by the automatic tide gate results in reduced habitat quality which may be reflected in lower abundance with fewer repeated visits by juvenile Chinook salmon
- Tide gates alter the salinity, temperature, dissolved oxygen, total suspended solids, *etc.* of the habitat upstream

Removal of tide gates or tidal levees is likely to result in restoration of estuarine functions related to regulation of temperature, tidal currents, and salinity; increased habitat abundance from distributary channels, that increase in size after tidal flows are allowed to inundate and scour on a twice daily basis; reduction of fine sediment in-channel and downstream; reduced estuary filling due to increased availability of low-energy, overbank storage areas for fine sediment; restoration of fish access into tributaries, off- and side-channel ponds and wetlands; restoration of saline-dependent plant species; increased primary productivity; increased estuarine food production; and restoration of an estuarine transition zone for fish and other species migrating through the tidal zone (Cramer 2012; Giannico and Souder 2004; Giannico and Souder 2005).

These findings suggest that (1) Tide gates designed to better accommodate fish passage may have only limited benefits for fish populations, (2) proper gate operation is an essential component in meeting project goals regardless of the gate design, (3) impacts of dikes and tide gates may not be completely mitigated with self-regulating tide gates (SRT) designs, (4) hydraulic modeling is an essential part of establishing both the feasibility and sustainability of project goals, and (5) continued monitoring and adaptive management is essential in meeting project goals.

Historically, tide and flood gates were constructed of cast iron or wood. Plastic, fiberglass and aluminum gates are also available and are preferred because the lighter gates open easier for better fish passage and for drainage. Today's designs include float-operated gates, such as self-regulating tide gates, automatic electric- or hydraulically-powered gates, and other mechanical systems that allow a specific and variable operating range of upstream water surface elevation. This class is collectively called *automatic* gates as opposed to *passive* gates that simply rely on the direction of flow to either close or open (Barnard 2011; Giannico and Souder 2005; Greene *et al.* 2012).

Replacement or Retrofit of Tide and Flood Gates. Replacement of tidegates is occasionally necessary, and usually involves the replacement of tubes to extend the life of the gate facility or to restore impaired function. Tubes typically collapse due to corrosion. A recent study by the NOAA Northwest Fisheries Science Center and the Skagit River System Cooperative (Greene *et al.* 2012) on "fish friendly" tide gates concluded:

a. The similarity of SRTs to flap- or side-hinged gates, or reference sites, depends upon which metrics are measured.
b. SRTs limit habitat use above the gates relative to natural channels, but perform slightly better than passive side hinged or flap gates.
c. Flap or side hinged gates that were held open during observation periods were consistently higher in cumulative Chinook salmon density ratio than purely passively operated gates.
d. SRT designs continue to limit tidal processes and habitat use.

e. SRT designs and operation standards that maximize connectivity, and site selection criteria that focus on reconnection of large amounts of habitat, may overcome some of the limitations of reduced habitat use associated with SRT installation.

In one instance, a passive side hinged gate was removed and replaced with an SRT -- the result was a nearly a 10-fold decline in cumulative density of juvenile Chinook salmon. It was observed that previous gate operations, which stipulated the former gate be manually held open during key migration periods for juvenile Chinook salmon, were not duplicated in the operation of the newly installed SRT. The unintended biological effects of the change in gate operation highlights the significance of operation plans, monitoring, maintenance, and adaptive management in meeting the goals for tidal restoration projects utilizing SRTs.

The potential for fish to be adversely affected is dependent upon small fish being present at the tidegate or floodgate sites. For many fish species, dependence on delta and estuary habitats is seasonal. The time of the year when juvenile fish utilize the delta and estuary habitats for rearing and refuge is different for different fish species and life histories. For salmonid species, small juveniles typically depend on the delta and estuary habitats between February and July, during which time they are at greatest risk of being adversely affected by tidegate and floodgate work. The velocity and depth in the barrel of the culvert may exceed the swimming ability of the fish that make it past the gate. There is often an increase in velocity at the inlet of the culvert as flow contracts into the smaller culvert. Head loss in excess of 0.5 feet (greater than 5 feet per second) is likely to be a barrier to juvenile and weak swimming fish.

The replacement of tide gates and flood gates using the proposed PDC are likely to have effects similar to those of the removal of water control structures or fish passage restoration, as described above, including impacts of work area isolation, fish capture, and release. The potential for fish to be adversely affected is also related to the size of fish. Larger fish are stronger swimmers and therefore better able to escape and avoid the potential impacts of replacement activities, whereas smaller fish are weaker swimmers and therefore at greater risk of being killed or injured. Additionally, the potential for fish to be adversely affected is greater in those habitats where small fish rear and seek refuge. Habitats typically associated with tidegates and floodgates in river deltas and estuaries provide optimal rearing and refuge habitat for smaller fish, whereas larger fish tend to seek optimal rearing and refuge conditions in deeper water and off shore habitats.

Tide and flood gate replacement or retrofit activities can result in direct and indirect impacts to fish. Replacement of tide gate "tubes" or culvert pipes is typically completed during the late summer to early fall months to coincide with the occurrence of extreme low tides during daylight hours behind cofferdams. Direct impacts include physical and/or chemical trauma to the fish that can result in injury or death. Whenever a watercourse is excavated with motorized equipment, fish can be killed or injured. Fish can be physically removed from the watercourse in the bucket of the excavator and discarded on the shoreline. The excavator bucket can also physically injure fish. Fish can also be chemically injured or killed through the inadvertent discharge of concrete leachate, or hydraulic fluid, gas, or diesel oil into the watercourse from the motorized equipment.

Indirect impacts are temporary and do not directly kill or injure fish. Indirect impacts disturb and/or alter the watercourse and shoreline habitats upon which fish depend for rearing and refuge, thus compromising their rearing ability and their potential to survive. Removing riparian and aquatic vegetation from the watercourse temporarily reduces detritus input into the watercourse and reduces the production of important epibenthic and benthic invertebrates and the availability of terrestrial insects that are important fish prey. The removal of riparian vegetation that provides shade to a watercourse also elevates water temperatures and can stress, displace or kill fish. Excavation of the watercourse (physically removing the aquatic vegetation) results in the temporary loss of refuge and cover habitat. Excavating the watercourse or disturbing the shoreline increases suspended sediments in the watercourse and temporarily reduces the light available for photosynthesis, thus reducing the production of aquatic vegetation. This activity also removes or buries epibenthic and benthic invertebrates that are important fish prey.

As described in section 2.2.2 of this opinion, coastal marsh lands have been extensively altered in the SONCC, OC, WLC, and PS recovery domains by the installation of dikes and tidegates to protect developments or to create pasturelands or land for development. In addition to the loss of these wetlands, fish passage into waterways has been adversely affected. While not a substitution for complete removal, replacing or retrofitting old tide gates with structures that are designed to increase the hydraulic connections between waterways will improve water quality, habitat conditions, and fish passage into coastal marsh habitat.

With NMFS oversight and approval, new tide gates and associated culverts and will be designed to allow fish passage through a substantially greater portion of the tidal cycle.

2.4.1 Effects of the Action on ESA-Listed Salmon and Steelhead

The most intense adverse effects of the proposed action result from in- or-near-water construction, *e.g.*, stream crossing replacement projects and channel reconstruction/relocation. Physical and chemical changes in the environment associated with construction, especially decreased water quality (*e.g.*, increased total suspended solids, contaminants, and temperature, and decreased dissolved oxygen) likely affect a larger area than direct interactions between fish and construction personnel. PDC related to in-water work timing, sensitive area protection, fish passage, erosion and pollution control, choice of equipment, in-water use of equipment, and work area isolation have been proposed to avoid or reduce these adverse effects. Those measures will ensure that USFWS and NOAA RC will (1) not undertake restoration at sites occupied by spawning adult fish or where occupied redds are present, (2) defer construction until the time of year when the fewest fish are present, and (3) otherwise ensure that the adverse environmental consequences of construction are avoided or minimized.

It is unlikely that individual adult or embryonic salmon or steelhead will be adversely affected by the proposed action because all in-water construction will be deferred until after spawning season has passed and fry have emerged from gravel. However, in some locations, where adult salmon or steelhead may be present during part of the in-water work, and juvenile steelhead may still be emerging from the gravel. Therefore, a judgment call will need to be made by NMFS to determine the best timing. The use of heavy equipment in-stream in spawning areas will likely disturb or compact spawning gravel. Upland erosion and sediment delivery will likely increase substrate embeddedness. These factors make it harder for fish to excavate redds, and decrease redd aeration (Cederholm *et al.* 1997). However, the degree of instream substrate compaction and upland soil disturbance likely to occur under most of these actions is so small that significant sedimentation of spawning gravel is unlikely. If, for some reason, an adult fish is migrating in an action area during any phase of construction, it is likely to be able to successfully avoid construction disturbances by moving laterally or stopping briefly during migration, although spawning itself could be delayed until construction was complete (Feist *et al.* 1996; Gregory 1988; Servizi and Martens 1991; Sigler 1988). To the extent that the proposed actions are successful at improving flow conditions and reducing sedimentation, future spawning success, and embryo survival in the action area will be enhanced.

In contrast to adult and embryonic fish that will likely be absent during implementation of projects, juvenile salmonids will be present at many or most of the restoration sites. At in- or near-water construction projects (*e.g.*, stream crossing replacement projects, channel reconstruction/relocation), some direct effects of the proposed actions are likely be caused by the isolation of in-water work areas, although other combined lethal and sublethal effects would be greater without the isolation. An effort will be made to capture all juvenile fish present within the work isolation area and to release them at a safe location, although some juvenile fish will likely evade capture and later die when the area is dewatered. Fish that are captured and transferred to holding tanks can experience trauma if care is not taken in the transfer process.

Fish can also experience stress and injury from overcrowding in traps, if the traps are not emptied on a regular basis. The primary contributing factors to stress and death from handling are: (1) Water temperature difference between the river and holding buckets; (2) dissolved oxygen conditions; (3) the amount of time that fish are held out of the water; and (4) physical trauma. Stress from handling increases rapidly if water temperature exceeds 18°C (64°F), or if dissolved oxygen is below saturation. Debris buildup at traps can also kill or injure fish if the traps are not monitored and cleared on a regular basis. PDC related to the capture and release of fish during work area isolation will avoid most of these consequences, and ensure that most of the resulting stress is short-lived (Portz 2007).

Rapid changes and extremes in environmental conditions caused by construction are likely to cause a physiological stress response that will change the behavior of juvenile fish (Moberg 2000; Shreck 2000). For example, reduced input of particulate organic matter to streams, addition of fine sediment to channels, and mechanical disturbance of shallow-water habitats are likely to cause displacement from, or avoidance of, preferred rearing areas. Actions that affect stream channel widths are also likely to impair local movements of juvenile fish for hours, days, or longer. Downstream migration will also likely be impaired. These adverse effects vary with the particular life stage, the duration and severity of the stressor, the frequency of stressful situations, the number and temporal separation between exposures, and the number of contemporaneous stressors experienced (Newcombe and Jensen 1996; Shreck 2000).

Juvenile fish compensate for, or adapt to, some of these disturbances so that they continue to perform necessary physiological and behavioral functions, although in a diminished capacity. However, fish that are subject to prolonged, combined, or repeated stress by the effects of the actions, combined with poor environmental baseline conditions, will likely suffer metabolic costs that are sufficient to impair their rearing, migrating, feeding, and sheltering behaviors and thereby increase the likelihood of injury or death. Because juvenile fish in the project areas are already subject to stress as a result of degraded watershed conditions, it is likely that a small number of those individuals will die due to increased competition, disease, and predation, and reduced ability to obtain food necessary for growth and maintenance (Moberg 2000; Newcombe and Jensen 1996; Sprague and Drury 1969). As explained more fully below in the *Amount or Extent of Take* section, approximately 499 juveniles are allowed to be injured or killed per year during in-water work area isolation across the region.

In addition to the short-term adverse effects of construction on listed species described above, each type of action will also have long-term effects to individual fish. Each proposed action will increase the amount of habitat available and promote the development of more natural riparian and stream channel conditions to improve aquatic functions and become more productive. This will allow more complete expression of essential biological behaviors related to reproduction, feeding, rearing, and migration. If habitat abundance or quality is a limiting factor for ESA-listed fish in streams, the long-term effects of access to larger or more productive habitat is likely to increase juvenile survival and adult reproductive success. However, individual response to habitat improvement will also depend on factors, such as the quality and quantity of newly available habitat, and the abundance and nature of the predators, competitors, and prey that reside there.

Instantaneous measures of population characteristics, such as population abundance, population spatial structure and population diversity, are the sum of individual characteristics within a particular area, while measures of population change, such as population growth rate, are measured as the productivity of individuals over the entire life cycle (McElhany *et al.* 2000). Thus, although the expected loss of a small number of individuals will have an immediate effect on population abundance at the local scale, the effect will not extend to measurable population change unless it reaches a scale that can be observed over an entire life cycle.

Because the juvenile-to-adult survival rate for salmon and steelhead is generally very low, the effects of a proposed action would have to kill hundreds or even thousands of juvenile fish in a single population before those effects would be equivalent even to a single adult, and would have to kill many times more than that to affect the abundance or productivity of the entire population over a full life cycle. Moreover, because the geographic area that will be affected by the proposed programmatic action is so large, juvenile fish that are likely to be killed are from more than 300 independent populations. The adverse effects of each proposed individual action will be too infrequent, short-term, and limited to kill more than a small number of juvenile fish at a particular site or even across the range of a single population, much less when that number is even partly distributed among all populations within the action area. Thus, the proposed actions will simply kill too few fish, as a function of the size of the affected populations and the habitat carrying capacity after each action is completed, to meaningfully affect the primary VSP attributes of abundance or population growth rate for any single population. This is also true for very small populations of endangered species considered in this opinion, *i.e.*, UCR spring-run Chinook salmon and SR sockeye salmon, for which a combination of low abundance, river-type ecology, and a distribution within the action area that is restricted to the mainstem of the

Columbia River make it unlikely that individuals from those species will be injured or killed by the proposed action.

The remaining VSP attributes are within-population spatial structure, a characteristic that depends primarily on spawning group distribution and connectivity, and diversity, which is based on a combination of genetic and environmental factors (McElhany *et al.* 2000). Because the proposed actions are only likely to have short-term adverse effects to spawning sites, if any, and in the long term will improve spawning habitat attributes, they are unlikely to adversely affect spawning group distributions or within-population spatial structure. Actions that restore fish passage will improve population spatial structure. Similarly, because the proposed action does not affect basic demographic processes through human selection, alter environmental processes by reducing environmental complexity, or otherwise limit a population's ability to respond to natural selection, the action will not adversely affect population diversity.

At the species level, biological effects are synonymous with those at the population level or, more likely, are the integrated demographic response of one or more subpopulations (McElhany *et al.* 2000). Because the likely adverse effects of any action funded or carried out under this opinion will not adversely affect the VSP characteristics of any salmon or steelhead population, the proposed actions also will not have any a measurable effect on species-level abundance, productivity, or ability to recover.

Of the ESA-listed species considered in this opinion, only juvenile salmon and steelhead are likely to be captured during work area isolation. The effects of proposed action, as a whole, on the 19 species of salmon and steelhead considered in this opinion will be the combined effects of all of the individual actions that are funded or carried out under this opinion. Combining the effects of many actions does not change the nature of the effects caused by individual actions, but does require an analysis of the additive effects of multiple occurrences of the same type of effects at the individual fish, population, and species scales. If the adverse effects of one action are added to the effects of one or more additional actions in the same place and time, individual fish will likely experience a more significant adverse effect than if only one action was present. This would occur when the action area for two or more restoration actions overlap, *i.e.*, are placed within 100 to 300 feet of each other and are constructed at approximately the same time.

The peak number of projects reviewed under the USFWS and NOAA RC programmatic opinion was 25 in 2012. Over the period 2010-2012, the average number of projects per year authorized by the USFWS and NOAA RC has been about 21 projects, with 17 or fewer projects in any recovery domain. USFWS, which only does restoration projects in Oregon and Southwest Washington, and NOAA RC focused most of their attention on the IC and OC recovery domains. With several additional action categories (channel reconstruction, dam removal, beaver restoration) included in this opinion, we anticipate there will be 126 or fewer total restoration projects per year, with 62 or fewer projects in a single recovery domain, under this opinion. Based on past experience, in most domains far fewer projects will likely be implemented (Table 2).

Numbers of projects will likely decrease if funding becomes less available and the obvious restoration sites are completed and only more comprehensive large scale projects, such as channel reconstruction/relocation projects, are implemented. The likelihood of additive effects on species at the program level due to projects occurring in close proximity within the same watershed, or even within sequential watersheds, is very remote, whether those effects are adverse or beneficial. It is very unlikely that two or more projects will occur within 100 to 300 feet of each other. Measured as miles of streambank disturbance, the average physical impact of these projects combined is small compared to the total number of miles of critical habitat available in each recovery domain.

The strong emphasis on use of proposed PDC to minimize the short-term adverse effects of these actions, the small size of individual action areas, and the design of actions that are likely to result in a long-term improvement in the function and conservation value of each action area will ensure that individual fish will not suffer greater adverse effects if two or more action areas do overlap. Moreover, the rapid onset of beneficial effects from these types of actions is likely to improve the baseline for subsequent actions so that adverse effects are not likely to be additive at the population or watershed scale.

2.4.2 Effects of the Action on ESA-Listed Eulachon

Eulachon are limited to a relatively few subtidal and intertidal areas, but they return to those areas with a presumed fidelity that indicates close association between a particular stock and its spawning environment (Gustafson *et al.* 2011; Gustafson *et al.* 2010). In the Columbia, major spawning runs occur in the mainstem lower Columbia and Cowlitz rivers with periodic runs appearing in the Grays, Skamokawa, Elochoman, Kalama, Lewis, and Sandy rivers. Washington rivers outside the Columbia Basin where eulachon have been known to spawn include the Bear, Naselle, Nemah, Wynoochee, Quinault, Queets, and Nooksack rivers. Oregon waterbodies include the Winchuck, Chetco, Pistol, Rogue, Elk, Sixes, Coquille, Coos, Siuslaw, Umpqua, and Yaquina rivers; and Hunter, and Euchre rivers, Tenmile Creek (draining Tenmile Lake), and Tenmile Creek (near Yachats, Oregon) (Gustafson *et al.* 2010). Spawning occurs between December and June with the majority of the run occurring over a 20-day period. Eggs hatch in 3 to 8 weeks depending on temperature, and larvae are transported rapidly by spring freshets to estuaries. Normal timing of migration coincides with the rainy season when few activities will occur and exposure to suspended sediment and other polluted runoff will be diluted (Gustafson *et al.* 2011; Gustafson *et al.* 2010). Of the numerous potential threats throughout every stage of their life cycle that eulachon face, shoreline construction effects and water quality would be ranked low compared to other factors.

Effects to eulachon will primarily result from instream and streambank work on the few streams where they occur. Impacts will be similar to those described for salmon and steelhead that are listed above. Because the likely adverse effects of any action funded or carried out under this opinion will not adversely affect the VSP characteristics of any eulachon population, the proposed actions also will not have any measurable effect on species-level abundance, productivity, or ability to recover.

2.4.3 Effects of the Action on Designated Critical Habitat

Each individual project, completed as proposed, including full application of the design criteria for restoration, is likely to have effects on critical habitat PCEs or physical and biological features. These effects will vary somewhat in degree between actions because of differences in the scope of construction at each, and in the current condition of PCEs and the factors responsible for those conditions. This assumption is based on the fact that all of the actions are based on the same set of underlying restoration actions, and the PCEs and conservation needs identified for each species are also essentially the same. In general, ephemeral effects are likely to last for hours or days, short-term effects are likely to last for weeks, and long-term effects are likely to last for months, years or decades. The intensity of each effect, in terms of change in the PCE from baseline condition, and severity of each effect, measured as recovery time, will vary somewhat between projects because of differences in the scope of the work. However, no individual restoration project is likely to have any effect on PCEs that is greater than the full range of effects summarized here.

No more than 17 restoration actions in a single recovery domain (IC) were completed using the USFWS and NOAA RC opinions in a single year (2012). As noted above, we anticipate there will be 62 or fewer restoration projects completed under this opinion in a single recovery domain, in a single year, and most domains will have many fewer. This number of projects is already small compared to the total number of watersheds in each recovery domain, but the intensity of those project effects appears far smaller when considered as a function of their average streamside footprint. The streamside footprint that will be temporarily disturbed by the full program each year corresponds to the area where almost all direct construction impacts will occur.

Because the area affected for individual projects is small, the intensity and severity of the effects described is relatively low, and their frequency in a given watershed is very low, any adverse effects to PCE conditions and conservation value of critical habitat at the site level or reach level are likely to quickly return to, and improve beyond, critical habitat conditions that existed before the action. Moreover, projects completed under the proposed program are also reasonably certain to lead to some degree of ecological recovery within each action area, including the establishment or restoration of environmental conditions associated with functional aquatic habitat and high conservation value. This is because each action is likely to partially or fully correct improper or inadequate engineering designs in ways that will help to restore lost habitat, improve water quality, reduce upstream and downstream channel impacts, improve floodplain connectivity, and reduce the risk of structural failure. Improved fish passage through culverts and more functional floodplain connectivity, in particular, may have long-term beneficial effects.

As noted above, the indirect effects, or effectiveness, of habitat restoration actions, in general, have not been well documented, in part because they often concentrate on instream habitat without addressing the processes that led to the loss of the habitat (Cederholm *et al.* 1997; Fox 1992; Simenstad and Thom 1996; Zedler 1996). Nonetheless, the careful, interagency process used by the USFWS and NOAA RC to develop the proposed program ensures that it is reasonably certain to lead to some degree of ecological recovery within each project area, including the establishment or restoration of environmental conditions associated with functional habitat and high conservation value.

Summary of the effects of the action on salmon and steelhead critical habitat PCEs:

1. <u>Freshwater spawning sites</u>
    a. Substrate – Short-term reduction in quality due to increased compaction and sedimentation; long-term increase in quality due to gravel placement, and increased sediment storage from boulders and LW.
    b. Water quantity – Brief reduction in flow due to short-term construction needs, reduced riparian permeability and increased riparian runoff due to compaction, and reduced late season flows; slight longer-term increase based on improved riparian function and floodplain connectivity.
    c. Water quality – Short-term increase in total suspended solids, contaminants, dissolved oxygen demand, and temperature due to riparian and channel disturbance; longer-term improvement due to improved riparian function and floodplain connectivity.
2. <u>Freshwater rearing sites</u>
    a. Floodplain connectivity – Short-term decrease due to increased compaction and riparian disturbance; long-term improvement due to off- and side channel habitat restoration, set-back of existing berms, dikes, and levees, and removal of water control structures.
    b. Forage – Short-term decrease due to riparian and channel disturbance, and water quality impairments; long-term improvement due to improved habitat diversity and complexity, improved riparian function and floodplain connectivity, and increased litter retention.
    c. Natural cover – Short-term decrease due to riparian and channel disturbance; long-term increase due to improved habitat diversity and complexity, improved riparian function and floodplain connectivity, and off- and side channel habitat restoration.
    d. Water quantity – as above.
    e. Water quality – as above.
3. <u>Freshwater migration corridors</u>
    a. Free passage – Short-term decrease due to decreased water quality and in-water work isolation; long-term increase due to fish passage barrier removal, improved water quantity and quality, habitat diversity and complexity, forage to support juvenile migration, and natural cover.
    b. Natural cover – as above
    c. Water quantity – as above
    d. Water quality – as above
4. <u>Estuarine areas</u>
    a. Forage – as above
    b. Free passage – as above
    c. Natural cover – as above
    d. Salinity – no effect
    e. Water quality – as above
    f. Water quantity – as above

5. Nearshore marine areas
    a. Forage – Short-term decrease due to beach restoration activities. Long term increase as a result of beach restoration activities.
    b. Free passage – Short-term decrease due to beach restoration activities. Long term increase as a result of beach restoration activities.
    c. Natural cover – Short-term decrease due to beach restoration activities. Long term increase as a result of beach restoration activities.
    d. Water quantity – no effect
    e. Water quality – Short-term decrease due to beach restoration activities.
6. Offshore marine areas – These PCEs do not occur in the action area.

Summary of the effects of the action on eulachon critical habitat physical and biological features: Critical habitat for eulachon includes: (1) Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles; (2) freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted; and, (3) nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. The effects on essential features for eulachon critical habitat are as follows:

1. Freshwater spawning sites and incubation
    a. Flow – Ephemeral reduction due to short-term construction needs, reduced riparian permeability and increased riparian runoff due to soil compaction; slight long-term increase based on improved riparian function and floodplain connectivity.
    b. Water quality – Short-term releases of suspended sediment, increased dissolved oxygen demand, and increased temperature due to riparian and channel disturbance; longer-term improvement due to improved riparian function and floodplain connectivity.
    c. Water temperature – Slight long-term increase based on improved riparian function and floodplain connectivity.
    d. Substrate – Short-term reduction in quality due to increased compaction, sedimentation and removal. Long-term benefit from the restoration of natural sediment transport.
    e. Free passage – Short-term decrease due to decreased water quality and in-water work isolation; long-term increase due to fish passage barrier removal, improved water quantity and quality, habitat diversity and complexity, and natural cover.
2. Freshwater and estuarine migration corridors
    e. Free passage – Short-term decrease due to decreased water quality and in-water work isolation; long-term increase due to fish passage barrier removal, improved water quantity and quality, habitat diversity and complexity, and natural cover.
    a. Flow – as above.
    b. Water quality – as above.
    c. Water temperature – no effect.

    d. Food – no effect.
3. Nearshore and offshore marine foraging areas
    a. Food – no effect.
    b. Water quality – no effect.

Summary of effects to critical habitat for all listed species. USFWS and NOAA RC projects are likely to have some short-term impacts, but none of those impacts will be severe enough to impair the ability of critical habitat to support recovery. The frequency of disturbance will usually be limited to a single event or, at most, a few projects within the same watershed. It is also unlikely that several projects within the same watershed, or even within the same action area, will have a severe enough adverse effect on the function of PCEs (physical and biological features) to affect the conservation value of critical habitat in the action area, watershed, or designation area.

All of the activities are designed to have long-term beneficial effects to critical habitat. However, as noted above, the long-term effectiveness of habitat restoration actions, in general, have not been well documented. In part, this is because they often concentrate on instream habitat without addressing the processes that led to the loss of the habitat (Cederholm *et al.* 1997; Doyle and Shields 2012; Fox 1992; Roper *et al.* 1997; Simenstad and Thom 1996; Zedler 1996). Nevertheless, the proposed actions are reasonably certain to lead to some degree of ecological recovery within each action area, including the establishment or restoration of environmental conditions associated with functional habitat and high conservation value. Fish passage improvement actions, in particular, are likely to have long-term beneficial effects at the watershed or designation-wide scale (Roni *et al.* 2002).

Synthesis of Effects. The scope of each type of activity that could be authorized under the proposed restoration program is narrowly proscribed, and is further limited by PDC tailored to avoid direct and indirect adverse effects of those actions. Administrative PDC are in place to ensure that requirements related to the scope of actions allowed and the mandatory PDC operate to limit direct lethal effects on listed fish to a few deaths associated with isolation and dewatering of in-water work areas, an action necessary to avoid greater environmental harm. Most other direct adverse effects will likely be transitory and within the ability of both juvenile and adult fish to avoid by bypassing or temporarily leaving the action area. Such behavioral avoidance will probably be the only significant biological response of listed fish to the proposed restoration program. This is because areas affected by the specific projects undertaken are likely to be widely distributed (the frequency of the disturbance will be limited to a single event or, at most, a few projects within the same watershed) and small compared with the total habitat area.

As noted above (Table 2), the number of restoration actions in a single recovery domain using the prior versions of this opinion in a single year has varied greatly. During the period 2010-2012, the majority of the restoration projects (31, 49%) occurred in the IC recovery domain. However, few actions per year have occurred in a single 5th field watershed over this large region. Projects were even further separated in the other recovery domains. The intensity of the predicted effects within the action area, in terms of the total condition and value of PCEs after each action is completed, and the severity of the effects, given the recovery rate for those same PCEs, are such that the function of PCEs and the conservation value of critical habitat are likely to be only impaired for a short time due to restoration actions funded or carried out under this opinion. The PCE conditions in each action area are likely to quickly return to, or exceed, pre-action levels. Thus, it is unlikely that several actions within the same watershed, or even within the same action area, will have an important adverse effect on the function of PCEs or the conservation value of critical habitat at the action area, watershed, or designation scales. The intensity and severity of environmental effects for each project will be comprehensively minimized by targeted PDC.

2.5 Cumulative Effects

Cumulative effects are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The contribution of non-Federal activities to the current condition of ESA-listed species and designated or proposed critical habitats within the program-level action area was described in the Status of the Species and Critical Habitats and Environmental Baseline sections, above. Among those activities were agriculture, forest management, mining, road construction, urbanization, water development, and river restoration. Those actions were driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of social groups dedicated to river restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

Resource-based industries caused many long-lasting environmental changes that harmed ESA-listed species and their critical habitats, such as state-wide loss or degradation of stream channel morphology, spawning substrates, instream roughness and cover, estuarine rearing habitats, wetlands, riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants), fish passage, and habitat refugia. Those changes reduced the ability of populations of ESA-listed species to sustain themselves in the natural environment by altering or interfering with their behavior in ways that reduce their survival throughout their life cycle. The environmental changes also reduced the quality and function of critical habitat PCEs that are necessary for successful spawning, production of offspring, and migratory access necessary for adult fish to swim upstream to reach spawning areas and for juvenile fish to proceed downstream and reach the ocean. Without those features, the species cannot successfully spawn and produce offspring. However, the declining level of resource-based industrial activity and rapidly rising industry standards for resource protection are likely to reduce the intensity and severity of those impacts in the future.

The economic and environmental significance of the natural resource-based economy is currently declining in absolute terms and relative to a newer economy based on mixed manufacturing and marketing with an emphasis on high technology (Brown 2011). Nonetheless, resource-based industries are likely to continue to have an influence on environmental conditions within the program-action area for the indefinite future. However, over time those industries have adopted management practices that avoid or reduce many of their most harmful impacts, as is evidenced by the extensive conservation measures included with the proposed action, but which were unknown or in uncommon use until even a few years ago.

In the Northwest, the percentage increase in population growth may provide the best estimate of general resource demands because as local human populations grow, so does the overall consumption of local and regional natural resources. For example, in Oregon natural resource extraction is declining, while general resource demands are increasing with growth in the size and standard of living of the local and regional human population (Metro 2010; Metro 2011). Between April 2010 and July 2012, the population of Oregon and Idaho both grew by 1.8% and the population of Washington State grew by 2.6%.[38] The NMFS assumes that private and state actions that have routinely occurred in the past will continue within the action area, increasing as population rises. The adverse effects of non-Federal actions stimulated by general resource demands are likely to continue in the future driven by changes in human population density and standards of living. These effects are likely to continue to a similar or reduced extent in the rural areas of the Northwest where counties are maintaining or losing population. Counties that are gaining population are likely to experience greater resource demands, and therefore more adverse environmental effects.

Oregon's land use laws and progressive policies related to long-range planning will help to limit those impacts by ensuring that concern for a healthy economy that generates jobs and business opportunities is balanced by concern for protection of farms, forests, rivers, streams and natural areas (Metro 2000; Metro 2008; Metro 2011). Washington's Growth Management Act (Washington Revised Code §§ 36.70A.010–36.70A.902) requires state and local governments to manage Washington's growth by identifying and protecting critical areas and natural resource lands, designating urban growth areas, preparing comprehensive plans and implementing them through capital investments and development regulations. The Idaho Local Land Use Planning Act (Idaho Code §§67.65) requires Idaho cities and counties to develop comprehensive plans and zoning ordinances, but Idaho does not have a state agency to ensure local implementation of comprehensive planning requirements or to provide technical assistance with local governmental planning. In addition to land use planning to minimize adverse environmental impacts, larger population centers may also partly offset the adverse effects of their growing resource demands with more river restoration projects designed to provide ecosystem-based cultural amenities, although the geographic distribution of those actions, and therefore any benefits to ESA-listed species or critical habitats, may occur far from the centers of human populations.

Similarly, demand for cultural and aesthetic amenities continues to grow with human population, and is reflected in decades of concentrated effort by Tribes, states, and local communities to restore an environment that supports flourishing wildlife populations, including populations of species that are now ESA-listed (CRITFC 1995; NMFS 2011g; NWPCC 2012; OWEB 2011). Reduced economic dependence on traditional resource-based industries has been associated with growing public appreciation for the economic benefits of river restoration, and growing demand for the cultural amenities that river restoration provides. Thus, many non-Federal actions have become responsive to the recovery needs of ESA-listed species. Those actions included efforts to

[38] http://quickfacts.census.gov/qfd/states/16000.html, accessed April 8, 2013.

ensure that resource-based industries adopt improved practices to avoid, minimize, or offset their adverse impacts. Similarly, many actions are focused on completion of river restoration projects specifically designed to broadly reverse the major factors now limiting the survival of ESA-listed species at all stages of their life cycle. Those actions have improved the availability and quality of estuarine and nearshore habitats, floodplain connectivity, channel structure and complexity, riparian areas and LW recruitment, stream substrates, stream flow, water quality, and fish passage. In this way, the goal of ESA-listed species recovery has become institutionalized as a common and accepted part of the economic and environmental culture. We expect this trend to continue into the future as awareness of environmental and at-risk species issues increases among the general public.

It is not possible to predict the future intensity of specific non-Federal actions related to resource-based industries at this program scale due to uncertainties about the economy, funding levels for restoration actions, and individual investment decisions. However, the adverse effects of resource-based industries in the action area are likely to continue in the future, although their net adverse effect is likely to decline slowly as beneficial effects spread from the adoption of industry-wide standards for more protective management practices. These effects, both negative and positive, will be expressed most strongly in rural areas where these industries occur, and therefore somewhat in contrast to human population density. The future effects of river restoration are also unpredictable for the same reasons, but their net beneficial effects may grow with the increased sophistication and size of projects completed and the additive effects of completing multiple projects in some watersheds.

In summary, resource-based activities such as timber harvest, agriculture, mining, shipping, and energy development are likely to continue to exert an influence on the quality of freshwater and estuarine habitat in the action area. The intensity of this influence is difficult to predict and is dependent on many social and economic factors. However, the adoption of industry-wide standards to reduce environmental impacts and the shift away from resource extraction to a mixed manufacturing and technology based economy should result in a gradual decrease in influence over time. In contrast, the population of the Pacific Northwest is expected to increase in the next several decades with a corresponding increase in natural resource consumption. Additional residential and commercial development and a general increase in human activities are expected to cause localized degradation of freshwater and estuarine habitat. Interest in restoration activities is also increasing as is environmental awareness among the public. This will lead to localized improvements to freshwater and estuarine habitat.

When considered together, these cumulative effects are likely to have a small negative effect on salmon and steelhead population abundance, productivity, and some short-term negative effects on spatial structure (short-term blockages of fish passage). Similarly, the condition of critical habitat PCEs will be slightly degraded by the cumulative effects.

2.6 Integration and Synthesis

The Integration and Synthesis section is the final step of NMFS' assessment of the risk posed to species and critical habitat as a result of implementing the proposed program. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's opinion as to whether the proposed program is likely to: (1) Result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 2.2).

2.6.1 Species at the Population Scale

The status of each species addressed by this consultation varies considerably from very high risk (SR sockeye salmon) to moderate risk (*e.g.,* OC coho salmon, MCR steelhead). Similarly, the hundreds of individual populations affected by the proposed program vary considerably in their biological status. The species addressed in this opinion have declined due to numerous factors. The one factor for decline that all these species share is degradation of freshwater and estuarine habitat. Human development of the Pacific Northwest has caused significant negative changes to stream and estuary habitat across the range of these species. The environmental baseline varies across the program area, but habitat will generally be degraded at sites selected for restoration actions.

The programmatic nature of the action prevents a precise analysis of each action that eventually will be funded or carried out under this opinion, although each type of action will be carefully designed and constrained by comprehensive design criteria such that the proposed activities will cause only short-term, localized, and minor effects. Also, actions are likely to be widely distributed across all recovery domains in Oregon, Washington, and Idaho, so adverse effects will not be concentrated in time or space within the range of any listed species. In the long term, these actions will contribute to a lessening of many of the factors limiting the recovery of these species, particularly those factors related to fish passage, degraded floodplain connectivity, reduced aquatic habitat complexity, and riparian conditions, and improve the currently-degraded environmental baseline, particularly at the site scale. A very small number of individual fish, far too few to affect the abundance, productivity, distribution, or genetic diversity of any salmon or steelhead population, will be affected by the adverse effects of any single action permitted under the proposed action. Because the VSP characteristics at the population scale will not be affected, the likelihood of survival and recovery of the listed species will not be appreciably reduced by the proposed action.

As described in Section 2.2, individuals of many ESA-listed salmon and steelhead species and eulachon use the program action area to fully complete the migration, spawning and rearing parts of their life cycle; some salmon, steelhead, and eulachon migrate and rear in the program action area; and some species only migrate through, once as out-migrating juveniles and then again as adult fish on upstream spawning migration. The viability of the various populations that comprise the 20 species considered in this opinion ranges from extirpated or nearly so to populations that are a low risk for extinction. Southern eulachon population abundance has declined significantly since the early 1990s and there is no evidence to date of their returning to former population levels. Although NMFS considers variation in ocean productivity to be the most important natural phenomenon affecting the productivity of these species, NMFS identified many other factors associated with the freshwater phase of their life cycle that are also limiting the recovery of these species. These factors include, but are not limited to, elevated water temperatures; excessive sediment; reduced access to spawning and rearing areas; reductions in habitat complexity, instream wood, and channel stability; degraded floodplain structure and function, and reduced flow. Tributary habitat actions are typically geared to improving spawning and rearing habitat, providing habitat access, and enhancing in-stream flows. Estuary habitat actions are implemented with a goal of improving survival for all populations. Estuary actions include protecting and restoring riparian and off-channel habitat, reconnecting flood plains, increasing fish access to productive habitat, and reducing predation. In general, actions carried out under the proposed program will address and help to alleviate many of these limiting factors. Cumulative effects described in section 2.5 are likely to have a small short-term negative effect on salmon and steelhead population abundance, productivity, and some short-term negative effects on spatial structure (short-term blockages of fish passage).

2.6.2 Critical Habitat at the Watershed Scale

Many streams in the action area are designated as critical habitat for ESA-listed salmon, steelhead, and eulachon. The physical and biological features of salmon and steelhead critical habitat in the action area are freshwater spawning, freshwater rearing, adult and juvenile migration corridors, and estuarine habitat. The features of eulachon critical habitat that are likely to be affected by projects completed under the proposed program are freshwater spawning and incubation habitat, and freshwater migration. Climate change and human development have and continue to adversely affect critical habitat, creating limiting factors and threats to the recovery of the ESA listed species.

Information in Section 2.3 described the environmental baseline in the action area as widely variable but NMFS assumes that restoration projects will occur at sites where the environmental baseline does not fully meet the biological requirements of individual fish due to the presence of impaired fish passage, floodplain fill, streambank degradation, or degraded riparian conditions. Similarly, it is likely that the environmental baseline is also not meeting the biological requirements of individual fish of ESA-listed species at sites where restoration projects will occur due to one or more impaired aquatic habitat functions related to any of the habitat factors limiting the recovery of the species in that area, but the quality of critical habitat at those sites is likely to be improved due to completion of the restoration projects.

Habitat improvement projects are being actively implemented through salmon recovery efforts, the FCRPS, and a combination of Federal, tribal, state and local actions. At the same time population growth and development pressures on aquatic systems are increasing, particularly in the Willamette Valley. The extent to which these trends may further reduce populations, degrade the quality and function of critical habitat, or preclude some restoration actions, is unknown.

As described in Section 2.4, most short-term effects of restoration actions on ESA-listed fish and designated critical habitat include effects related to erosion and runoff from the construction site, work area isolation, and the use of herbicides. Each project that eventually will be implemented under this opinion will be carefully designed and constrained by conservation measures such that construction impacts of restoration projects will cause only short-term, localized, and minor effects. The longer-term impacts of restoration projects are likely to include corrections of engineering flaws in existing stream crossings that do not currently allow for adequate fish passage or the functional riparian area or floodplains.

Restoration projects will have short-term impacts due to construction, but long-term will contribute to reducing many of the factors limiting the recovery of these species including fish passage, floodplain connectivity and function, channel structure and complexity, and riparian vegetation and streambank conditions.

As noted in Sections 2.2 and 2.3, climate change is likely to affect all species considered in this opinion and their habitat in the program area. These effects are expected to be positive and negative, but are likely to result in a generally negative trend for stream flow and temperature.

As described in Section 2.5, the cumulative effects of state and private actions that are reasonably certain to occur within the action area are also variable across the program action area. In urban areas there will be continued population growth, but redevelopment will begin to improve negative baseline conditions. Agricultural and forestry practices in rural areas will also likely become restorative in nature. Federal efforts to improve aquatic habitat conditions throughout the action area will gradually improve habitat conditions overall.

In summary, projects completed under the proposed program will result in relatively intense but brief disturbances to a small number of areas distributed throughout each recovery domain, but these disturbances will not appreciably reduce or prevent the increase of abundance or productivity of the populations addressed by this consultation. This is because: (1) Effects from construction-related activities are short-term and temporary, (2) a very small portion of the total number of fish in any one population will be exposed to the adverse effects of the proposed action, and (3) the geographic extent of the adverse effects is small when compared to the size of any watershed where an action will occur or the total area occupied by any of the species affected. Similarly, projects completed under the proposed program will not affect the diversity of any populations or species because the effects of the action will not adversely affect factors that primarily influence population diversity such as management of hatchery fish or selective harvest practices. Projects that improve fish passage may improve population spatial structure. By contributing to improved habitat conditions that will, over the long term, support populations with higher abundance and productivity, projects completed under the proposed program are consistent with the recovery strategies of increasing productivity and spatial diversity, a critical step toward recovery of these species as whole.

The conservation value of critical habitat within the action area for salmon and steelhead varies by life history strategy, and is higher for species with stream-type histories than for the ocean-type. That is because the latter group is more reliant on shallow-water habitats and small tributaries that are easily affected by a wide range of natural and human disturbances.
In Oregon, critical habitat for eulachon is designated in the Lower Columbia River, Umpqua River, Ten Mile Creek, and the Sandy River. In Washington, critical habitat for eulachon is designated in the Grays River, Skamokawa Creek, Cowlitz River, Toutle River, Kalama River, Lewis River, Quinault River, and Elwha River. For habitat in the Columbia River, the size of the river helps to intercept and buffer the short-term impact of construction actions, and to attenuate

the benefits of local restoration, although it is likely that increasing the conservation function of estuaries will be a focus of future restoration projects.

For the most part, the conservation value of these critical habitats is high and the projects completed under the proposed program will have minor short-term effects on the quality and function of critical habitat PCEs. The full set of management measures proposed by the USFWS and NOAA RC will ensure that these short-term effects to PCEs remain minimal. As restoration projects accumulate over time, habitat conditions may improve and critical habitat will be able to better serve its intended conservation role, supporting viable populations of ESA-listed salmon, steelhead, and eulachon.

Thus, the proposed program is not likely to result in appreciable reductions in the likelihood of both survival and recovery of listed species by reducing their numbers, reproduction, or distribution; or reduce the value of designated or proposed critical habitat for the conservation of the species.

2.7 Conclusion

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR Chinook salmon, UWR spring-run Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, PS Chinook salmon, CR chum salmon, Hood Canal summer-run chum salmon, LCR coho salmon, OC coho salmon, SONCC coho salmon, SR sockeye salmon, LO sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, PS steelhead, or southern DPS eulachon, or result in the destruction or adverse modification of critical habitat that has been designated for these species.

We also conclude that the proposed action will not adversely modify critical habitat proposed for LCR coho salmon and PS steelhead. You may ask NMFS to adopt the conference opinion as a biological opinion when critical habitat for LCR coho salmon and PS steelhead is designated. The request should be in writing. If we review the proposed action and find there have been no significant changes to the action that would alter the contents of the opinion and no significant new information has been developed (including during the rulemaking process), we may adopt the conference opinion as the biological opinion on the proposed action and no further consultation will be necessary.

2.8 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take

is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity.
For this consultation, we interpret "harass" to mean an intentional or negligent action that has the potential to injure an animal or disrupt its normal behaviors to a point where such behaviors are abandoned or significantly altered.[39] Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

2.8.1 Amount or Extent of Take

Work necessary to construct and maintain the restoration projects that will be authorized or carried out each year under this opinion will take place beside and within aquatic habitats that are reasonably certain to be occupied by individuals of the 20 ESA-listed species considered in this opinion. As described below, each type of restoration action is likely to cause incidental take of one or more of those species. Juvenile life stages are most likely to be affected, although adults will sometimes also be present when the actions occur in coastal areas or the Willamette Valley, and when actions do not involve work within the active channel and therefore may not be constrained by application of an in-water work window.

Juvenile fish will be captured during work area isolation necessary to minimize construction-related disturbance of streambank and channel areas caused by fish passage restoration; dam, tide gate, and legacy structure removal; channel reconstruction/relocation; off- and side-channel habitat restoration; and set-back or removal of existing berms, dikes, and levees. In-stream disturbance that cannot be avoided by work area isolation will lead to short-term increases in suspended sediment, temperature, dissolved oxygen demand, or other contaminants, and an overall decrease in habitat function that harms adult and juvenile fish by denying them normal use of the action area for reproduction, rearing, feeding, or migration. Exclusion from preferred habitat areas causes increased energy use and an increased likelihood of predation, competition and disease that is reasonably likely to result in injury or death of some individual fish.

Similarly, adult and juvenile fish will be harmed by construction-related disturbance of upland, riparian and in-stream areas for actions related to LW, boulder, and gravel placement; streambank restoration; reduction/relocation of recreation impacts; livestock fencing, stream crossings and off-channel livestock watering; piling and other structure removal; in-channel nutrient enhancement; road and trail erosion control and decommissioning; non-native invasive plant control; juniper removal; riparian vegetation treatment (controlled burning); riparian vegetative planting; bull trout protection; beaver habitat restoration; physical and biological surveys; and related in-stream work.

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[39] NMFS has not adopted a regulatory definition of harassment under the ESA. The World English Dictionary defines harass as "to trouble, torment, or confuse by continual persistent attacks, questions, *etc.*" The U.S. Fish and Wildlife Service defines "harass" in its regulations as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). The interpretation we adopt in this consultation is consistent with our understanding of the dictionary definition of harass and is consistent with the Service's interpretation of the term.

The effects of those actions will include additional short-term reductions in water quality, as described above, and will also harm adult and juvenile fish as described above. Herbicide applications will result in herbicide drift or transportation into streams that will harm listed species by chemically impairing normal fish behavioral patterns related to feeding, rearing, and migration. These effects are also reasonably likely to result in injury or death of some individual fish.

Projects that require two or more years of work to complete will cause adverse effects that last proportionally longer, and effects related to runoff from the project site may be exacerbated by winter precipitation. These adverse effects may continue intermittently for weeks, months, or years until riparian vegetation and floodplain vegetation are restored and a new topographic equilibrium is reached. Incidental take that meets the terms and conditions of this incidental take statement will be exempt from the taking prohibition.

Capture of Juvenile Fish During In-water Work Area Isolation

With the additional Partners programs in Washington and Idaho, as well as additional activity categories, NMFS assumes that a greater number of projects will be completed annually under this opinion than under the 2009 opinions. With the Washington and Idaho Partners programs covered by this opinion, additional aquatic restoration actions will occur in the PS, WLC, and IC recovery domains. Therefore, to account for an expected increase in projects we will assume that twice as many actions as the maximum number of projects per year from 2010-2012 will be funded or carried out in each of recovery domains per year under this opinion.

During the period 2010-2012, USFWS-Oregon and NOAA RC reported that they funded or carried out 63 restoration actions per year using the October 21 and 22, 2009, opinions. Those actions were distributed as follows: PS 5%, WLC 11%, IC 49%, OC 33%, and SONCC 2% (Table 2). With the Washington Partners Program projects added to the total we could see many more projects in the PS recovery domain (31). We estimate that there will be nearly as many aquatic restoration projects in Washington as there have been in all of Oregon. Therefore, with the programs combined under this opinion, the number of projects will likely double.

Under the 2009 opinions, over half of all the actions reported involve fish passage restoration (Table 3), and often secondary actions such as instream wood or streambank restoration. Thus, under this scenario, about 126 projects will likely be completed across the region per year. We assume that 60% of those projects (*i.e.*, 76 actions per year) will require inwater work with fish capture. USFWS (Oregon) and NOAA RC had an average capture of approximately 132 ESA-listed salmon and steelhead per project for the 35 projects where isolation and dewatering was required (NMFS 2009c; NMFS 2009d). No eulachon were captured in these fish salvage operations.

Of the ESA-listed salmonids to be captured and handled, less than 2% are likely to be injured or killed, including by delayed mortality, and the remaining 98% will likely survive with no long-term adverse effects. Thus, NMFS anticipates that no eulachon and up to 9,978 juvenile individuals of the salmon and steelhead species[40] considered in the consultation will be captured, per year, and up to 200 juvenile individuals will be injured or killed, per year, (*i.e.*, 2% of 9,978 = 200) as a result of fish capture necessary to isolate in-water construction areas.

Nonetheless, a more expansive estimate of 5% average annual lethal take (*i.e.*, 5% of 9,978 = 499) will be used here to allow for variations in experience and work conditions. Because these fish are from different species that are similar to each other in appearance and life history, and to unlisted species that occupy the same area, it is not possible to assign this take to individual species. NMFS will, however, allocate this take proportionally across recovery domain areas, as it is more practical to predict which fish will be present in these defined areas. Consultation will be reinitiated if the amount or extent of take is exceeded for any domain.

An estimate of the maximum effect that capture and release operations for projects authorized or completed under this opinion will have on the abundance of adult salmon and steelhead in each recovery domain was obtained as follows: A = n(pct), where:

> A = number of adult equivalents "killed" each year
> n = number of projects likely to occur in a recovery domain each year
> p = 132, *i.e.*, number of juveniles to be captured per project
> c = 0.05, *i.e.*, rate of juvenile injury or death caused by electrofishing during capture and release, primarily steelhead and coho salmon. Consistent with observations by Cannon (2008; 2012) and data reported in McMichael *et al.* (1998).[41]
> t = 0.02, *i.e.*, an estimated average smolt to adult survival ratio, see Smoker *et al.* (2004) and Scheuerell and Williams (2005). This is very conservative because many juveniles are likely to be captured as fry or parr, life history stages that have a survival rate to adulthood that is exponentially smaller than for smolts.

The number of projects (n) estimated to be implemented per recovery domain per year under this joint-opinion is expected to be greater than under the 2009 opinions because there are additional restoration categories and this opinion will include Partners Programs in Washington and Idaho. For this opinion, we doubled maximum number of projects completed from 2010 to 2012 under the 2009 opinions. We also doubled the number of projects in Puget Sound based on work by the USFWS-Washington Office Partner Program over that same period. About 60% of the 2010-2012 projects required work area isolation. The effects of work area isolation on the abundance of juvenile or adult salmon or steelhead in any population is likely to be small, no more than five adult-equivalent per year in any recovery domain (Table 33).

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[40] 4,910 (PS) + 475 (WLC) + 2,693 (IC) +1,742 (OC) + 158 (SONCC) = 9,978

[41] In 2007, ODOT completed 36 work area isolation operations involving capture and release using nets and electrofishing; 12 of those operations resulted in capture of 0 Chinook salmon, 345 coho salmon, and 22 steelhead; with an average mortality of 5% (Cannon 2008). Cannon (2012) reported a mortality rate of 4.4% for 455 listed salmon and steelhead captures during 30 fish salvage operations in 2012. No sturgeon or eulachon have been captured as a result of ODOT salvage operations.

Table 33. Estimate of the amount of take by direct capture (*i.e.,* culvert replacements), per year, for projects authorized or carried out under PROJECTS, by NMFS recovery domain. "PS" means Puget Sound; "WLC" means Willamette/Lower Columbia; "IC" means Interior Columbia; "OC" means Oregon Coast; "SONCC" means Southern Oregon/Northern California Coasts; "n" means the estimated number of projects per year (126), 60% of which will require work area isolation.

Type of take	Recovery Domain				
	PS n=62	WLC n=6	IC n=34	OC n=22	SONCC n=2
Juvenile fish captured	4,910	475	2,693	1,742	158
Juvenile fish killed or injured	246	24	135	87	8
"Adult equivalents" killed or injured	4.9	0.5	2.7	1.7	0.2

NMFS does not anticipate that any adult salmon or steelhead or southern DPS eulachon will be captured as a result of work necessary to isolate in-water construction areas. SR sockeye salmon are only present in the mainstem Snake and Columbia rivers in Oregon and Washington. No members of this species will be captured while migrating through these large rivers. Therefore, no incidental take is anticipated or exempted for this species.

Harm due to habitat-related effects

Take caused by the habitat-related effects of this action cannot be accurately quantified as a number of fish because the distribution and abundance of fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by projects that will be completed under the proposed program. Thus, the distribution and abundance of fish within the program action area cannot be attributed entirely to habitat conditions, nor can NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by actions that will be completed under the proposed program. Additionally, there is no practical way to count the number of fish exposed to the adverse effects of the proposed action without causing additional stress and injury. In such circumstances, NMFS uses the causal link established between the activity and the likely changes in habitat conditions affecting the listed species to describe the extent of take as a numerical level of habitat disturbance.

Suspended sediment and contaminants. Near and instream construction activities required for many activities will result in an increase in suspended sediment and contaminants that will cause juvenile fish to move away from the action area.

Salmon, steelhead, and eulachon exposed to suspended sediment are likely to experience gill abrasion, decreased feeding, stress, or be unable to use the action area, depending on the severity of the suspended sediment release. Salmonids and eulachon exposed to petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, are likely to be killed or suffer acute and chronic sublethal effects. Construction activities will also cause a minor increase in fine sediment levels in downstream substrates, temporarily reducing the value of that habitat for spawning and rearing.

For projects involving near- and in-water construction, the extent of take due to suspended sediment and contaminants is best identified as the maximum extent of the turbidity plume generated by construction activities. The distance that take (turbidity) will extend downstream will be proportional to the size of the stream. A turbidity flux will likely be measureable downstream from a nonpoint discharge a proportionately shorter distance in small streams than large streams. Turbidity will also more likely be measureable for a greater distance for project areas that are subject to tidal or coastal scour (Rosetta 2005).

USFWS and NOAA RC will complete and record the following water quality observations to ensure that any increases in suspended sediment do not exceed background levels:

1. Take a turbidity sample using an appropriately and regularly calibrated turbidimeter, or a visual turbidity observation, every 4 hours when work is being completed, or more often as necessary to ensure that the in-water work area is not contributing visible sediment to water, at a relatively undisturbed area approximately 100 feet upstream from the project area, or 300 feet from the project area if it is subject to tidal or coastal scour. Record the observation, location, and time before monitoring at the downstream point.
2. Take a second visual observation, immediately after each upstream observation, approximately 50 feet downstream from the project area in streams that are 30 feet wide or less, 100 feet from the project area for streams between 30 and 100 feet wide, 200 feet from the discharge point or nonpoint source for streams greater than 100 feet wide, and 300 feet from the discharge point or nonpoint source for areas subject to tidal or coastal scour. Record the downstream observation, location, and time.
3. Compare the upstream and downstream observations. If more turbidity or pollutants is/are observed downstream than upstream, the activity will be modified to reduce pollution. Continue to monitor every 4 hours.
4. If the exceedance continues after the second monitoring interval (after 8 hours), the activity will stop until the levels returns to background.

The extent of take will be exceeded if the turbidity plume generated by construction activities is visible above background levels, about a 10% increase in natural stream turbidity, downstream from the project area source as follows: A visible increase in suspended sediment (as estimated using turbidity measurements) 50 feet from the project area in streams that are 30 feet wide or less, 100 feet from the discharge point or nonpoint source of runoff for streams between 30 and 100 feet wide, 200 feet from the discharge point or nonpoint source for streams greater than 100 feet wide, or 300 feet from the discharge point or nonpoint source for areas subject to tidal or coastal scour. If monitoring or inspections show that the pollution controls are ineffective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.

Construction-related disturbance of streambank and channel areas. The best available indicator for the extent of take due to construction-related disturbance of streambank and channel areas is the total length of stream reach that will be modified by construction each year. This variable is proportional to the amounts of harm that each action is likely to cause through short-term degradation of water quality and physical habitat. USFWS and NOAA RC reported for 2010 to 2012 that nearly 9 linear-miles of channel and stream banks were restored on 16 restoration projects, which is roughly 0.56 stream miles per project. These 16 projects represented approximately one-fourth (25%) of the 63 total projects.

In this opinion, about 32 stream bank- and channel-altering actions per year (25% of 126 total projects = 31.5; rounded up to 32) may be funded or carried out under this opinion. Therefore, extent of take for construction-related disturbance of streambank and channel areas is up to 17.92 linear-miles (32 projects x 0.56 miles = 17.92 miles) (94,618 stream-feet) per year.

Application of herbicides to control invasive and non-native plant species. Application of manual, mechanical, biological or chemical plant controls will result in short-term reduction of vegetative cover, soil disturbance, and degradation of water quality, which will cause injury to fish in the form of sublethal adverse physiological effects. This is particularly true for herbicide applications in riparian areas or in ditches that may deliver herbicides to streams occupied by listed salmonids. These sublethal effects, described in the effects analysis for this opinion, will include increased respiration, reduced feeding success, and subtle behavioral changes that can result in predation. Direct measurement of herbicide transport using the most commonly accepted method of residue analysis, *e.g.*, liquid chromatography–mass spectrometry (Pico *et al.* 2004) is burdensome and expensive for the type and scale of herbicide applications proposed. Thus, use of those measurements in this take statement as an extent of take indicator is likely to outweigh any benefits of using herbicide as a simple and economical restoration tool, and act as an insurmountable disincentive to their use for plant control under this opinion. Further, the use of simpler, indirect methods, such as olfactometric tests, do not correlate well with measured levels of the airborne pesticides, and may raise ethical questions (Brown *et al.* 2000) that cannot be resolved in consultation. Therefore, the best available indicator for the extent of take due to the proposed invasive plant control is the extent of treated areas, *i.e.*, less than, or equal to, 10% of the acres of riparian habitat within a 6^{th}-field HUC per year.

In summary, the best available indicators for amount and extent of take for these proposed actions are as follows. For actions that involve:

- ***Capture of juvenile fish during in-water work area isolation*** – The amount of take is 9,978 ESA-listed fish per year.
- ***Visible suspended sediment (turbidity)*** – The extent of take indicator for suspended sediments and contaminants is no more than a 10% increase in natural stream turbidity visible beyond the discharge point or nonpoint source of runoff.
- ***Streambank and channel alteration*** – The extent of take indicator is no more than 17.92 linear-miles (94,618 stream-feet) of streambank and channel alteration per year.
- ***Application of herbicide for invasive and non-native plant control within the riparian area*** – The extent of take indicator is a treated area of up 10% of the acres of riparian habitat within a 6^{th}-field HUC per year.

NMFS assumes that the proposed actions will continue to be distributed among the recovery domains in the same proportion as in the past and has assigned this take to individual recovery domains whenever possible (Table 34).

Table 34. Extent of take indicators for actions authorized or carried out under the PROJECTS, by NMFS recovery domain. "WLC" means Willamette/Lower Columbia; "IC" means Interior Columbia; "OC" means Oregon Coast; "SONCC" means Southern Oregon/Northern California Coasts; "n" means the estimated number of projects per year.

	Recovery Domains				
Extent of Take Indicator	PS n=62	WLC n=6	IC n=34	OC n=22	SONCC n=2
ESA-listed fish captured (number salvaged)	4,910	475	2,693	1,742	158
Visible suspended sediment (turbidity)	10% increase in natural stream turbidity				
Streambank &channel alteration (linear feet)	46,558	4,506	25,532	16,521	1,502
Herbicide applications (acres)	10% of a riparian habitat within a 6th field HUC per year				

2.8.2 Effect of the Take

In Section 2.7, NMFS determined that the level of anticipated take, coupled with other effects of the proposed program, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.8.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). The following measures are necessary and appropriate to minimize the impact of incidental take of listed species from the proposed program.

The USFWS and NOAA RC shall:

1. Minimize incidental take due to authorizing or conducting restoration projects by ensuring that all such projects use the conservation measures described in this opinion, as appropriate.
2. Ensure completion of a comprehensive monitoring and reporting program regarding all restoration projects conducted by the USFWS and NOAA RC.

2.8.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the USFWS and NOAA RC, or any other party affected by these terms and conditions must comply with them to implement the reasonable and prudent measures (50 CFR 402.14). The USFWS and NOAA RC have a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 CFR

402.14). If the following terms and conditions are not complied with, the protective coverage of section 7(o)(2) will likely lapse.

1. To implement reasonable and prudent measure #1 (conservation measures for restoration projects), the USFWS and NOAA RC shall ensure that:
   a. Every action funded or carried out under this opinion will be administered by the USFWS and NOAA RC consistent with conservation measures 1 through 12.
   b. For each action involving construction, conservation measures 13 through 32, as appropriate, will be added as conditions of funding.
   c. For specific types of actions, the USFWS and NOAA RC will apply criteria 33 through 50 as appropriate.

2. To implement reasonable and prudent measure #2 (monitoring and reporting), the USFWS and NOAA RC shall ensure that:
   a. The following notifications and reports (Appendix A) are submitted to NMFS for each project to be completed under this opinion. USFWS notifications and reports are to be submitted electronically to NMFS at usfws.biop.nwr@noaa.gov. NOAA RC's notifications and reports are to be submitted electronically to NMFS at noaarc.biop.nwr@noaa.gov.
      i. Project notification at least 30-days before start of construction (Part 1).
      ii. Project completion within 60-days of end of construction (Part 1 with Part 2 completed).
      iii. Fish salvage within 60-days of work area isolation with fish capture (Part 1 with Part 3 completed).
   b. The USFWS and NOAA RC will each submit a monitoring report to NMFS by February 15 each year that describes the USFWS and NOAA RC efforts to carry out this opinion. The report will include an assessment of overall program activity, a map showing the location and type of each action authorized and carried out under this opinion, and any other data or analyses the USFWS and NOAA RC deem necessary or helpful to assess habitat trends as a result of actions authorized under this opinion.
   c. The USFWS and NOAA RC will each attend an annual coordination meeting with NMFS by March 31 each year to discuss the annual monitoring report and any actions that will improve conservation under this opinion, or make the program more efficient or more accountable.
   d. Failure to provide timely reporting may constitute a modification of this biological opinion that has an effect to listed species or critical habitat that was not considered in the opinion and thus may require reinitiation of this consultation.

2.9 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). The following conservation recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the USFWS and NOAA RC:

- The effectiveness of some types of stream restoration actions are not well documented, partly because decisions about which restoration actions deserve support do not always address the underlying processes that led to habitat loss. NMFS recommends that the USFWS and NOAA RC use species' recovery plans to help ensure that their actions will address those underlying processes that limit fish recovery.
- NMFS also recommends that the USFWS and NOAA RC evaluate web-based reporting to lessen the administrative burden, with the goal of improving completion reporting and tracking of incidental take.

Please notify NMFS if the USFWS or NOAA RC carries out these recommendations so that we will be kept informed of actions that minimize or avoid adverse effects and those that benefit the listed species or their designated critical habitats.

2.10 Reinitiation of Consultation

As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) The amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

2.11 "Not Likely to Adversely Affect" Determination

In this biological opinion, NMFS concludes that the proposed action is not likely to adversely affect southern green sturgeon, southern resident killer whales, or their designated critical habitat. Additionally, the proposed action is not likely to adversely affect Puget Sound/Georgia Basin DPSs of yelloweye rockfish (*Sebastes ruberrimus*), canary rockfish (*Sebastes pinniger*), and bocaccio rockfish (*Sebastes paucispinis*) (and their critical habitat where it has been designated). These conclusions are based on the following considerations:

Puget Sound/Georgia Basin DPSs Yelloweye Rockfish, Canary Rockfish, and Bocaccio Determination. Rockfish fertilize their eggs internally and the young are extruded as larvae. Rockfish larvae are pelagic, often found near the surface of open waters, under floating algae, detached seagrass, and kelp. Juvenile bocaccio and canary rockfish settle into shallow nearshore water on rocky or cobble substrate that support kelp and other macroalgae at 3 to 6 months of age, and move to progressively deeper waters as they grow (Love *et al.* 2002). Juvenile yelloweye rockfish do not typically occupy shallow waters (Love *et al.* 1991) and are very unlikely to be within the action area. Adult yelloweye rockfish, canary rockfish, and bocaccio typically occupy waters deeper than 120 feet (Love *et al.* 2002).

Larval yelloweye rockfish, canary rockfish or bocaccio could occur within the project and action area, though they are readily dispersed by currents after they are born, making the concentration or probability of presence of larvae in any one location extremely small (Kendall and Picquelle 2003). The size of the project and action area where effects could occur to larval ESA-listed rockfish, combined with the short duration of project activities, make it extremely unlikely, and therefore discountable, that a larvae will be present and exposed to project activities. Because all potential adverse effects are discountable, the NMFS concludes that the action may affect, but will not likely adversely affect yelloweye rockfish, canary rockfish, and bocaccio.

Southern DPS Green Sturgeon Determination. Two DPSs have been defined for green sturgeon: a northern DPS (spawning populations in the Klamath and Rogue rivers) and a southern DPS (spawners in the Sacramento River). The southern DPS of green sturgeon was listed as threatened in 2006, and includes all naturally-spawned populations of green sturgeon that occur south of the Eel River in Humboldt County, California. When not spawning, this anadromous species is broadly distributed in nearshore marine areas from Mexico to the Bering Sea. Although it is commonly observed in bays, estuaries, and sometimes the deep riverine mainstem in lower elevation reaches of non-natal rivers along the west coast of North America, the distribution and timing of estuarine use are poorly understood.

The principal factor for the decline of southern green sturgeon is the reduction of its spawning area to a single known population limited to a small portion of the Sacramento River. It is currently at risk of extinction primarily because of human-induced ''takes'' involving elimination of freshwater spawning habitat, degradation of freshwater and estuarine habitat quality, water diversions, fishing, and other causes (USDC 2010). Adequate water flow and temperature are issues of concern. Water diversions pose an unknown but potentially serious threat within the Sacramento and Feather Rivers and the Sacramento River Delta. Poaching also poses an unknown but potentially serious threat because of high demand for sturgeon caviar. The effects of contaminants and nonnative species are also unknown but potentially serious threats. Retention of green sturgeon in both recreational and commercial fisheries is now prohibited within the western states, but the effect of capture/release on these fisheries is unknown. There is evidence of fish being retained illegally, although the magnitude of this activity likely is small (NOAA Fisheries 2011). Climate change, as described in Section 2.2, is likely to reduce the conservation value of designated critical habitats in the Pacific Northwest.

Critical habitat for the southern DPS of green sturgeon was designated in 2009, and the designation includes coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington. Within the action area, this includes the Lower Columbia River estuary and certain coastal bays and estuaries in Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) (USDC 2009b). Table 35 delineates physical and biological features for southern DPS green sturgeon.

Table 35. Physical and biological features of critical habitat for southern green sturgeon and corresponding species life history events.

Physical or Biological Features		Species Life History Event
Site Type	**Site Attribute**	
Freshwater riverine system	Food resources Migratory corridor Sediment quality Substrate type or size Water depth Water flow Water quality	Adult spawning Embryo incubation, growth and development Larval emergence, growth and development Juvenile metamorphosis, growth and development
Estuarine areas	Food resources Migratory corridor Sediment quality Water flow Water depth Water quality	Juvenile growth, development, seaward migration Subadult growth, development, seasonal holding, and movement between estuarine and marine areas Adult growth, development, seasonal holding, movements between estuarine and marine areas, upstream spawning movement, and seaward post-spawning movement
Coastal marine areas	Food resources Migratory corridor Water quality	Subadult growth and development, movement between estuarine and marine areas, and migration between marine areas Adult sexual maturation, growth and development, movements between estuarine and marine areas, migration between marine areas, and spawning migration

Large estuaries are clearly important habitats for green sturgeon (Lindley *et al.* 2011). Southern green sturgeon subadults and adults may enter the action area for non-breeding, non-rearing purposes. Tagged adults and subadults in the San Francisco Bay Estuary occupied shallow depths during directional movements but stayed close to the bottom during non-directional movements, presumably because they were foraging in depths as shallow as 1.7 m (Kelly *et al.* 2007). However, information from fisheries-dependent sampling suggests that green sturgeon only occupy large estuaries during the summer and early fall, and would not be present during the in-water work period (Moser and Lindley 2007), which is generally late-fall to spring in Oregon estuaries (ODFW 2008).

NMFS does not expect green sturgeon to be present in the vicinity of most of the actions covered by this opinion. Impacts from construction to green sturgeon are the same as those described above for salmonids. From 2010 to 2012, the USFWS and NOAA RC only conducted two projects in estuaries (Table 3). Most restoration projects authorized or carried out under this opinion will occur in the upper reaches and tributaries of the larger rivers, or in riparian and wetland areas along the water's edge for estuarine and coastal areas. Green sturgeon congregate in deeper mid-channel areas. Potential projects in estuaries might include fish passage projects, such as tide gate removals, or the removal or setback of existing berms, dikes, and levees, and the removal of pilings. While these projects may release a small amount of suspended sediment temporarily, the long-term effects on water quality are beneficial.

Because of their age, location, and life history, green sturgeon individuals are relatively distant from, and insensitive to, the effects of the actions described above, and those effects are unrelated to the principal factor for the decline of this species, *i.e.*, the reduction of its spawning area in the Sacramento River. Adult and subadult green sturgeon are likely to be far less sensitive to suspended sediment and deposition than salmonids, and will not be present in the tributaries where the vast majority of the activities will occur. The NMFS is also reasonably certain that elevated suspended sediment concentrations will result in insignificant behavioral and physical responses in green sturgeon due to its higher tolerance of these effects, since green sturgeon usually inhabit much more turbid environments than salmonids.

NMFS believes that it is unlikely that green sturgeon will be encountered during work area isolation and fish salvage for implementation of these projects based on: 1) monitoring information from previous fish salvage operations associated with similar projects; 2) the large size of subadult and adult southern green sturgeon; and 3) the type and location of projects typically funded.

Effects to green sturgeon would primarily result from impacts associated with general disturbance related to in-water construction. However, green sturgeon are unlikely to occur in the vicinity of any projects implemented under this opinion, and are accustomed to the level of background activity associated with the proposed action. NMFS does not expect impacts to accrue from the other activities considered in this opinion.

Based on this analysis, NMFS finds that the effects of the proposed action are expected to be insignificant and/or discountable, and thus are not likely to adversely affect the southern DPS of green sturgeon or their critical habitat.

Southern Resident Killer Whale Determination. Southern Resident killer whales spend considerable time in the Georgia Basin from late spring to early autumn, with concentrated activity in the inland waters of Washington State around the San Juan Islands, and typically move south into Puget Sound in early autumn (NMFS 2008d). Pods make frequent trips to the outer coast during this season. In the winter and early spring, Southern Resident killer whales move into the coastal waters along the outer coast from the Queen Charlotte Islands south to central California, including coastal Oregon and off the Columbia River, although they do not have critical habitat designated in Oregon (NMFS 2008d).

No documented sightings exist of Southern Resident killer whales in coastal bays, and there is no documented pattern of predictable Southern Resident occurrence along the outer coast, and any potential occurrence would be infrequent and transitory. Southern Residents primarily eat salmon and prefer Chinook salmon (Hanson *et al.* 2010; NMFS 2008d).

The proposed program may affect the quantity of the Southern Resident killer whale's preferred prey, Chinook salmon. Any salmonid take including Chinook salmon up to the aforementioned amount and extent of take will result in an insignificant reduction in adult equivalent prey resources for Southern Resident killer whales that may intercept these species within their range.

NMFS finds that any affect the proposed program may have on Southern Resident killer whales, including indirect effects on their prey, is likely to be discountable, insignificant or beneficial. Therefore, NMFS finds that the proposed program may affect, but is not likely to adversely affect Southern Resident killer whales.

3.0 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirement of section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

3.1 Essential Fish Habitat Affected by the Project

This analysis is based, in part, on the EFH assessment provided by the Federal action agency and descriptions of EFH contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce for EFH species, including groundfish (PFMC 2005); coastal pelagic species (PFMC 1998); and Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for various life-history stages of Chinook and coho salmon; groundfish; and coastal pelagic species. In addition, the following HAPCs are present in the action area: estuarine and seagrass areas.

3.2 Adverse Effects on Essential Fish Habitat

While the ESA portion of this document determined that water quality and physical habitat effects were discountable or insignificant to salmon, groundfish, and coastal pelagic species habitat, we conclude that the proposed action may adversely affect EFH for these species. We conclude that the following adverse effects on EFH designated for 49 species of Pacific Coast groundfish, five coastal pelagic species, pink, coho, and Chinook salmon are reasonably certain to occur:

1. Freshwater EFH quantity will be reduced due to short-term construction effects, including increased riparian soil compaction and runoff. Freshwater EFH quantity will increase slightly over the long-term due to improved riparian function and floodplain connectivity.
2. Freshwater EFH quality will be reduced due to a short-term release of suspended sediment, increased dissolved oxygen demand, and increased water temperature due to

riparian and channel disturbance. These conditions will improve over the long term due to improved riparian function and floodplain connectivity.

3. The quality of tributary substrate will be reduced in the short term due to increased compaction and sedimentation, and will increase over the long term due to gravel placement, and increased sediment storage from boulders and LW.
4. Floodplain connectivity will decrease in the short-term due to increased compaction and riparian disturbance during construction, and a will improve over the long term due to off- and side channel habitat restoration, set-back of existing berms, dikes, and levees, and removal of water control structures.
5. Forage availability will decrease in the short term due to riparian and channel disturbance, and improve over the long term due to improved habitat diversity and complexity, and improved riparian function and floodplain connectivity.
6. Natural cover will decrease in the short term due to riparian and channel disturbance, and increase in the long term due to improved habitat diversity and complexity, improved riparian function and floodplain connectivity, and off- and side channel habitat restoration.
7. Fish passage will be impaired in the short term due to decreased water quality and in-water work isolation, and improved over the long-term due to improved water quantity and quality, habitat diversity and complexity, forage, and natural cover.
8. Estuarine and nearshore EFH quality will be temporarily reduced due to short-term releases of suspended sediment, benthic disturbance, and damage to submerged aquatic vegetation.
9. Localized, short-term increase in creosote-associated contaminants from the removal of treated-wood materials, including piles. Affected habitat includes:
    - water column
    - substrate
    - benthic productivity
    - prey
    - estuary (HAPC)
10. Short-term decrease in water quality, fish passage, and natural cover from the shellfish bed restoration, beach nourishment, and piling and structure removal activities in estuary and nearshore habitat. Affected habitat includes:
    - water column
    - estuary (HAPC)

3.3 Essential Fish Habitat Conservation Recommendations

The following three conservation recommendations are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH:

1. The effectiveness of some types of stream restoration actions are not well documented, partly because decisions about which restoration actions deserve support do not always address the underlying processes that led to habitat loss. NMFS recommends that the USFWS and NOAA RC use species recovery plans to help ensure that their actions will address the underlying processes that limit fish recovery.

2. NMFS also recommends that the USFWS and NOAA RC evaluate whether the regulatory streamlining provided by this opinion influences the design of restoration actions, or acts as an incentive that increases the likelihood that restoration actions will be completed.
3. As appropriate to each action issued a regulatory permit under this opinion, NMFS recommends that the USFWS and NOAA RC include the PDC for administration, construction, and types of actions as enforceable permit conditions.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Federal action agencies must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation from NMFS. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations, unless NMFS and the Federal action agency have agreed to use alternative time frames for the Federal action agency response. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS Conservation Recommendations, the Federal action agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects, 50 CFR 600.920(k)(1).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The Federal action agencies (USFWS and NOAA RC) must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations, 50 CFR 600.920(l).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users are the Federal action agencies (USFWS and NOAA RC). An individual copy was provided to the USFWS and NOAA RC. This consultation will be posted on the NMFS West Coast Region website (http://www.westcoast.fisheries.noaa.gov/). The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

***Information Product Category*:** Natural Resource Plan.

***Standards*:** This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01, *et seq*., and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

***Best Available Information*:** This consultation and supporting documents use the best available information, as referenced in the Literature Cited section. The analyses in this opinion/EFH consultation contain more background on information sources and quality.

***Referencing*:** All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

***Review Process*:** This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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Appendix A: PROJECTS Programmatic Email Guidelines and Implementation Forms

Use the USFWS or NOAA RC Programmatic email box (usfws.biop.nwr@noaa.gov or noaarc.biop.nwr@noaa.gov) to transmit the following information to NMFS regarding use of this Programmatic Biological Opinion (opinion):

Send only one project per email submittal, attach all related documents preferably in *pdf* format; and ensure the final project is being submitted to avoid multiple submittals and withdrawals. Please send:

1. Action Implementation Form, containing Action Notification and Action Completion and Fish Salvage reports (if fish salvage is conducted).
2. Map(s) and project design drawings (if applicable)
3. Final project plan.

If a withdrawal is necessary, please specify in the email subject line that the project is being withdrawn. Simply state the reason for the withdrawal and submit to the email box, following the email titling conventions. If a previously-withdrawn notification is resubmitted later, this resubmittal will be regarded as a new action notification.

An automatic reply will be sent upon receipt, but no other communication will be sent from the programmatic email box; this box is used for **Incoming Only**. All other pre-decisional communication should be conducted **outside** the use of the usfws.biop.nwr@noaa.gov and noaarc.biop.nwr@noaa.gov email boxes.

In the subject line of the email (see below for requirements), clearly identify the specific submittal category (action notification, project completion, withdrawal, or salvage report), and the Restoration Center Database number. The submitted documents will contain identifying information, including the Applicant Name, County, Waterway, and State.

Email Titling Conventions

Use caution when entering the necessary information in the subject line. **If these titling conventions are not used, the email will not be accepted.** Ensure that you clearly identify:

1. The specific submittal category: (a) Action Notification; (b) Action Completion Report; (c) Fish Salvage Report; or (d) Annual Report
2. USFWS or Restoration Center Database number
3. Applicant Name
4. County
5. Waterway
6. State

PROJECTS Implementation Forms

NMFS Review and Approval. USFWS or NOAA RC project managers shall submit this form with the Action Notification portion completed to NMFS at usfws.biop.nwr@noaa.gov and noaarc.biop.nwr@noaa.gov for notification or approval.

The Following Actions Require Approval from NMFS as consistent with PROJECTS before that action is authorized:

- Modification or variance of any requirement for fish passage restoration (PDC 7)
- Fish screen review for pump intakes that exceeds 3 cfs (PDC 27)
- Installation of pilings (PDC 30)
- Culverts and bridges that do not meet width standards (PDC 33c)
- Grade control, stream stability, or headcut countermeasures (PDC 33d.ii)
- Fish ladders and channel-spanning non-porous structures (PDC 33e)
- Irrigation diversion replacement/relocation (PDC 33f)
- Fish screen installation/replacement (PDC 33f)
- Engineered log jams (ELJs) that occupy > 25% of the bankfull area (PDC 34 b)
- Constructed or engineered riffles (PDC 34c)
- Dam removal projects (35a)
- Channel reconstruction/relocation (36)
- Off- and side-channel reconstruction >20% of the bankfull flow (37)
- Alluvium placement that occupies >25% of the channel bed or >25% of the BF cross sectional area (38d)
- LW placement that occupies >25% of the bankfull cross section (38e)
- Beach nourishment projects (43c)
- Tide/flood gate removal, replacement or retrofit projects (50)

NMFS will notify the USFWS or NOAA RC within 30 calendar days if the action is approved or disqualified. When requested, NMFS will provide an estimate of the time necessary to complete the review based on the complexity of the proposed action and work load considerations at the time of the request. Approval may be delayed if a substandard design is submitted for review during the post-design or action implementation stage and significant revision is necessary. These reviews are best initiated in the context of informal consultation during the preliminary development project phase, when project team members are developing goals and objectives with stakeholders.

Attach information to e-mail message if required or relevant to NMFS' review, such as:

- Erosion and pollution control plan
- Engineering designs

Project Reporting. The project manager shall submit the following reports as necessary:
Action Completion Reporting. Submit this form to NMFS within 60 days of completing all work below ordinary high water (OHW).
Fish Salvage Reporting. Submit this form to NMFS within 60 days of completing a capture and release as part of an action completed under PROJECTS.

The usfws.biop.nwr@noaa.gov and noaarc.biop.nwr@noaa.gov email boxes are to be used for **incoming only**.

PROJECTS Action Notification Form

DATE OF REQUEST:		**NMFS TRACKING #: NWR-2013-9717**	
TYPE OF REQUEST:	☐ ACTION NOTIFICATION (NO APPROVAL) ☐ ACTION NOTIFICATION (APPROVAL REQUIRED)		
Statutory Authority:	☐ ESA-ONLY	☐ EFH-ONLY	☐ ESA & EFH COMBINED
Lead Action Agency:	☐ **USFWS**	☐ **NOAA RC**	
Action Agency Contact:		Action ID #:	
Project Name:			
6th Field HUC & Name:			
Latitude & Longitude Longitude (in signed degrees format: DDD.dddd)			
Proposed Construction Period:	***Start Date:***	***End Date:***	
Proposed Length of Channel and/or Riparian Modification in linear feet:			
Proposed Area of Herbicide Application in acres:			

Project Description:

Type of Action: *Identify the type of action proposed.*

- ☐ Fish Passage Restoration (Stream Simulation Culvert and Bridge Projects; Headcut and Grade Stabilization; Fish Ladders; Irrigation Diversion Replacement/Relocation and Screen Installation/Replacement)
- ☐ Large Wood (LW), Boulder, and Gravel Placement; Engineered Logjams (ELJ); Constructed Riffles, Porous Boulder Weirs and Vanes; Gravel Augmentation; Tree Removal for LW Projects
- ☐ Dam and Legacy Structure Removal
- ☐ Channel Reconstruction/Relocation
- ☐ Off- and Side-Channel Habitat Restoration
- ☐ Streambank Restoration
- ☐ Set-Back or Removal of Existing Berms, Dikes, and Levees
- ☐ Reduction/Relocation of Recreation Impacts
- ☐ Livestock Fencing, Stream Crossings and Off-Channel Livestock Watering
- ☐ Piling and other Structure Removal
- ☐ Shellfish Bed/Nearshore Habitat Restoration
- ☐ In-channel Nutrient Enhancement
- ☐ Road and Trail Erosion Control and Decommissioning
- ☐ Juniper Removal
- ☐ Riparian Vegetative Planting
- ☐ Bull Trout Protection
- ☐ Beaver Habitat Restoration
- ☐ Wetland Restoration
- ☐ Tide Gate Removal, Replacement, or Retrofit

NMFS Species/Critical Habitat Present in Action Area: *Identify the species and critical habitats present in the action area (N/A means not applicable):*

Species	*Critical Habitat*		*EFH Species*
☐	☐	LCR Chinook salmon	☐ Salmon, Chinook
☐	☐	UWR Chinook salmon	☐ Salmon, coho
☐	☐	UCR spring-run Chinook salmon	☐ Salmon, pink
☐	☐	SR spring/summer-run Chinook salmon	☐ Coastal Pelagics
☐	☐	SR fall-run Chinook salmon	☐ Groundfish
☐	☐	PS Chinook salmon	
☐	☐	CR chum salmon	
☐	☐	HC summer-run chum salmon	
☐	N/A	LCR coho salmon	
☐	☐	OC coho salmon	
☐	☐	SONCC coho salmon	
☐	☐	LO sockeye salmon	
☐	☐	SR sockeye salmon	
☐	☐	LCR steelhead	
☐	☐	UWR steelhead	
☐	☐	MCR steelhead	
☐	☐	UCR steelhead	
☐	☐	SRB steelhead	
☐	N/A	PS steelhead	
☐	☐	Southern DPS eulachon	

Terms and Conditions: *Check the terms and conditions from the biological opinion that will be included as conditions for any action funded or carried out under this opinion.*

Administration

- ☐ USFWS/NOAA RC review
- ☐ Restoration Review Team review
- ☐ Request for NMFS review
- ☐ Site access
- ☐ Site assessment for contaminants
- ☐ Funding conditions
- ☐ Fish Salvage notice

General Construction Measures

- ☐ Flagging sensitive areas
- ☐ Temporary access roads and paths
- ☐ In-water work period
- ☐ Fish Capture and release
- ☐ Construction water
- ☐ Vehicle staging and use
- ☐ Work from top of bank
- ☐ Staging, Storage, and Stockpile Areas
- ☐ Dust Abatement
- ☐ Surveys
- Piling installation or removal
- ☐ Temporary erosion controls
- ☐ Fish passage
- ☐ Work area isolation
- ☐ Electrofishing
- ☐ Fish screens
- ☐ Choice of equipment
- ☐ Stationary power equipment
- ☐ Site restoration
- ☐ Temporary Stream Crossings
- ☐ Revegetation

Invasive and non-native plant control

- ☐ Non-herbicide methods
- ☐ Required herbicide buffer distances
- ☐ Herbicide transportation and safety plan
- ☐ Approved herbicide adjuvants
- ☐ Approved dye
- ☐ Approved herbicide application rates
- ☐ Approved application methods
- ☐ Power equipment
- ☐ Herbicide applicator qualifications
- ☐ Approved herbicides
- ☐ Approved herbicide carriers
- ☐ Herbicide mixing
- ☐ Minimize herbicide drift and leaching

Types of Restoration Actions

Fish Passage Restoration

- ☐ Stream Crossing
- ☐ Stabilize Headcut
- ☐ Irrigation Diversion
- ☐ Fish Ladder
- ☐ Screen Installation/Replacement
- ☐ Grade Stabilization

Large Wood, Boulder, and Gravel Placement

- ☐ Large Wood or Boulders
- ☐ Constructed Riffles
- ☐ Gravel Augmentation
- ☐ Engineered Logjams
- ☐ Porous Boulder Structures and Vanes
- ☐ Tree Removal for LW Projects

Dam and Legacy Structure Removal

- ☐ Dam Removal
- ☐ Legacy Structure Removal

Channel Reconstruction/Relocation

- ☐ Design Guidance
- ☐ Monitoring and adaptive plan
- ☐ Project documentation

Off- and Side Channel Habitat Restoration

- ☐ Review and approve
- ☐ Allowable excavation
- ☐ Data requirements

Streambank Restoration

- ☐ Streambank shaping
- ☐ Large wood
- ☐ Planting or installing vegetation
- ☐ Fencing
- ☐ Soil reinforcement
- ☐ Use of rock in streambank restoration
- ☐ Fertilizer

Set-Back or Removal of Existing Berms, Dikes, and Levees

- ☐ Floodplains and Freshwater Deltas
- ☐ Estuary Restoration

Livestock Stream Crossings and Off-Channel Livestock Watering Facilities

- ☐ Livestock stream crossings
- ☐ Livestock Fencing
- ☐ Off-channel watering facilities

Shellfish Bed/Nearshore Habitat Restoration

- ☐ Replace shoreline armor
- ☐ Shell source and methods
- ☐ Beach nourishment plan approved by NMFS
- ☐ Minimize impact to aquatic vegetation

Road and Trail Erosion Control and Decommissioning

- ☐ Road Decommissioning/ Stormproofing
- ☐ Road Relocation

Juniper Tree Removal

- ☐ Approved juniper tree removal methods
- ☐ Management of juniper slash

Beaver Habitat Restoration

- ☐ In-channel structures
- ☐ Habitat Restoration

Tide/Flood Gate Removal, Replacement, or Retrofit

- ☐ Removal
- ☐ Retrofit
- ☐ Culvert or bridge
- ☐ Design Approved by NMFS
- ☐ Replacement
- ☐ Dike breach or setback
- ☐ Monitoring/Adaptive Management Plan

PROJECTS Action Completion Reporting Form

Within 60 days of completing all work below ordinary high water (OHW) as part of an action completed under PROJECTS, submit the completed Action Completion Form with the following information to NMFS at usfws.biop.nwr@noaa.gov or noaarc.biop.nwr@noaa.gov.

Actual Start and End Dates for the Completion of In-water Work:	***Start*:**	***End*:**
Actual Linear-feet of Riparian and/or Channel Modification:		
Actual Acreage of Herbicide Treatment		
Turbidity Monitoring/Sampling Completed	☐ Yes (include details below)	☐ No

Please include the following:

1. Photos of habitat conditions before, during, and after action completion.
2. A summary of the results of pollution and erosion control inspections, including any erosion control failure, contaminant release, and correction effort.
3. Records of turbidity monitoring (visual or by turbidimeter) including dates, times and location of monitoring. Include any exceedances and steps taken to reduce turbidity observed.

PROJECTS Fish Salvage Reporting Form

If applicable: Within 60 days of completing a capture and release as part of an action completed under PROJECTS, submit a complete Salvage Reporting Form, with the following information to NMFS at usfws.bio.nwr@noaa.gov or noaarc.biop.nwr@noaa.gov.

Date(s) of Fish Salvage Operation(s): ______________________

Supervisory Fish Biologist: ______________________

Address ______________________

Telephone Number ______________________

Describe methods that were used to isolate the work area and remove fish

Fish Salvage Data

Water Temperature:

Air Temperature:

Time of Day:

ESA-Listed Species	Number Handled		Number Injured		Number Killed	
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult
Lower Columbia River Chinook salmon						
Upper Willamette River Chinook salmon						
Upper Columbia River spring-run Chinook salmon						
Snake River spring/summer run Chinook salmon						
Snake River fall-run Chinook salmon						
Puget Sound Chinook salmon						
Lake Ozette sockeye salmon						
Columbia River chum salmon						
Lower Columbia River coho salmon						
Oregon Coast coho salmon						
Southern Oregon/Northern California Coasts coho salmon						
Snake River sockeye salmon						
Lake Ozette sockeye salmon						
Lower Columbia River steelhead						
Upper Willamette River steelhead						
Middle Columbia River steelhead						
Upper Columbia River steelhead						
Snake River Basin steelhead						
Eulachon						