UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to NOAA Fisheries No.:
2004/01043

November 30, 2004

Mr. Lawrence Evans
U.S. Army Corps of Engineers, Portland District
ATTN: Ms. Judy Linton
P.O. Box 2946
Portland, Oregon 97208-2946

Mr. Robert Willis
U.S. Army Corps of Engineers, Portland District
ATTN: Mr. Kim Larson
P.O. Box 2946
Portland, Oregon 97208-2946

Mr. Thomas Mueller
U.S. Army Corps of Engineers, Seattle District
ATTN: Marcy Reed
P.O. Box 3755
Seattle, Washington 98124-2255

Re: Programmatic Biological and Conference Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Revised Standard Local Operating Procedures for Endangered Species (SLOPES III) to Administer Certain Activities Authorized or Carried Out by the Department of the Army in the State of Oregon and on the North Shore of the Columbia River

Dear Mr. Evans, Mr. Willis, and Mr. Mueller:

The enclosed document contains a biological and conference opinion (Opinion) prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) pursuant to section 7(a)(2) of the Endangered Species Act (ESA) on the effects of implementing the second proposed revision to the standard local operating procedures (SLOPES) for certain Department of Army (Corps) activities in Oregon and the north shore of the Columbia River. Actions covered in this Opinion are modified and expanded from those analyzed in the biological opinions[1] issued on June 14, 2002 and July 8, 2003, as summarized in the Consultation History section of this Opinion. Other proposed revisions are intended to refine and simplify the existing SLOPES framework.

In this Opinion, NOAA Fisheries concludes that the proposed action is not likely to jeopardize the continued existence of the Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Willamette River (UWR) Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer-run Chinook salmon, SR fall-run Chinook salmon, Columbia River chum salmon (*O. keta*), Southern Oregon/Northern California coho salmon (*Oncorhynchus kisutch*), SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), UWR steelhead, Middle Columbia River steelhead, UCR steelhead, or SR Basin steelhead, or result in the destruction or adverse modification of critical habitat designated for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SONC coho salmon, or SR sockeye salmon. Further, NOAA Fisheries concludes that the proposed action is not likely to jeopardize the continued existence of Oregon Coast coho salmon or LCR coho salmon, species which are proposed for listing as threatened under the ESA.

As required by section 7(a)(4) of the ESA, NOAA Fisheries included an Incidental Take Statement with Terms and Conditions that NOAA Fisheries believes are necessary to minimize the impact of taking caused by this action. The action agency and applicant, if any, must comply with these Terms and Conditions for exemption from the prohibition against taking in section 7(o) to apply.

This document also presents the results of our consultation on the proposal's effect on essential fish habitats (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes conservation recommendations to avoid, minimize, or otherwise offset likely adverse effects to EFH. Section 305(b)(4)(B) of the MSA requires Federal agencies to provide a detailed written response to NOAA Fisheries 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.

---

[1] NOAA Fisheries, Programmatic Biological Opinion and Magnuson-Stevens Act Essential Fish Habitat Consultation for Standard Local Operating Procedures for Endangered Species (SLOPES) for Certain Activities Requiring Department of Army Permits in Oregon and the North Shore of the Columbia River (SLOPES I) (June 14, 2002, NOAA Fisheries No.: 2002/00976) and Programmatic Biological Opinion and Magnuson-Stevens Act Essential Fish Habitat Consultation for Standard Local Operating Procedures for Endangered Species (SLOPES II) for Certain Activities Requiring Department of Army Permits in Oregon and the North Shore of the Columbia River (July 8, 2003, NOAA Fisheries No.: 2003/00850).

If you have any questions regarding this consultation, please contact Marc Liverman at 503-231-2336 or Ben Meyer at 503-230-5425, of my staff in the Oregon State Habitat Office, or Dan Guy at 360-534-9342, of my staff in the Washington State Habitat Office.

Sincerely,

Russell M Strach for

D. Robert Lohn
Regional Administrator

CC: Lyndsay Ball, ODFW
Ken Bierly, OWEB
David Cox, FHWA
Bob Graham, NRCS
Ann Hanus, ODSL
Kemper McMaster, USFWS
Bruce Warner, ODOT

Endangered Species Act - Section 7 Consultation
Programmatic Biological Opinion and Conference Opinion

&

Magnuson-Stevens Fishery Conservation and Management Act
Essential Fish Habitat Consultation

Revised Standard Local Operating Procedures for Endangered Species (SLOPES III) to Administer Certain Activities Authorized or Carried Out by the Department of the Army in the State of Oregon and on the North Shore of the Columbia River

Agency: Army Corps of Engineers,
Portland District, Operations and Regulatory Branches
Seattle District, Regulatory Branch

Consultation Conducted By: NOAA's National Marine Fisheries Service,
Northwest Region

Date Issued: November 30, 2004

Issued by: Russell M Strach for
D. Robert Lohn
Regional Administrator

Refer to: **2004/01043**

TABLE OF CONTENTS

INTRODUCTION

This document prepared by NOAA's National Marine Fisheries Service (NOAA Fisheries) includes a biological and conference opinion (Opinion) and Incidental Take Statement in accordance with section 7(b) the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, *et seq*.), and implementing regulations at 50 C.F.R. 402, but does not rely on the regulatory definition of "adverse modification or destruction" of critical habitat recently at issue in the 9th Circuit Court of Appeals case *Gifford Pinchot Task Force, et. al, vs. U.S. Fish and Wildlife Service,* No. 03-35279, August 6, 2004. The essential fish habitat (EFH) consultation was prepared 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 C.F.R. 600. The administrative record for this consultation is on file at the Oregon State Habitat Office, Portland, Oregon.

Background and Consultation History

The U.S. Army Corps of Engineers (Corps), Portland and Seattle Districts, proposes to revise the "Standard Local Operating Procedures for Endangered Species" (SLOPES). "SLOPES" refers to the process and criteria that the Corps uses to guide the administration of certain activities regulated under section 10 of the Rivers and Harbors Act of 1899 and section 404 of the Clean Water Act, or carried out by the Corps as part of civil works programs authorized by sections 206, 536, and 1135 of the Water Resources Development Act.

Structures or work outside the limits defined for navigable waters of the United States require a section 10 permit if the structure or work affects the course, location, or condition of the waterbody. The law applies to any dredging or disposal of dredged material, excavation, filling, rechannelization, or any other modification of a navigable water of the United States, and applies to all structures, from the smallest floating dock to the largest commercial undertaking. It further includes, without limitation, any wharf, dolphin, weir, boom, breakwater, jetty, groin, bank stabilization, mooring structures (such as pilings), aerial or subaqueous power transmission lines, intake or outfall pipes, permanently moored floating vessel, tunnel, artificial canal, boat ramp, aids to navigation, and any other permanent or semi-permanent obstacle or obstruction.

Section 404 of the Clean Water Act requires authorization from the Secretary of the Army, acting through the Corps, for the discharge of dredged or fill material into all waters of the United Stated, including adjacent wetlands. Discharges of fill material generally include, without limitation: (1) Placement of fill that is necessary for the construction of any structure, or impoundment requiring rock, sand, dirt, or other material for its construction; (2) site-development fills for recreational, industrial, commercial, residential, and other uses; (3) causeways or road fills; (4) dams and dikes; artificial islands; (5) property protection or reclamation devices such as riprap, groins, sea walls, breakwaters, and revetments; (6) beach nourishment; (7) levees; (8) fill for intake and outfall pipes and subaqueous utility lines; (9) fill associated with the creation of ponds; and (10) other work involving the discharge of fill or dredged material. A Corps permit is required whether the work is permanent or temporary. Examples of temporary discharges included dewatering of dredged material before final disposal, and temporary fills for access roadways, cofferdams, storage and work areas.

The Portland District of the Corps issues on average between 600 and 800 permits for these types of activities each year. Nearly all anadromous fish-bearing streams within this area are occupied by ESA-listed species and designated as EFH. The requirements for ESA and EFH consultation on these permits has resulted in a substantial workload for both the Corps and NOAA Fisheries, often with little additional benefit to the species. Many of these activities are minor and repetitive in nature and consultation on them has resulted in standardized requirements for regulatory approval.

Since March 21, 2001, the Portland District has used SLOPES as conditioned in the Programmatic Biological Opinion to guide its review of individual permit requests under section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act.[2] That Opinion was revised on June 14, 2002, amended on August 14, 2002, and revised again on July 8, 2003.[3] Under SLOPES, applications for proposed actions that the Corps finds to be within the range of effects considered in the July 8, 2003 Opinion are issued a permit with conditions. Applications found not be within this range of effects are submitted to NOAA Fisheries for additional site specific ESA and EFH consultation.

Under SLOPES, the Corps is required to provide an annual monitoring report. The report is intended to be a summary of project data and a description of program participation, the quality of supporting analyses, monitoring information, compensatory mitigation provided by permittees, trends in the environmental baseline, and recommendations to improve the effectiveness of the program. In reports submitted for 2001 and 2002, the Corps identified a total of 313 permits that have been issued using SLOPES (Table 1). The number of permits issued grew slightly in 2002, with streambank stabilization, stream and wetland restoration, and recreational boating facilities accounting for most of the increase. The number of permits increased again, with 254 issued in 2003. The types of permits issued were similar to that of 2002, with streambank stabilization and recreational boating facilities having large numbers. Road maintenance/construction numbers doubled in 2003, becoming the permit most often issued under SLOPES.

The Corps completed inspections on 58 projects authorized before July 1, 2002. Of those, 14 projects were complete, 14 had not started, the rest were partially complete. The Corps also confirmed that the quality of information provided in required project-level monitoring reports is adequate to demonstrate compliance with permit requirements.

---

[2] NOAA Fisheries. 2001. Programmatic Biological Opinion – 15 Categories of Activities Requiring Department of the Army Permits. (March 21, 2001) (refer to:OSB2001-0016).

[3] Letter from D. Robert Lohn, NOAA Fisheries, to Lawrence Evans and Thomas Mueller, U.S. Army Corps of Engineers (August 14, 2002) (Amending Terms and Conditions for SLOPES issued June 14, 2002).

Table 1. Number of Corps Permits Issued Within the Action Area by Activity Type

ACTIVITY	2001 (n = 143)[4]	2002 (n = 170)	2003 (n=254)
Site Preparation for Construction of Buildings	0	3	4
Streambank stabilization	19	29	51
Stream and Wetland Restoration	0	8	24
Water Control Structures	4	9	5
Road Construction, Repairs and Improvements	47	43	81
Utility Lines	18	18	22
Over and In-water Structures	24	32	46
Minor Discharge and Excavation	22	16	17
Maintenance Dredging	9	11	2
Return Water from Upland Disposal Sites	0	1	0
Survey and Exploration (2003 first year)			2

If permits issued using SLOPES are arranged by geographic areas corresponding to recovery planning domains and the currently listed ESUs they contain, 56% were in the Willamette/ Lower Columbia area, 26% were in the Oregon Coast area, 11% were within the Interior Columbia, and 6% were within the Southern Oregon/Northern California Coasts area (Table 2).[5] Most projects were authorized for the Willamette Valley. This pattern reflects the higher level of economic activity that takes place in the Willamette/ Lower Columbia coastal geographic areas compared with the part of the much larger Interior Columbia area, home for the most endangered ESUs (*i.e.*, Upper Columbia River Chinook, Upper Columbia River steelhead and Snake River sockeye). As in previous years, the Willamette/Lower Columbia area had the most permits (49%), followed by Oregon Coast (25%), Southern Oregon/Northern California (16%) and Interior Columbia (10%).

---

[4] In 2001, permit activity on the north shore of the Columbia River consisted of four minor discharge and excavation projects and an unknown number of restoration actions in 2001. Those actions are included in this total although the north shore was not part of the SLOPES action area until 2002 to provide a more complete baseline from which to measure permits that may be covered in the future. In 2002, seven permits for actions on the north shore were issued under SLOPES for the following types of actions: one utility line, four recreational boating facilities, and two maintenance dredging.

[5] See, NOAA Fisheries, Northwest Salmon Recovery Planning, at http://research.nwfsc.noaa.gov/cbd/trt/index.html.

Table 2. Number of Corps Permits Issued Within the Action Area by Geographic Domain

GEOGRAPHIC DOMAIN	ESUs AFFECTED	2001 (n = 143)	2002 (n = 170)	2003 (n=254)
Willamette/Lower Columbia	LCR Chinook, UWR Chinook, CR chum, LCR steelhead, UWR steelhead	92	96	124
Interior Columbia	SR fall-run Chinook, SR spring/ summer-run Chinook, UCR spring-run Chinook, SR sockeye, UCR steelhead, SR Basin steelhead, MCR steelhead	21	19	26
Oregon Coast	OC coho	13	44	63
Southern Oregon/ Northern California Coasts	SONC coho	17	11	41

Experiences of the Corps and NOAA Fisheries during administration of the July 8, 2003 Opinion and results of the annual monitoring conference showed that permit applicants and others found the interpretation of some provisions unclear or impractical. Moreover, NOAA Fisheries has completed programmatic consultation on actions that require Department of Army permits but that were not analyzed in the previous Opinions that suggested additional opportunities to broaden the range of activities covered by SLOPES process.[6]

By design, SLOPES serves as a fundamental forum for informal and formal consultation between NOAA Fisheries, the Corps, and applicants for Corps permits regarding ways to reduce or remove the adverse effects of regulated actions on ESA-listed species, designated critical habitat, and EFH. The delivery of technical assistance for administration of individual projects under SLOPES, interagency training in the use of SLOPES, the SLOPES annual review process, and many individual consultations beyond the range of actions authorized by SLOPES have all been informed by this Opinion, and thus helped to ensure that SLOPES will continue to be adaptive, accountable, and credible as a conservation and regulatory tool. Over the years, the Federal Highways Administration, Natural Resources Conservation Service, Oregon Division of State Lands, Oregon Marine Board, Oregon Watershed Enhancement Board, Oregon Public Ports Association, port authorities, and others with a substantial and recurrent stake in the Corps' regulatory program have made major contributions to this process.

Sometimes, requests by those action agencies for separate programmatic consultations were collected into SLOPES. This was possible because the Corps consented to act as the lead

[6] Letter from Lawrence C. Evans, U.S. Army Corps of Engineers, to Michael Crouse, NOAA Fisheries, (December 26, 2002) (requesting programmatic consultation for maintenance and restoration activities conducted by port authorities and commercial/industrial organizations). See, also, NOAA Fisheries (2003).

agency, and this Opinion already encompassed analyses of effects of those actions and corresponding measures to minimize take, or could be easily expanded to do so (*e.g.*, activities related to geological drilling and surveying; maintenance of boat docks, commercial marinas, ports, and roads; regulatory streamlining; stream and wetland restoration). This helped to ensure that SLOPES is based on the highest quality science and strong, collaborative partnerships, and will continue to yield the highest degree of conservation effectiveness and regulatory efficiency.

In this way, NOAA Fisheries and the Corps have examined the shared characteristics of many regulatory actions with similar effects and identify those types of actions whose environmental effects are minor, repetitive, and predictable. These individual actions also have similar requirements for regulatory approval and, beyond confirmation that each project meets applicable constraints on design and the use of conservation practices, do not reward additional analysis or deliberation with further conservation benefits. NOAA Fisheries and the Corps have used this information in SLOPES to set clear expectations and achieve consistent outcomes that, with other important regulatory initiatives, have significantly reduced conflict over listed species and regulatory actions, thus improving public relations and creating new opportunities for further advances in listed species conservation.

The broad scope of the Corps' regulatory program, the rapid pace at which interested parties have gained and shared practical experience using the Opinion, and the need to assure adequate oversight in light of evolving ESA policies frequently require the Corps to adjust the actions authorized by SLOPES. Previous versions of this Opinion have presented those changes as increments added or deleted each year. Rather than repeat that pattern by tiering to an increasingly long series of Opinions, the proposed SLOPES revisions, as developed using the process outlined above and presented here, is a complete and up-to-date list of all activities that may be authorized under this Opinion.

Proposed Action

For purposes of this consultation, the proposed action is revision of SLOPES that the Corps uses to guide the administration of certain activities regulated under section 10 of the Rivers and Harbors Act of 1899 and section 404 of the Clean Water Act, or are carried out by the Corps as part of civil works programs authorized by sections 206, 536, and 1135 of the Water Resources Development Act. The Corps may use SLOPES to issue permits for the following types of actions: Site preparation for buildings and related features; streambank stabilization; stream and wetland restoration; water control structures; road construction, repairs and improvements; utility lines; over and in-water structures; and other minor discharges and excavations. Use of the revised SLOPES will ensure that these regulatory and habitat improvement programs continue to meet requirements of the ESA and MSA with procedures that are simpler to use, more efficient, and more accountable for all parties.

Maintenance dredging and return water from upland disposal sites were reviewed under earlier versions of SLOPES but are being excluded now pending revision of the Dredged Material Evaluation Framework (USACE *et al.* 1998) and issues related to management of contaminated dredge materials. The following sections describe the range of projects included in each type of action, and the proposed conservation measures corresponding to that action.

Standard Local Operating Procedures for Endangered Species

As part of a permit evaluation or operational planning process the Corps will confirm that a project is within the present or historic range of a listed species or a designated critical habitat. If the Corps determines that the proposed project may adversely affect an ESA-listed species, critical habitat, or designated EFH, the Corps will use the following criteria to determine whether the project may be completed using terms and conditions in the Incidental Take Statement issued with this Opinion or must complete additional site-specific consultation.

- Each project will be individually reviewed by the Corps to ensure that all adverse effects to ESA-listed salmon and steelhead and their designated critical habitats are within the range of effects considered in this Opinion.
- For regulatory projects, each applicable term and condition in this Incidental Take Statement will be included as an enforceable part of the permit document.
- For the projects carried out by the Corps, each applicable term and condition will be included as a final project specification.
- The Corps will retain the right or reasonable access to projects authorized using SLOPES to monitor the use and effectiveness permit conditions.
- Each permit will contain an appropriate notice on the disposition of listed species that are injured or killed.
- Project notification, monitoring, and reporting information will be collected and forwarded to NOAA Fisheries as required, including an individual project notification, copies of necessary project plans (*i.e.*, pollution and erosion control, work area isolation, stormwater management, site restoration, and/or compensatory mitigation) commensurate with the size of the project, project completion report or memo to file, a site restoration and/or compensatory mitigation report, and an annual program report.
- The Corps will complete an annual coordination meeting with NOAA Fisheries to discuss the annual monitoring report and any actions that will improve conservation or make the program more efficient or more accountable.
- If the Corps chooses to continue programmatic coverage under this Opinion, it will reinitiate consultation within three years of the date of issuance.
- Any Statewide Programmatic General Permit (SPGP) issued to the State of Oregon to defer regulatory review and evaluation of permits under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act will: (1) Require the State to administer the permit program using the same criteria the Corps applies under SLOPES, including the requirement that each applicable term and condition in this Incidental Take Statement must be attached as an enforceable part of each permit document authorized under this Opinion; (2) be limited to projects that affect 0.5 acres or less of fill in a wetland and one thousand cubic yards or less of fill and removal below ordinary high water; and (3) include only the following types of actions as described in this Opinion: Piling installation and removal; site preparation for buildings and related features;

streambank stabilization; stream and wetland restoration; water control structures; road construction, repairs and improvements; utility lines; and other minor discharges and excavations.

Construction

Although construction, by itself, is not a proposed type of action for purposes of SLOPES, most of the adverse effects of the activities regulated by SLOPES will be caused by the construction component of that action. Thus, the Corps will apply the following set of conservation measures to each action authorized using SLOPES:

- Explicit exclusions are used to show that individual consultation is required to analyze the effects for exploration or construction actions proposed within 300 feet of spawning areas or submerged native aquatic vegetation (*e.g.*, eelgrass beds, sea grasses, wapato beds) and for exploration actions in estuaries that cannot be conducted from a work barge or an existing bridge, dock, wharf, and to develop corresponding conservation measures.
- Hydraulic measurements are limited to the in-water work period designated for that area, or must have a fisheries biologist verify no occupied redd is present at the site. Only non-toxic vegetable dyes are authorized
- Construction must be limited to the minimum area necessary to complete the project.
- Work below ordinary high water must be completed when at a time when the adverse effects of in-water work are least likely to be severe for ESA-listed species.
- Project operations must cease under high flow conditions, such as when the streamflow is greater than 10% of exceedance level for the in-water work period designated for that area, except for efforts to avoid or minimize resource damage.
- Surface water may be diverted, consistent with appropriate state water law, to meet construction needs only if developed sources are unavailable or inadequate, and with precautions to minimize disruption of instream flows.
- Fish passage must be provided for any adult or juvenile salmonid species present in the project area during construction, unless passage did not previously exist. After construction, adult and juvenile passage must be provided for the life of the project.
- A pollution and erosion control plan, commensurate with the size of the project, must be prepared and carried out to prevent pollution caused by surveying or construction operations.
- All discharge water created by construction (*e.g.*, concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids) must be treated before discharge.
- Projects that require in-water installation of hollow steel piling greater than 24-inches in diameter, or use of H-pile larger than designation HP24, are not proposed to be authorized using SLOPES; smaller pilings may be installed below ordinary high water with appropriate measures to minimize the effects of sound pressure waves.
- Piling removal must be accomplished with minimum disturbance.
- Use of lumber, pilings, or other wood products that are treated or preserved with pesticidal compounds may not be used below ordinary high water, or as part of a submerged, in-water or over-water structure, without visual inspection; application of

NOAA Fisheries' guidelines; and care for cutting and drilling, abrasion, leaching, and eventual removal.

- The project area must be flagged to identify sensitive resource areas, such as below ordinary high water and wetlands, and erosion controls must be in place before any significant alteration of the area take place
- Temporary access roads and drilling pads must avoid steep slopes, where grade, soil types, or other features suggest a likelihood of excessive erosion or failure; must use existing ways whenever possible; and minimize soil disturbance and compaction within 150 feet of a stream, waterbody, or wetland.
- New temporary stream crossings must meet rigorous design criteria and be properly abandoned and the stream channel restored when the project is complete.
- Choice of heavy equipment will be restricted by ground pressure, and the storage and use of heavy equipment and construction materials limited by proximity to riparian and aquatic habitats.
- Large wood, native vegetation, weed-free topsoil, and native channel materials (gravel, cobble, and boulders) disturbed during site preparation must be conserved on site for site restoration.
- If adult or juvenile fish are reasonably certain to be present, or if the work area is 300 feet or less upstream from spawning habitats, the work area must be completely isolated from the active flowing stream, and any fish captured and released at a safe release site.
- Earthwork, including drilling, excavation, dredging, filling and compacting, must be completed as quickly as possible.
- All disturbed areas must be stabilized following any break in work longer than 4 days.
- Drilling and sampling are restricted to uncontaminated areas, and any associated waste or spoils must be completely isolated and disposed of away from surface waters, off-channel habitats and wetlands.
- A stormwater management plan, commensurate to the size of the project, must be prepared and carried out for any project that will produce any new impervious surface or a land cover conversion that will slow the entry of water into the soil to ensure that effects to water quality and hydrology are minimal.
- A site restoration plan, commensurate to the size of the project, must be prepared and carried out to ensure that all streambanks, soils and vegetation disturbed by the project are cleaned up and restored as necessary to renew habitat access, water quality, production of habitat elements (*e.g.*, large wood), channel conditions, flows, watershed conditions and other ecosystem processes that form and maintain productive fish habitats.
- A compensatory mitigation plan, commensurate to the size of the project, must be prepared and carried out as necessary to ensure the project meets the goal of "no net loss" of aquatic functions (see, NMFS 1996a and 1999f). Actions of concern that will trigger the need for compensatory mitigation are primarily those that will permanently displace riparian or aquatic habitats, such as construction of structural stormwater facilities in the

riparian management area,[7] a new or enlarged boat ramp, scour protection, or otherwise prevent development of properly functioning condition of natural habitat processes.

Site Preparation for Construction of Buildings and Related Features

The Corps proposes to authorize a site to be prepared for construction of any type of building, driveway, parking area, garage and storage or utility building and site preparation may involve excavation, filling or grading. In addition to conservation measures for general construction described above, the Corps propose to exclude site preparation from sites within the riparian management area.

Streambank Stabilization

Streambank stabilization slows bank erosion by altering or hardening the bank with vegetation, soil, large wood, rock, or by creating structures to divert stream flow or reduce the effects of wave action. Streambank stabilization may also include construction of a footing, facing, head wall, or other protection necessary to prevent scouring or downcutting of, or fill slope erosion or failure at, an existing structure, such as a road, bridge support, culvert, water intake, utility line, or boat ramp. Methods such as dikes, groins, buried groins, drop structures, porous weirs, weirs, riprap, rock toes, and similar structures are explicitly not proposed to be authorized using SLOPES. Further, in addition to conservation measures for general construction described above, the Corps proposes the following conservation measures for streambank stabilization:

- The goal of streambank stabilization is to avoid and minimize adverse affects to natural stream and floodplain function by limiting actions to those that are not expected to have long-term adverse effects on aquatic habitats.
- Large wood must be used as an integral component of all streambank stabilization treatments that include large rock as a structural element. The wood must be intact, hard, and undecayed to partly decaying with untrimmed root wads to provide functional refugia habitat for fish.
- Use of rock, stone, and similar materials must be avoided, except as necessary to anchor or stabilize large wood, fill scour holes, to prevent scouring or downcutting of an existing structure, and to construct a barb according to narrow specifications.
- If a barb cannot be constructed primarily out of wood or otherwise incorporate large wood at a suitable elevation near the tip of the barb, large wood must be added to the

[7] "Riparian management area" means land: (1) Within 150 feet of any natural water occupied by listed salmonids during any part of the year or designated as critical habitat; (2) within 100 feet of any natural water within 1/4 mile upstream from areas occupied by listed salmonids or designated as critical habitat and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat; and (3) within 50 feet of any natural water upstream from areas occupied by listed salmonids or designated as critical habitat and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat. "Natural water" means all perennial or seasonal waters except water conveyance systems that are artificially constructed and actively maintained for irrigation.

stream nearby where water depths are likely to be greater than 1 meter in depth, sufficient for salmon rearing habitats.

- The following streambank stabilization methods, individually or in combination, are proposed: Woody plantings; herbaceous cover; deformable soil reinforcement; coir logs, straw bales and straw logs to trap sediment; engineered log jams (use of concrete logs is not proposed); and stream barbs.

Large Woody Debris. Placing large woody debris (LWD) into streams can result in the creation of pools that may influence the distribution and abundance of juvenile salmonids (Beechie and Sibley 1997; Spalding *et al.* 1995). Bilby and Ward (1989) state that LWD influences the physical form of the channel, retention of organic matter, and biological community composition. Cederholm *et al.* (1997) indicate that in small (<10 m bankfull width) and intermediate (10-20 m bankfull width) streams, LWD contributes channel stabilization, energy dissipation and sediment storage and that low gradient, large (>5th order) streams do not normally have LWD mid-stream. The presence and abundance of LWD are correlated with growth, abundance, and survival of juvenile salmonids (Spalding *et al.* 1995; Fausch and Northcote 1992). Carlson *et al.* (1990) found that pool volume was inversely related to stream gradient with a direct relation to the amount of LWD. Fausch and Northcote (1992) indicate that size of LWD is important for habitat creation. Hicks *et al.* (1991) indicate that lack of LWD available for recruitment from the riparian zone also leads to reduction in the quality of fish habitat. LWD has a substantial influence on intermediate streams (10-30 m bankfull width, <4% gradient), but is less important in small (<10 m bankfull width, >4% gradient) and large (>30 m bankfull width, <2% gradient) streams (Hogan and Ward 1997). Kauffman *et al.* (1997) indicate that length of LWD is critical in retaining the piece in the sited area, with pieces longer than the active channel width less likely to move during high flows.

Placement of LWD. In addition to conservation measures for general construction and streambank stabilization described above, the Corps proposes the following conservation measures for placement of LWD:

- Large wood will be intact, hard, and undecayed to partly decaying with untrimmed root wads to provide functional refugia habitat for fish.
- Use of decayed or fragmented wood found laying on the ground or partially sunken in the ground is not acceptable.
- Rock may be used as ballast to anchor or stabilize large wood. Use of cable (wire rope) or chain to anchor large wood is not authorized, unless otherwise approved in writing by NOAA Fisheries.

Stream and Wetland Restoration

Many types of actions feature a restoration component. However, a restoration action, per se, is one whose primary purpose is to restore natural aquatic or riparian habitat process or conditions, and that would not be undertaken but for its restoration purpose. Stream and wetland restoration actions that the Corps proposes to authorize using SLOPES include: Road decommissioning;

actions to set-back or remove water control structures (*e.g.*, levees, dikes, berms, weirs); remove trash and other artificial debris dams that block fish passage; provide stormwater management that restores natural or normative hydrology; stabilize streambanks, replace culverts, or replace bridges as otherwise authorized by SLOPES and when completed for a restoration purpose; remove sediment bars or terraces that block fish passage within 50 feet of a tributary mouth; place large wood within the channel or riparian area. The conservation measures that the Corps has proposed to apply to stream and wetland restoration actions include those for general construction and streambank stabilization, described above.

Water Control Structures

Water control structures direct the flow of water to prevent or reduce the risk of flooding or to maintain drainage. The only actions related to water control structures proposed to be authorized under this Opinion are repairs or modifications of existing structures, except tide gates, as necessary to provide fish passage, although installation of any fish passage system based on construction or repair of a fish ladder (*e.g.*, pools and weirs, vertical slots, Denil fishways) or fish trapping system is <u>not</u> proposed for authorization under SLOPES because those devices require site-specific engineering that is beyond the scope of this analysis. Similarly, installation, maintenance, or replacement of tide gates are not included because guidance necessary to understand the full effects of tide gate operation on fish behavior and habitat conditions, and to predict the consequences of alternative tide gate designs, is not yet available. New water control structures and upgraded water control structures that do not provide fish passage, are <u>not</u> proposed to be authorized using SLOPES. Conservation measures that the Corps has proposed to apply to water control structures include those for general construction and streambank stabilization, described above.

Road Construction, Repairs, Maintenance and Improvements

Road-related actions that the Corps proposes to authorize under this Opinion include: Geotechnical surveys; replacement and maintenance of culverts; and upgrades, maintenance and repairs of an existing roadway (*e.g.*, ditch cleaning, beaver dam removal, trash rack maintenance within 20 feet from the structure, sign installation, guardrail maintenance, drift removal from structures, minor bridge repairs, temporary bridge structures, manual vegetation removal). These actions may involve excavation, grading, filling, placement of culverts, and construction and maintenance of bridges and drainage features.

Actions that are <u>not</u> proposed to be authorized using SLOPES include: Construction of new roads within the riparian management area that are not a bridge approach, new or replacement bridge abutments below ordinary high water, channel maintenance, use of a baffled culvert or fishway, tide gate maintenance or replacements other than full removals, trash rack cleaning more than 20 feet upstream or downstream from the trash rack; a replacement bridge without full removal of the existing bridge, support structures and approach fill; any bridge approach within the Federal Emergency Management Agency (FEMA)-designated floodway which will require embankment fills that significantly impair floodplain function; and maintenance activities that do not return all native materials to the stream channel.

In addition to conservation measures for general construction and streambank stabilization, described above, the Corps proposes the following conservation measures for road construction, repairs, maintenance and improvements:

- Road maintenance activities must be completed in accordance with the most current version of the Oregon Department of Transportation (ODOT) Routine Road Maintenance Water Quality and Habitat Guide Best Management Practices, or other ESA-approved road maintenance programs.
- Ditch cleaning, culvert and trash rack maintenance, and drift removal must be completed by working from the top of the bank, unless work area isolation would result in less habitat disturbance.
- Only the minimum amount of native material necessary to maintain culvert or trash rack function, or improve water quality or quantity, will be removed and native material will be replaced downstream from the structure.
- Drift removal will be completed in the following priority: (1) Pull and release whole logs or trees downstream; (2) pull whole logs and trees and place in the riparian area; (3) remove whole logs or trees for replacement within the same stream reach or a reach nearby; and (4) pull, cut only as necessary, and release logs and trees downstream.
- Replacement of existing or new permanent stream crossings will be designed to promote natural sediment transport, allow maximum fluvial debris movement, and improve longitudinal continuity and connectivity of the stream-floodplain system[8] by choosing crossing types in the following priority: Road realignment to avoid crossing the stream, bridge, and streambed simulation.

Utility Lines

The Corps proposes to authorize installation or repair of pipes or pipelines used to transport gas or liquids, and cables, lines or wires used to transmit electricity or communication. These actions may involve excavation, temporary side casting of excavated material, backfilling of the trench, and restoration of the work site to pre-construction contours and vegetation. Construction or upgrading of a gas, sewer or water line to support a new or expanded service area for which effects, including indirect effects from interrelated or interdependent activities, have not been analyzed in this Opinion, or that transit the bed of an estuary or saltwater area at depths less than -10.0 feet (mean lower low water), are <u>not</u> proposed be authorized using SLOPES. In addition to conservation measures for construction and stream restoration described above, the Corps has proposed to apply the following measures to utility line projects:

[8] "Fluvial debris movement" means transportation of fluvial debris, including large wood, and is a function of stream channel morphology, stream power, and site potential tree height. Site potential tree height can be obtained in county-specific soil surveys reports published by the Natural Resources Conservation Service.

- Utility stream crossings will be selected in the following priority: (1) Aerial lines, including lines hung from existing bridges; and (2) directional drilling, boring or jacking; trenching – this method will only be used in a seasonally dewatered stream or adjacent wetland where the work area can be completely isolated using silt screens and without the need for any fish salvage.
- Stream crossings will be aligned perpendicular to the watercourse in areas that will ensure the lines do not cause lateral migration, head cutting, general scour, or debris loading.
- If trenching or plowing are used, they will be completed in the dry and backfilled with native material and any large wood displaced by trenching or plowing will be returned to its original position.
- All pits and other excavations associated with utility installation will be placed where they will not cause damage to the streambed or streambanks, or allow wastewater or spoil material to enter the water.

Over-Water and In-Water Structures

Actions related to over-water and in-water structures that the Corps is proposing to authorize using SLOPES include: Installation, maintenance or replacement of boat ramps, buoys, covered boat houses, docks, marinas, floating walkways, moorages, navigational aids (temporary and permanent mooring buoys and channel markers), piers, wharfs, and similar structures with these important exceptions. The following types of new or expanded structures, locations for new or expanded structures, and maintenance activities are not proposed to be authorized using SLOPES: Boat houses, boat ramps made of asphalt, covered moorages, floating storage units, houseboat, marinas, non-water-related facility (*e.g.*, parking lots, picnic areas, rest rooms) inside the riparian management area, or any other new over-water structure more than 6 feet wide. Similarly, new or expanded structures are not proposed to be authorized in areas with estuarine or saltwater characteristics; where flow is insufficient to dissipate fuels and other pollutants from vessels; within 0.5 miles downstream from the confluence of a spawning tributary; where the structure is likely to ground out or where moored boats will prop wash the bottom; or areas that would require significant pre-construction excavation, routine maintenance dredging (*e.g.*, alcoves, backwater sloughs, side channels, other shallow-water areas), or construction of a breakwater, jetty, or groin. In addition to conservation measures for construction and stream stabilization described above, the Corps has proposed to apply the following measures to over-water and in-water structures:

- Because the best way to minimize adverse effects caused by boating is to educate the public about pollution and its prevention, specific information about ESA-listed species, their biological requirements, and measures the public may take to minimize adverse effects will be posted and maintained at all public recreational facilities.
- Synthetic flotation material must be permanently encapsulated to prevent breakup into small pieces and dispersal in water, small temporary floats can be deployed for a limited time only, and mooring buoys and other temporary floats will be placed a minimum distance and depth relative to native submerged aquatic vegetation and the shoreline.

- Clean sediment or other natural debris that obstructs or interferes with normal use of an over-water or in-water structure may be removed or excavated, provided that only the minimum amount of sediment and debris necessary to restore normal use are disturbed, and then side cast or returned to the water downstream where it will continue to provide aquatic habitat function.
- Concrete boat ramps will consist of pre-cast concrete slabs below ordinary high water, and upland portions of the ramp must be completed in the dry.
- Rock may be used to prevent scouring, downcutting, or failure at the boat ramp, provided that the rock does not extend further than 4 feet from the edge of the ramp in any direction.
- Any replacement roof, wall or garage door for covered moorages and boat houses will be made of translucent materials or incorporate skylights to allow light penetration.
- An existing marina may be modified within the existing footprint of the moorage, or in water more than 50 feet from the shoreline and more than 20 feet deep, except that structures may not be placed in areas that support aquatic vegetation or areas where boat operations may damage aquatic vegetation.
- All pilings, mooring buoys, and navigational aids will be fitted with devices to prevent perching by piscivorus birds.

Minor Discharge and Excavation

The Corps proposes to authorize minor discharge or excavation as necessary to maintain or repair previously authorized structures or fills, such as culverts, intakes, boat ramps and outfalls, provided that the action is consistent with conservation measures for construction, the volume of material moved is limited to the minimum amount necessary to restore normal use and does not exceed 25 cubic yards, and all naturally-occurring sediment and debris, including large wood, are side cast or returned to the water downstream from the structure where it will continue to provide aquatic habitat function. Further, the Corps is <u>not</u> proposing to authorize minor discharge and excavation of any channel or water intake that does not have a fish screen that is installed, operated and maintained according to NOAA Fisheries fish screen criteria.

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 C.F.R. 402.02). For purposes of this consultation, the overall action area consists of the combined actions areas of each project authorized under this Opinion. This includes all upland, riparian and aquatic areas affected by site preparation, construction, site restoration, and any offsite conservation measures at each project site. Individual action areas also cover up to 300 feet downstream from the project footprint where aquatic habitat conditions may be temporarily degraded by increased runoff and erosion until site restoration is complete. All projects authorized by this Opinion will occur within these areas: (1) "Waters of the United States," including wetlands; (2) the range of ESA-listed salmon or steelhead, designated critical habitat, or EFH designated under the MSA; and (3) either within the jurisdiction of the Portland District or that part of the Seattle District on the north shore of the mainstem Columbia River downstream from McNary Dam (all tributaries to the north shore, the mainstem Columbia River upstream from McNary Dam, and other areas in the Seattle District are excluded).

The overall action area is used by 15 ESUs of juvenile and adult salmon and steelhead (Table 3) and includes critical habitat designated for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SONC coho salmon, and SR sockeye salmon. The overall action area is also designated as EFH for Pacific Coast groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Pacific Coast salmon (PFMC 1999), or is in an area where environmental effects of the proposed project may adversely affect designated EFH for those species.

ENDANGERED SPECIES ACT

The ESA (16 U.S.C. 1531-1544), amended in 1988, establishes a national program for the conservation of threatened and endangered species of fish, wildlife, and plants and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitats. This Opinion is the product of an interagency consultation pursuant to section 7(a)(2) of the ESA and implementing regulations found at 50 Code of Federal Regulations (C.F.R.) Part 402.

Biological Opinion

This Opinion presents NOAA Fisheries' review of the status of each ESU considered in this consultation, the condition of designated critical habitat, the environmental baseline for the action area, all the effects of the action as proposed, and cumulative effects (50 C.F.R. 402.14(g)).

For the jeopardy analysis, NOAA Fisheries considers those combined factors to conclude whether the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the affected ESA-listed species. The critical habitat analysis determines whether the proposed action will destroy or adversely modify designated critical habitat for listed species by examining any change in the conservation value of the essential features of critical habitat. However, this analysis does not rely on the regulatory definition of "adverse modification or destruction" of critical habitat recently at issue in the 9th Circuit Court of Appeals case *Gifford Pinchot Task Force, et. al, vs. U.S. Fish and Wildlife Service,* No. 03-35279, August 6, 2004. Instead, it focuses on the effects of the proposed action on critical habitat features and on the role that designated critical habitat must play in the action area with respect to the survival or recovery of each listed ESU.

If the action under consultation is likely to jeopardize the continued existence of an ESA-listed species, or destroy or adversely modify critical habitat, NOAA Fisheries must identify any reasonable and prudent alternatives for the action that avoid jeopardy or destruction or adverse modification of critical habitat and meet other regulatory requirements (50 C.F.R. 402.02).

Table 3. Federal Register Notices for Final Rules that list species, designate critical habitat, or apply protective regulations to ESUs considered in this consultation. (For listing status, "T" means listed as threatened, "E" means endangered, "P" means proposed for listing.)

Species ESU	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Lower Columbia River (LCR)	T 3/24/99; 64 FR 14308	Not applicable	7/10/00; 65 FR 42422
Upper Willamette River (UWR)	T 3/24/99; 64 FR 14308	Not applicable	7/10/00; 65 FR 42422
Upper Columbia River (UCR) spring-run	E 3/27/99; 64 FR 14308	Not applicable	ESA section 9 applies
Snake River (SR) spring / summer-run	T 4/22/92; 57 FR 14653	10/25/99; 64 FR 57399	7/10/00; 65 FR 42422
Snake River (SR) fall-run	T 6/3/92; 57 FR 23458	12/28/93; 58 FR 68543	7/10/00; 65 FR 42422
Chum salmon (*O. keta*)			
Columbia River (CR)	T 3/25/99; 64 FR 14508	Not applicable	7/10/00; 65 FR 42422
Coho salmon (*O. kisutch*)			
Lower Columbia River (LCR)	P 6/14/04; 69 FR 33102	Not applicable	Not applicable
Oregon Coast (OC)	P 6/14/04; 69 FR 33102	Not applicable	Not applicable
Southern Oregon / Northern California Coasts (SONC) coho	T 5/6/97; 62 FR 24588	5/5/99; 64 FR 24049	7/18/97; 62 FR 68479
Sockeye salmon (*O. nerka*)			
Snake River (SR)	E 11/20/91; 56 FR 58619	12/28/93; 58 FR 68543	ESA section 9 applies
Steelhead (*O. mykiss*)			
Lower Columbia River (LCR)	T 3/19/98; 63 FR 13347	Not applicable	7/10/00; 65 FR 42422
Upper Willamette River (UWR)	T 3/25/99; 64 FR 14517	Not applicable	7/10/00; 65 FR 42422
Middle Columbia River (MCR)	T 3/25/99; 64 FR 14517	Not applicable	7/10/00; 65 FR 42422
Upper Columbia River (UCR)	E 8/18/97; 62 FR 43937	Not applicable	ESA section 9 applies
Snake River Basin (SR)	T 8/18/97; 62 FR 43937	Not applicable	7/10/00; 65 FR 42422

Status of the ESUs

This section defines range-wide biological requirements of each ESU considered in this Opinion, and reviews the status of the ESUs relative to those requirements (Table 3). The present risk faced by each ESU informs NOAA Fisheries' determination as to whether additional risk would "appreciably reduce" the likelihood of survival or recovery in the wild. The greater the present risk, the more likely any additional risk resulting from the proposed action's effects on the population size, trend (growth rate), distribution, and genetic diversity of the listed species would be an appreciable reduction (McElhaney *et al.* 2000). All status information below is adapted from work by the West Coast Salmon Biological Review Team (BRT) reported in BRT (2003), with particular emphasis on population characteristics and risk factors.

Chinook Salmon. Chinook salmon, also commonly referred to as king, spring, quinnat, Sacramento, California, or tyee salmon, is the largest of the Pacific salmon (Myers *et al.* 1998). The species historically ranged from the Ventura River in California to Point Hope, Alaska, in North America, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia (Healey 1991). Additionally, Chinook salmon have been reported in the Mackenzie River area of Northern Canada (McPhail and Lindsey 1970). Chinook salmon exhibit very diverse and complex life-history strategies. Healey (1986) described 16 age categories for Chinook salmon, seven total ages with three possible freshwater ages. This level of complexity is roughly comparable to sockeye salmon, although sockeye salmon have a more extended freshwater residence period and use different freshwater habitats (Miller and Brannon 1982, Burgner 1991).

Two generalized freshwater life-history types were initially described by Gilbert (1912): "stream-type" Chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon migrate to the ocean predominately within their first year. Healey (1983, 1991) has promoted the use of broader definitions for "ocean-type" and "stream-type" to describe two distinct races of Chinook salmon. This racial approach incorporates life-history traits, geographic distribution, and genetic differentiation and provides a valuable frame of reference for comparisons of Chinook salmon populations. For this reason, the BRT has adopted the broader "racial" definitions of ocean- and stream-type for this review.

Of the two life-history types, ocean-type Chinook salmon exhibit the most varied and plastic life-history trajectories. Ocean-type Chinook salmon juveniles outmigrate to the ocean as fry, subyearling juveniles (during their first spring or fall), or as yearling juveniles (during their second spring), depending on environmental conditions. Ocean-type Chinook salmon also undertake distinct, coastally oriented, ocean migrations. The timing of the return to freshwater and spawning is closely related to the ecological characteristics of a population's spawning habitat.

Five different run times are expressed by different ocean-type Chinook salmon populations: Spring, summer, fall, late-fall, and winter. In general, early run times (spring and summer) are exhibited by populations that use high spring flows to access headwater or interior regions.

Ocean-type populations within a basin that express different runs times appear to have evolved from a common source population. Stream-type populations appear to be nearly obligate yearling out migrants (some 2-year-old smolts have been identified), they undertake extensive off-shore ocean migrations, and generally return to freshwater as spring-run- or summer-run fish. Stream-type populations are found in northern British Columbia and Alaska, and in the headwater regions of the Fraser River and Columbia River interior tributaries.

Before development of the ESU policy (Waples 1991), NOAA Fisheries recognized Sacramento River winter-run Chinook salmon as a "distinct population segment" under the ESA (NMFS 1987). Subsequently, in reviewing the biological and ecological information concerning West Coast Chinook salmon, BRTs have identified additional ESUs for Chinook salmon from Washington, Oregon, and California: Snake River fall-run (Waples *et al.* 1991a), Snake River spring- and summer-run (Matthews and Waples 1991), and Upper Columbia River summer-run and fall-run Chinook salmon (originally designated as the mid-Columbia River summer-run- and fall-run Chinook salmon, Waknitz *et al.* 1995), Puget Sound Chinook salmon, Washington Coast Chinook salmon, Lower Columbia River Chinook salmon, Upper Willamette River Chinook salmon, Middle Columbia River spring-run Chinook salmon, Upper Columbia River spring-run Chinook salmon, Oregon Coast Chinook salmon, Upper Klamath and Trinity Rivers Chinook salmon, Central Valley fall-run and late-fall-run Chinook salmon, and Central Valley spring-run Chinook salmon (Myers *et al.* 1998), the Southern Oregon and Northern California Chinook salmon, California Coastal Chinook salmon, and Deschutes River (NMFS 1999a).

Of the 17 Chinook salmon ESUs identified by NOAA Fisheries and listed as threatened or endangered under the ESA, five occur in the overall action area (Table 3). NOAA Fisheries convened a BRT to update the status of listed Chinook salmon ESUs in Washington, Oregon, California, and Idaho. The Chinook salmon BRT met in January, March and April of 2003 in Seattle, Washington, to review updated information on each of the ESUs under consideration (BRT 2003).

Lower Columbia River (LCR) Chinook Salmon. The status of LCR Chinook was initially reviewed by NOAA Fisheries in 1998 (Myers *et al.* 1998) and updated in that same year (NMFS 1998a). In the 1998 update, the BRT noted several concerns for this ESU. The 1998 BRT was concerned that there were very few naturally self-sustaining populations of native Chinook salmon remaining in the LCR ESU. Naturally-reproducing (but not necessarily self-sustaining) populations identified by the 1998 BRT were the Lewis and Sandy Rivers "bright" fall-runs and the "tule" fall-runs in the Clackamas, East Fork Lewis and Coweeman Rivers. These populations were identified as the only bright spots in the ESU. The few remaining populations of spring Chinook salmon in the ESU were not considered by the previous BRT to be naturally self-sustaining because of either small size, extensive hatchery influence, or both. The previous BRT felt that the dramatic declines and losses of spring-run Chinook salmon populations in the LCR ESU represented a serious reduction in life-history diversity in the region. The previous BRT felt that the presence of hatchery Chinook salmon in this ESU posed an important threat to the persistence of the ESU and also obscured trends in abundance of native fish. The previous BRT noted that habitat degradation and loss due to extensive hydropower development projects, urbanization, logging and agriculture threatened the Chinook salmon spawning and rearing habitat in the Lower Columbia River. A majority of the previous (1998) BRT concluded that the LCR ESU was likely to become endangered in the foreseeable future. A minority felt that Chinook salmon in this ESU were not presently in danger of extinction, nor were they likely to become so in the foreseeable future.

New data acquired for the BRT (2003) report includes spawner abundance estimates through 2001, new estimates of the fraction of hatchery spawners and harvest estimates. In addition, estimates of historical abundance have been provided by the Washington Department of Fish and Wildlife (WDFW). Information on recent hatchery releases was also obtained. New analyses include the designation of relatively demographically independent populations, recalculation of previous BRT metrics with additional years data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, and estimates of current and historically available kilometers of stream.

The ESU exhibits three major life history types: Fall-run ("tules"), late fall-run ("brights"), and spring-run. The ESU spans three ecological zones: Coastal (rain driven hydrograph), Western Cascade (snow or glacial driven hydrograph), and Gorge (transitioning to drier interior Columbia ecological zones). The fall Chinook populations are currently dominated by large scale hatchery production, relatively high harvest and extensive habitat degradation (discussed in previous status reviews). The Lewis River late fall Chinook population is the healthiest in the ESU and has a reasonable probability of being self-sustaining. The spring-run populations are largely extirpated as the result of dams which block access to their high elevation habitat. Abundances have largely declined since the last status review update (1998) and trend indicators for most populations are negative, especially if hatchery fish are assumed to have a reproductive success equivalent to that of natural-origin fish. However, 2001 abundance estimates increased for most LCR Chinook populations over the previous few years and preliminary indications are that 2002 abundance also increased (Rawding, personal communication, cited in BRT 2003). Many salmon populations in the Northwest have shown increases in abundance over the last few years and the relationship of these increases to potential changes in marine survival are discussed in the introduction to the BRT (2003) report.

A majority (71%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. Moderately high concerns for all Viable Salmonid Populations (VSP) elements are indicated by estimates of moderate to moderately high risk for abundance and diversity. All of the risk factors identified in previous reviews were still considered important by the BRT. The Willamette/Lower Columbia River Technical Review Team has estimated that 8-10 historic populations in this ESU have been extirpated, most of them spring-run populations. Near loss of that important life history type remains in important BRT concern. Although some natural production currently occurs in 20 or so populations, only one exceeds 1000 spawners. High hatchery production continues to pose genetic and ecological risks to natural populations and to mask their performance. Most populations in this ESU have not seen as pronounced increases in recent years as occurred in many other geographic areas.

Upper Willamette River (UWR) Chinook Salmon. The status of UWR Chinook was initially reviewed by NOAA Fisheries in 1998 (Myers *et al.* 1998) and updated in that same year (NMFS 1998a). In the 1998 update, the BRT noted several concerns for this ESU. The previous BRT was concerned about the few remaining populations of spring Chinook salmon in the UWR ESU, and the high proportion of hatchery fish in the remaining runs. The BRT noted with concern that the Oregon Department of Fish and Wildlife (ODFW) was able to identify only one remaining naturally-reproducing population in this ESU–the spring Chinook salmon in the McKenzie River. The previous BRT was concerned about severe declines in short-term abundance that occurred throughout the ESU, and the McKenzie River population had declined precipitously, indicating that it may not be self-sustaining. The 1998 BRT also noted the potential for interactions between native spring-run and introduced fall-run Chinook salmon had increased relative to historical times due to fall-run Chinook salmon hatchery programs and the laddering of Willamette Falls. The previous BRT partially attributed the declines in spring Chinook salmon in the UWR ESU to the extensive habitat blockages caused by dam construction. The previous BRT was encouraged by efforts to reduce harvest pressure on naturally-produced spring Chinook salmon in Upper Willamette River tributaries, and the increased focus on selective marking of hatchery fish should help managers targeting specific populations of wild or hatchery Chinook salmon. A majority of the previous (1998) BRT concluded that the LCR ESU was likely to become endangered in the foreseeable future. A minority felt that Chinook salmon in this ESU were not presently in danger of extinction, nor were they likely to become so in the foreseeable future.

New data for this update include spawner abundance through 2002 in the Clackamas River, 2001 in the McKenzie River and 2001 at Willamette Falls. In addition, new data include updated redd surveys in the basin, new estimates of the fraction of hatchery-origin spawners in the McKenzie and North Santiam from an otolith marking study, the first estimate of hatchery fraction in the Clackamas (2002 data), and information on recent hatchery releases. New analyses for this update include: the designation of relatively demographically independent populations, recalculation of previous BRT metrics in the McKenzie with additional years of data, estimates of current and historically available kilometers of stream, and updates on current hatchery releases.

The updated information provided in the BRT (2003) report, the information contained in previous UWR Chinook status reviews, and preliminary analysis by the Willamette/Lower Columbia Technical Review Team, indicate that most natural spring Chinook populations are likely extirpated or nearly so. The only population considered potentially self-sustaining is the McKenzie. However, its abundance has been relatively low (low thousands) with a substantial number of these fish being of hatchery origin. The population has shown a substantial increase in the last couple of years, hypothesized to be a result of increase ocean survival. It is unknown what ocean survivals will be in the future and the long-term sustainability of this population in uncertain.

Although the number of adult spring-run Chinook salmon crossing Willamette Falls is in the same range (about 20,000–70,000) it has been for the last 50 years, a large fraction of these are hatchery produced. The score for spatial structure reflects concern by the BRT that perhaps a third of the historic habitat used by fish in this ESU is currently inaccessible behind dams, and the BRT remained concerned that natural production in this ESU is restricted to a very few areas. Increases in the last 3 to 4 years in natural production in the largest remaining population (the McKenzie) were considered encouraging by the BRT. With the relatively large incidence of hatchery fish, it is difficult to determine trends in natural production.

A majority (70%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT found moderately high risks in all VSP elements, with risk estimates ranging from moderate for growth rate/productivity to moderately high for spatial structure.

Upper Columbia River (UCR) Spring-run Chinook Salmon. No estimates of historical abundance specific to this ESU are available before the 1930s. The drainages supporting this ESU are all above Rock Island Dam on the Upper Columbia River. Rock Island Dam is the oldest major hydroelectric project on the Columbia River; it began operations in 1933. Counts of returning Chinook salmon have been made since the 1930s. Annual estimates of the aggregate return of spring-run Chinook salmon to the Upper Columbia River are derived from the dam counts based on the nadir between spring and summer return peaks. Spring-run Chinook salmon currently spawn in three major drainages above Rock Island Dam--Wenatchee, Methow and Entiat Rivers. Historically, spring-run Chinook salmon may have also used portions of the Okanogan River.

Grand Coulee Dam, completed in 1938, formed an impassable block to the upstream migration of anadromous fish. Chief Joseph Dam was constructed on the mainstem Columbia River downstream from Grand Coulee Dam and is also an anadromous block. No specific estimates are available of historical production of spring-run Chinook salmon from mainstem tributaries above Grand Coulee Dam. Habitat typical of that used by spring-run Chinook salmon in accessible portions of the Columbia River Basin is found in the middle/upper reaches of mainstem tributaries above Grand Coulee Dam. It is possible that the historical range of this ESU included these areas; alternatively, fish from the upper reaches of the Columbia River may have been in a separate ESU.

Artificial production efforts in the area occupied by the UCR spring-run Chinook salmon ESU extend back to the 1890s. Hatchery efforts were initiated in the Wenatchee and Methow systems to augment catches in response to declining natural production (*e.g.*, Craig and Soumela 1941). While there are no direct estimates of adult production from early efforts, it is likely contributions were small.

In the late 1930s, the Grand Coulee Fish Maintenance Program (GCFMP) was initiated to address the fact that the completion of the Grand Coulee dam cut off anadromous access above site of the dam. Returning salmonids, including spring-run Chinook salmon, were trapped at Rock Island Dam and either transplanted as adults or released as juveniles into selected production areas within the accessible drainages below Grand Coulee Dam. Nason Creek in the Wenatchee system was a primary adult transplantation area in this effort. The program was conducted annually from 1938 until the mid-1940s.

The UCR spring-run Chinook salmon ESU was reviewed by the BRT in late 1998 (NMFS 1998a). The BRT was mostly concerned about risks falling under the abundance/distribution and trends/productivity risk categories for the ESU. Average recent escapement to the ESU has been less than 5,000 hatchery plus wild Chinook salmon, and individual populations all consist of less than 100 fish. The BRT was concerned that at these population sizes, negative effects of demographic and genetic stochastic processes are likely to occur. Furthermore, both long- and short-term trends in abundance are declining, many strongly so. The BRT noted that the implementation of emergency natural broodstocking and captive broodstocking efforts for the ESU indicates the severity of the population declines to critically small sizes. The BRT recognized that habitat degradation, blockages and hydrosystem passage mortality all have contributed to the significant declines in this ESU.

The WDFW, the Yakima Tribe and the Fish and Wildlife Service conduct annual redd count surveys in nine selected production areas within the geographical area encompassed by this ESU (Mosey and Murphy 2002, Hubble and Crampton 2000, Carie 2000). Before 1987, redd count estimates were single-survey peak counts. From 1987 on, annual redd counts are generated from a series of on-the-ground counts and represent the total number of redds constructed in any particular year. The agencies use annual dam counts from the mainstem Mid-Columbia River dams as the basis for expanding redd counts to estimates of total spring-run Chinook salmon returns. In the Wenatchee Basin, video counts at Tumwater Dam are available for recent years. Returns to hatchery facilities are subtracted from the dam counts before the expansion.

An initial set of population definitions for UCR spring-run Chinook salmon ESU along with basic criteria for evaluating the status of each population were developed using the VSP guidelines described in McElhany *et al.* (2000). The definitions and criteria are described in Ford *et al.* (2000) and have been used in the development and review of Mid-Columbia River Public Utility District plans and the Biological Opinion for those plans. The interim definitions and criteria are being reviewed as recommendations by the Interior Columbia Technical Recovery Team. The historical status of spring-run Chinook salmon production in the Okanogan River is uncertain. The committee deferred a decision on the Okanogan to the Technical Recovery Team. Abundance, productivity and spatial structure criteria for each of the populations in the ESU were developed and are described in Ford *et al.* (2001).

Many populations in this ESU have rebounded somewhat from the critically low levels that immediately preceded the last status review evaluation, and this was reflected in the substantial minority of BRT votes cast that were not cast in the “danger of extinction” category. Although this was considered an encouraging sign by the BRT, the last year or two of higher returns come on the heels of a decade or more of steep declines to all time record low escapements. In addition, this ESU continues to have a very large influence by hatchery production, both from production/mitigation and supplementation programs. The extreme management measures taken in an effort to maintain populations in this ESU during some years in the late 1990s (collecting all adults from major basins at downstream dams) are a strong indication of the ongoing risks to this ESU, although the associated hatchery programs may ultimately play a role in helping to restore self-sustaining natural populations.

Assessments by the BRT of the overall risks faced by this ESU were divided, with a slight majority (53%) of the votes being cast in the "danger of extinction" category and a substantial minority (45%) in the "likely to be endangered" category. The risk estimates reflect strong ongoing concerns regarding abundance and growth rate/productivity (high to very high risk) in this ESU and somewhat less (but still significant) concerns for spatial structure (moderate risk) and diversity (moderately high risk).

Snake River (SR) Spring/Summer-run Chinook Salmon. Spring and summer Chinook salmon runs returning to the major tributaries of the Snake River were classified as an ESU by NOAA Fisheries (Matthews and Waples 1991). This ESU includes production areas that are characterized by spring-timed returns, summer-timed returns, and combinations from the two adult timing patterns. Runs classified as spring Chinook salmon are counted at Bonneville Dam beginning in early March and ending the first week of June; runs classified as summer-run Chinook salmon return to the Columbia River from June through August. Returning fish hold in deep mainstem and tributary pools until late summer, when they outmigrate up into tributary areas and spawn. In general, spring-run type Chinook salmon tend to spawn in higher elevation reaches of major Snake River tributaries in mid- through late August, and summer-run SR Chinook salmon spawn approximately 1 month later than spring-run fish.

Many of the Snake River tributaries used by spring and summer Chinook salmon runs exhibit two major features: extensive meanders through high elevation meadowlands and relatively steep lower sections joining the drainages to the mainstem Salmon (Matthews and Waples 1991). The combination of relatively high summer temperatures and the upland meadow habitat creates the potential for high juvenile salmonid productivity. Historically, the Salmon River system may have supported more than 40% of the total return of spring-run and summer-run Chinook salmon to the Columbia River system (*e.g.*, Fulton 1968).

The SR spring/summer-run Chinook salmon ESU includes current runs to the Tucannon River, the Grand Ronde River system, the Imnaha River and the Salmon River (Matthews and Waples 1991). The Salmon River system contains a range of habitats used by spring/summer-run Chinook salmon. The South Fork and Middle Fork tributaries to the Salmon currently support the bulk of natural production in the drainage. Two large tributaries entering above the confluence of the Middle Fork, the Lemhi and Pahsimeroi Rivers, drain broad alluvial valleys and are believed to have historically supported substantial, relatively productive anadromous fish runs. Returns into the Upper Salmon River tributaries have re-established following the opening of passage around Sunbeam Dam on the mainstem Salmon River downstream from Stanley, Idaho. Sunbeam Dam in the Upper Salmon River was a serious impediment to migration of anadromous fish and may have been a complete block in at least some years before its partial removal in 1934 (Waples *et al.* 1991a).

Current runs returning to the Clearwater River drainages were not included in the SR spring/summer-run Chinook salmon ESU. Lewiston Dam in the lower mainstem of the Clearwater River was constructed in 1927 and functioned as an anadromous block until the early 1940s (Matthews and Waples 1991). Spring and summer Chinook salmon runs into the Clearwater system were reintroduced via hatchery outplants beginning in the late 1940s. As a result, Matthews and Waples (1991) concluded that even if a few native salmon survived the hydropower dams, the massive outplantings of non-indigenous stocks presumably substantially altered, if not eliminated, the original gene pool.

Spring-run and summer-run Chinook salmon from the Snake River Basin exhibit stream type life-history characteristics (Healey 1983). Eggs are deposited in late summer and early fall, incubate over the following winter and hatch in late winter/early spring of the following year. Juveniles rear through the summer, overwinter and migrate to sea in the spring of their second year of life. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer rearing and/or overwintering areas. SR spring/summer-run Chinook salmon return from the ocean to spawn primarily as 4 and 5 year old fish, after 2 to 3 years in the ocean. A small fraction of the fish return as 3-year-old "jacks," heavily predominated by males.

The 1991 ESA status review (Mathews and Waples 1991) of the SR spring/ summer-run Chinook salmon ESU concluded that the ESU was at risk based on a set of key factors. Aggregate abundance of naturally-produced SR spring/summer-run Chinook salmon runs had dropped to a small fraction of historical levels. Short-term projections (including jack counts, habitat/flow conditions in the brood years producing the next generation of returns) were for a continued downward trend in abundance. Risk modeling indicated that if the historical trend in abundance continued, the ESU as a whole was at risk of extinction within 100 years. The review identified related concerns at the population level within the ESU. Given the large number of potential production areas in the Snake Basin and the low levels of annual abundance, risks to individual subpopulations may be greater than the extinction risk for the ESU as a whole. The 1998 Chinook salmon status review (Myers *et al.* 1998) summarized and updated these concerns. Both short and long-term abundance trends had continued downward. The report identified continuing disruption due to the impact of mainstem hydroelectric development including altered flow regimes and impacts on estuarine habitats. The 1998 review also identified regional habitat degradation and risks associated with the use of outside hatchery stocks in particular areas—specifically including major sections of the Grande Ronde River Basin.

Tributary habitat conditions vary widely among the various drainages of the Snake River Basin. Habitat degradation in many areas of the basin are a result of forest, grazing and mining practices. Impacts relative to anadromous fish include lack of pools, increased water temperatures, low flows, poor overwintering conditions, and high sediment loads. Substantial portions of the Salmon River drainage, particularly in the Middle Fork, are protected in wilderness areas.

Direct estimates of annual runs of historical spring/summer-run Chinook salmon to the Snake River are not available. Chapman (1986) estimated that the Columbia River produced 2.5 million to 3.0 million spring-run and summer-run Chinook salmon per year in the late 1800s. Total spring-run and summer-run Chinook salmon production from the Snake River Basin contributed a substantial proportion of those returns; the total annual production of SR spring-run and summer-run Chinook salmon may have been in excess of 1.5 million adult returns per year (Matthews and Waples 1991). Returns to Snake River tributaries had dropped to roughly 100,000 adults per year by the late 1960s (Fulton 1968). Increasing hatchery production contributed to subsequent years' returns, masking a continued decline in natural production.

Although there are concerns about loss of an unquantified number of spawning aggregations that historically may have provided connectivity between headwater populations, natural spawning in this ESU still occurs in a wide range of locations and habitat types.

Like many others, this ESU saw a large increase in escapement in many (but not all) populations in 2001. The BRT considered this an encouraging sign, particularly given the record low returns seen in many of these populations in the mid 1990s. However, recent abundance in this ESU is still short of the levels that the proposed recovery plan for SR salmon indicated should be met over at least an eight year period (NMFS 1995a). The BRT considered it a positive sign that the non-native Rapid River broodstock has been phased out of the Grande Ronde system, but the relatively high level of both production/mitigation and supplementation hatcheries in this ESU leads to ongoing risks to natural populations and makes it difficult to assess trends in natural productivity and growth rate.

About two-thirds (68%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT rated abundance and growth rate/productivity factors as moderately high risk, and spatial structure and diversity as moderately low risk.

Snake River (SR) Fall-run Chinook Salmon. SR fall-run Chinook salmon enter the Columbia River in July and August. The Snake River component of the fall Chinook salmon run migrates past the Lower Snake River mainstem dams from August through November. Spawning occurs from October through early December. Juveniles emerge from the gravels in March and April of the following year. SR fall-run Chinook salmon are subyearling migrants, moving downstream from natal spawning and early rearing areas from June through early fall.

Fall-run Chinook salmon returns to the Snake River generally declined through the first half of this century (Irving and Bjornn 1981). In spite of the declines, the Snake River Basin remained the largest single natural production area for fall-run Chinook salmon in the Columbia River drainage into the early 1960s (Fulton 1968). Spawning and rearing habitat for SR fall-run Chinook salmon was significantly reduced by the construction of a series of Snake River mainstem dams. Historically, the primary spawning fall-run Chinook salmon spawning areas were on the upper mainstem Snake River. Currently, natural spawning is limited to the area from the upper end of Lower Granite Reservoir to Hells Canyon Dam, the lower reaches of the

Imnaha, Grande Ronde, Clearwater and Tucannon Rivers, and small mainstem sections in the tail races of the Lower Snake hydroelectric dams.

Adult counts at Snake River dams are an index of the annual return of SR fall-run Chinook salmon to spawning grounds. Lower Granite Dam is the uppermost of the mainstem Snake River dams that allow for passage of anadromous salmonids. Adult traps at Lower Granite Dam have allowed for sampling of the adult run as well as for removal of a portion of non-local hatchery fish passing above the dam. The dam count at Lower Granite covers a majority of fall-run Chinook salmon returning to the Snake Basin. However, SR fall-run Chinook salmon do return to locations downstream from Lower Granite Dam and are therefore not included in the ladder count. Lyons Ferry Hatchery is on the mainstem Snake River below both Little Goose and Lower Monumental Dams. Although a fairly large proportion of adult returns from the Lyons Ferry Hatchery program do stray to Lower Granite Dam, a substantial proportion of the run returns directly to the facility. In addition, mainstem surveying efforts have identified relatively small numbers of fall-run Chinook salmon spawning in the tail races of Lower Snake River mainstem hydroelectric dams (Dauble *et al.* 1999).

Lyons Ferry Hatchery was established as one of the hatchery programs under the Lower Snake Compensation Plan administered through the USFWS. SR fall-run Chinook salmon production is a major program for Lyons Ferry Hatchery, which is operated by the WDFW and is along the SR mainstem between Little Goose Dam and Lower Monumental Dam. The WDFW began developing a SR fall-run Chinook salmon broodstock in the early 1970s through a trapping program at Ice Harbor Dam and Lower Granite Dam. The Lyons Ferry facility became operational in the mid-1980s and took over incubation and rearing for the SR fall Chinook mitigation/compensation program.

Previous Chinook salmon status reviews (Waples *et al.* 1991a, Myers *et al.* 1998) identified several concerns regarding SR fall-run Chinook salmon; steady and severe decline in abundance since the early 1970s, loss of primary spawning and rearing areas upstream from the Hells Canyon Dam complex, increase in non-local hatchery contribution to adult escapement over Lower Granite Dam, and relatively high aggregate harvest impacts by ocean and in-river fisheries. Available habitat for SR fall-run Chinook salmon has not had any major changes since the previous status reviews.

On the positive side, the number of natural origin spawners in 2001 was well in excess of 1000 for the first time since counts at Lower Granite Dam began in 1975. Management actions have reduced (but not eliminated) the fraction of fish passing Lower Granite Dam that are strays from out-of-ESU hatchery programs. Returns in the last two years also reflect an increasing contribution from supplementation programs based on the native Lyons Ferry Broodstock. With the exception of the increase in 2001, the ESU has fluctuated between approximately 500 to1000 adults, suggesting a somewhat higher degree of stability in growth rate and trends than is seen in many other salmon populations.

In spite of the recent increases, however, the recent geometric mean number of naturally-produced spawners is still less than 1000, a very low number for an entire ESU. Because of the large fraction of naturally-spawning hatchery fish, it is difficult to assess the productivity of the natural population. The moderately high risk estimate for spatial structure and diversity reflect the concerns of the BRT that a large fraction of historic habitat for this ESU is inaccessible, diversity associated with those populations has been lost, the single remaining population is vulnerable to variable environmental conditions or catastrophes, and continuing immigration from outside the ESU at levels that are higher than occurred historically. Some BRT members were concerned that the efforts to remove stray, out-of-ESU hatchery fish only occur at Lower Granite Dam, well upstream from the geographic boundary of this ESU. Specific concerns are that natural spawners in lower river areas will be heavily affected by strays from Columbia River hatchery programs, and that this approach effectively removes the natural buffer zone between the SR ESU and Columbia River ocean-type Chinook salmon. The effects of these factors on ESU viability are not known, as the extent of natural spawning in areas below Lower Granite Dam is not well understood, except in the Lower Tucannon River.

A majority (60%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with minorities falling in the "danger of extinction" and "not likely to become endangered" categories. This represented a somewhat more optimistic assessment of the status of this ESU than was the case at the time of the original status review, when the BRT concluded that SR fall-run Chinook salmon face a substantial risk of extinction if present conditions continue (Waples *et al.* 1991a). The BRT found moderately high risks in all VSP elements, with risk estimates ranging from moderate for growth rate/productivity to moderately high for spatial structure.

Chum Salmon. Chum salmon are semelparous, spawn primarily in freshwater, and apparently exhibit obligatory anadromy, as there are no recorded landlocked or naturalized freshwater populations (Randall *et al.* 1987). The species is known for the enormous canine-like fangs and striking body color (a calico pattern, with the anterior two thirds of the flank marked by a bold, jagged, reddish line and the posterior third by a jagged black line) of spawning males. Females are less flamboyantly colored and lack the extreme dentition of the males.

The species has the widest natural geographic and spawning distribution of any Pacific salmonid, primarily because its range extends further along the shores of the Arctic Ocean than other salmonids. Chum salmon have been documented to spawn from Korea and the Japanese island of Honshu, east around the rim of the North Pacific Ocean, to Monterey Bay in California. Presently, major spawning populations are found only as far south as Tillamook Bay on the Northern Oregon coast. The species' range in the Arctic Ocean extends from the Laptev Sea in Russia to the Mackenzie River in Canada. Chum salmon may historically have been the most abundant of all salmonids; Neave (1961) estimated that before the 1940s, chum salmon contributed almost 50% of the total biomass of all salmonids in the Pacific Ocean. Chum salmon also grow to be among the largest of Pacific salmon, second only to Chinook salmon in adult size, with individual chum salmon reported up to 108.9 cm in length and 20.8 kg in weight (Pacific Fisherman 1928). Average size for the species is around 3.6 to 6.8 kg (Salo 1991).

Chum salmon spend more of their life history in marine waters than other Pacific salmonids. Chum salmon, like pink salmon, usually spawn in coastal areas, and juveniles out migrate to seawater almost immediately after emerging from the gravel that covers their redds (Salo 1991). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus *Oncorhynchus* (*e.g.*, coastal cutthroat trout, steelhead, coho salmon, and most types of Chinook and sockeye salmon), which usually migrate to sea at a larger size, after months or years of freshwater rearing. This means survival and growth in juvenile chum salmon depends less on freshwater conditions than on favorable estuarine conditions. Another behavioral difference between chum salmon and species that rear extensively in freshwater is that chum salmon form schools, presumably to reduce predation (Pitcher 1986), especially if their movements are synchronized to swamp predators (Miller and Brannon 1982).

In December 1997, the first ESA status review of west coast chum salmon (Johnson *et al.* 1997) was published which identified four ESU: (1) Puget Sound/Strait of Georgia ESU, which includes all chum salmon populations from Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca up to and including the Elwha River, with the exception of summer-run chum salmon from Hood Canal; (2) Hood Canal summer-run ESU, which includes summer-run populations from Hood Canal and Discovery and Sequim Bays on the Strait of Juan de Fuca; (3) Pacific coast ESU, which includes all natural populations from the Pacific coasts of California, Oregon, and Washington, west of the Elwha River on the Strait of Juan de Fuca; and (4) Columbia River ESU.

In March 1998, NOAA Fisheries published a Federal Register notice describing the four ESUs and proposed a rule to list two--Hood Canal summer-run and Columbia River ESUs--as threatened under the ESA (NMFS 1998c). In March 1999, the two ESUs were listed as proposed, with the exception that the Hood Canal summer-run ESU was extended westward to include summer-run fish recently documented in the Dungeness River (NMFS 1999b).

NOAA Fisheries convened a BRT to update the status of listed chum salmon ESUs coastwide. The chum salmon BRT1 met in January, March and April 2003 in Seattle, Washington, to review updated information on each of the ESUs under consideration.

Columbia River (CR) Chum Salmon. NOAA Fisheries last provided an updated status report on CR chum in 1999 (NMFS 1999b). As documented in the 1999 report, the previous BRT was concerned about the dramatic declines in abundance and contraction in distribution from historical levels. The previous BRT was also concerned about the low productivity of the extant populations, as evidenced by flat trend lines at low population sizes. A majority of the previous BRT concluded that the CR chum salmon ESU was likely to become endangered in the foreseeable future and a minority concluded that the ESU was currently in danger of extinction.

New data includes spawner abundance through 2000, with a preliminary estimate of 2002, new information on the hatchery program, and new genetic data describing the current relationship of spawning groups. New analyses include designation of relatively demographically independent populations, recalculation of previous BRT metrics with additional years data, estimates of median annual growth rate, and estimates of current and historically available kilometers of stream.

Updated information provided in the BRT (2003), the information contained in previous Lower Columbia River status reviews, and preliminary analyses by the Willamette/Lower Columbia Technical Review Team suggest that 14 of the 16 historical populations (88%) are extinct or nearly so. The two extant populations have been at low abundance for the last 50 years in the range where stochastic processes could lead to extinction. Encouragingly, there has been a substantial increase in the abundance of these two populations. In addition there are the new (or newly discovered) Washougal River mainstem spawning groups. However, it is not known if the increase will continue and the abundance is still substantially below the historical levels.

Nearly all of the likelihood votes for this ESU fell in the “likely to become endangered” (63%) or “danger of extinction” (34%) categories. The BRT had substantial concerns about every VSP element, as indicated risk estimates scores that ranged from moderately high for growth rate/productivity to high to very high for spatial structure. Most or all of the risk factors identified previously by the BRT remain important concerns. The Willamette/Lower Columbia Technical Review Team has estimated that close to 90% of the historical populations in the ESU are extinct or nearly so, resulting in loss of much diversity and connectivity between populations. The populations that remain are small, and overall abundance for the ESU is low. This ESU has showed low productivity for many decades, even though the remaining populations are at low abundance and density dependent compensation might be expected. The BRT was encouraged that unofficial reports for 2002 suggest a large increase in abundance in some (perhaps many) locations. Whether this large increase is due to any recent management actions or simply reflects unusually good conditions in the marine environment is not known at this time, but the result is encouraging, particularly if it were to be sustained for a number of years.

Coho Salmon. Coho salmon is a widespread species of Pacific salmon, occurring in most major river basins around the Pacific Rim from Monterey Bay in California north to Point Hope, Alaska, through the Aleutians and from Anadyr River south to Korea and northern Hokkaido, Japan (Laufle *et al.* 1986). From central British Columbia south, the vast majority of coho salmon adults are 3-year-olds, having spent approximately 18 months in freshwater and 18 months in saltwater (Gilbert 1912, Pritchard 1940, Sandercock 1991). The primary exceptions to this pattern are “jacks,” sexually mature males that return to freshwater to spawn after only 5-7 months in the ocean. However, in southeast and central Alaska, the majority of coho salmon adults are 4-year-olds, having spent an additional year in freshwater before going to sea (Godfrey *et al.* 1975, Crone and Bond 1976). The transition zone between predominantly 3-year-old and 4-year-old adults occurs somewhere between central British Columbia and southeast Alaska.

With the exception of spawning habitat, which consists of small streams with stable gravels, summer and winter freshwater habitats most preferred by coho salmon consist of quiet areas with low flow, such as backwater pools, beaver ponds, dam pools, and side channels (Reeves *et al.* 1989). Habitats used during winter generally have greater water depth than those used in summer, and also have greater amounts of LWD. West Coast coho smolts typically leave freshwater in the spring (April to June) and re-enter freshwater when sexually mature from September to November and spawn from November to December and occasionally into January (Sandercock 1991). Stocks from British Columbia, Washington, and the Columbia River often have very early (entering rivers in July or August) or late (spawning into March) runs in addition to "normally" timed runs.

The status of coho salmon for purposes of ESA listings has been reviewed many times, beginning in 1990. The first two reviews occurred in response to petitions to list coho salmon in the Lower Columbia River and Scott and Waddell Creeks (central California) under the ESA. The conclusions of these reviews were that NOAA Fisheries could not identify any populations that warranted protection under the ESA in the LCR (Johnson *et al.* 1991), and that Scott and Waddell Creeks' populations were part of a larger, undescribed ESU (Bryant 1994).

A review of West Coast (Washington, Oregon, and California) coho salmon populations began in 1993 in response to several petitions to list numerous coho salmon populations and NOAA Fisheries' own initiative to conduct a coastwide status review of the species. This coastwide review identified six coho salmon ESUs, of which the three southern most were proposed for listing, two were candidates for listing, and one was deemed "not warranted" for listing (Weitkamp *et al.* 1995). In October 1996, the BRT updated the status review for the Central California ESU, and concluded that it was at risk of extinction (NMFS 1996b). In October 1996, NOAA Fisheries listed this ESU as threatened (Table 1).

In December 1996, the BRT updated the status review update for both proposed and candidate coho salmon ESUs (NMFS 1996b). However, because of the scale of the review, comanagers' requests for additional time to comment on the preliminary conclusions, and NOAA Fisheries' legal obligations, the status review was finalized for proposed coho salmon ESUs in 1997 (NMFS 1997a), but not for candidate ESUs. In May 1997, NOAA Fisheries listed the SONC ESU as threatened, while it announced that listing of the OC ESU was not warranted due to measures in the "Oregon Coastal Salmon Restoration Initiative" (Oregon Plan 1997, now referred to as the "Oregon Plan for Salmon and Watersheds"). This finding for OC coho salmon was overturned in August 1998, and the ESU listed as threatened (Table 1).

The process of updating the coho salmon status review was begun again in October 1998 for coho salmon in Washington and the Lower Columbia River. However, this effort was terminated before the BRT could meet, due to competing activities with higher priorities.

In response to a petition by (Oregon Trout *et al.* 2000), the status of LCR coho salmon was revisited in 2000, with BRT meetings held in March and May 2001 (NMFS 2001a). The BRT concluded that splitting the Lower Columbia River/Southwest Washington Coast ESU to form separate LCR and Southwest Washington Coast coho salmon ESUs was most consistent with available information and the LCR coho ESU was at risk of extinction. Like the 1996 status review update, these results were never finalized.

The coho salmon BRT met in January, March, and April 2003 to discuss new data received and to determine if the new information warranted any modification of the conclusions of the original BRTs.

Lower Columbia River (LCR) Coho Salmon. The status of LCR coho salmon was initially reviewed by NOAA Fisheries in 1996 (NMFS 1996c) and the most recent review occurred in 2001 (NMFS 2001a). In the 2001 review, the BRT was very concerned that the vast majority (over 90%) of the historical populations in the LCR coho salmon ESU appear to be either extirpated or nearly so. The two populations with any significant production (Sandy and Clackamas) were at appreciable risk because of low abundance, declining trends, and failure to respond after a dramatic reduction in harvest. The large number of hatchery coho salmon in the ESU was also considered an important risk factor. The majority of the 2001 BRT votes were for "at risk of extinction" with a substantial minority in "likely to become endangered."

New data include spawner abundance estimates through 2002 for Clackamas and Sandy populations (the previous status review had data just through 1999). In addition, the ODFW conducted surveys of Oregon LCR coho salmon using a stratified random sampling design in 2002, which provided the first abundance estimates for lower tributary populations (previously only limited index surveys were available. Estimates of the fraction of hatchery-origin spawners accompany the new abundance estimates. In Washington, no surveys of natural-origin adult coho salmon abundance are conducted. Updated information through 2002 on natural-origin smolt production from Cedar, Mill, Germany, and Abernathy Creeks and the Upper Cowlitz River were provided by the WDFW.

New analyses include the tentative designation of demographically independent populations, the recalculation of metrics reviewed by previous BRTs with additional years of data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, a new stock assessment of Clackamas River coho by the ODFW (Zhou and Chilcote 2003), and estimates of current and historically available kilometers of stream.

As part of its effort to develop viability criteria for LCR salmon and steelhead, the Willamette/Lower Columbia Technical Recovery Team has identified historically demographically independent populations of ESA-listed salmon and steelhead in the Lower Columbia River (Myers *et al.* 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany *et al.* 2000). Based on the Willamette/Lower Columbia Technical Review Team's framework for Chinook and steelhead, the BRT tentatively designated populations of LCR coho salmon. A working group at the Northwest Fisheries Science Center hypothesized that the LCR coho salmon ESU historically consisted of 23 populations. These population designations have not yet been reviewed by the Willamette/Lower Columbia Technical Review Team.

Previous BRT and ODFW analyses have treated the coho in the Clackamas River as a single population (see previous status review updates for more complete discussion and references). However, recent analysis by the ODFW (Zhou and Chilcote 2003) supports the hypothesis that coho salmon in the Clackamas River consist of two populations, an early-run and a late-run. The late-run population is believed to be descendant of the native Clackamas River population, and the early-run is believed to descend from hatchery fish introduced from Columbia River populations outside the Clackamas River Basin. The population structure of Clackamas River coho is uncertain, therefore, in the BRT (2004) report, analyses on Clackamas River coho are conducted under both the single population and two population hypotheses for comparison.

For other salmonid species, the Willamette/Lower Columbia Technical Review Team partitioned LCR populations into a number of "strata" based on major life-history characteristics and ecological zones. These analyses suggest that a viable ESU would require a number of viable populations in each of these strata. Coho salmon do not have the major life-history variation seen in LCR steelhead or Chinook, and would thus be divided into strata based only on ecological zones.

On the positive side, adult returns in 2000 and 2001 were up noticeably in some areas, and evidence for limited natural production has been found in some areas outside the Sandy and Clackamas. The paucity of naturally-produced spawners in this ESU can be contrasted with the very large number of hatchery-produced adults. Although the scale of the hatchery programs, and the great disparity in relative numbers of hatchery and wild fish, produce many genetic and ecological threats to the natural populations, collectively these hatchery populations contain a great deal of genetic resources that might be tapped to help promote restoration of more widespread naturally-spawning populations.

The status of the LCR coho salmon ESU was reviewed by the BRT in 2000, so relatively little new information was available. A majority (68%) of the likelihood votes for LCR coho salmon fell in the "danger of extinction" category, with the remainder falling in the "likely to become endangered" category. As indicated by the risk matrix totals, the BRT had major concerns for this ESU in all VSP risk categories (risk estimates ranged from high risk for spatial structure/connectivity and growth rate/productivity to very high for diversity). The most serious overall concern was the scarcity of naturally-produced spawners throughout the ESU, with attendant risks associated with small population, loss of diversity, and fragmentation and isolation of the remaining naturally-produced fish. In the only two populations with significant natural production (Sandy and Clackamas), short and long-term trends are negative and productivity (as gauged by pre-harvest recruits) is down sharply from recent (1980s) levels.

Oregon Coast (OC) Coho Salmon. The OC coho ESU has been assessed in three previous status reviews (Weitkamp *et al.* 1995, NMFS 1996b, 1997). In the 1995 status review (Weitkamp *et al.* 1995), the BRT considered evidence from many sources to identify ESU boundaries in coho populations from Washington to California. For the most part, evidence from physical environment, ocean conditions/upwelling patterns, marine and coded wire tag recovery patterns, coho salmon river entry and spawn timing as well as estuarine and freshwater fish and terrestrial vegetation distributions were the most informative to the ESU delineation process. Genetic information was used for an indication of reproductive isolation between populations and groups of populations. Based on this assessment, six ESUs were identified, including the OC coho ESU, which includes naturally-spawning populations in Oregon coastal streams north of Cape Blanco, to south of the Columbia River.

In 1997, there were extensive survey data available for coho salmon in this region. Overall, spawning escapements had declined substantially during the century, and may have been at less than 5% of their abundance in the early 1900s. Average spawner abundance had been relatively constant since the late 1970s, but pre-harvest abundance had declined. Average recruits-per-spawner may also have declined. Coho salmon populations in most major rivers appeared to have had heavy hatchery influence, but some tributaries may have been sustaining native stocks.

For this ESU, information on trends and abundance were better than for the more southerly ESUs. Main uncertainties in the assessment included the extent of straying of hatchery fish, the influence of such straying on natural population trends and sustainability, the condition of freshwater habitat, and the influence of ocean conditions on population sustainability. Total average (5-year geometric mean) spawner abundance for this ESU in 1996 was estimated at about 52,000. Corresponding ocean-run size for the same year was estimated to be about 72,000; this corresponds to less than one-tenth of ocean-run sizes estimated in the late 1800s and early 1900s, and only about one-third of those in the 1950s (ODFW 1995). Total freshwater habitat production capacity for this ESU was estimated to correspond to ocean-run sizes between 141,000 under poor ocean conditions and 924,000 under good ocean conditions (Oregon Coastal Salmon Restoration Initiative Science Team 1996c). Abundance was unevenly distributed within the ESU at this time, with the largest total escapement in the relatively small Mid/South Coast Gene Conservation Group and lower numbers in the North/Mid-Coast and Umpqua Gene Conservation Groups.

Trend estimates using data through 1996 showed that for all three measures (escapement, run size, and recruits-per-spawner), long-term trend estimates were negative. More recent escapement trend estimates were positive for the Umpqua and Mid/South Coast Monitoring Areas, but negative in the North/Mid-Coast. Recent trend estimates for recruitment and recruits-per-spawner were negative in all three areas, and exceed 12% annual decline in the two northern areas. Six years of stratified random survey population estimates showed an increase in escapement and decrease in recruitment.

To put these data in a longer term perspective, ESU-wide averages in 1996 that were based on peak index and area under the curve escapement indices, showed an increase in spawners up to levels of the mid-to-late 1980s, but much more moderate increases in recruitment. Recruitment remained only a small fraction of average levels in the 1970s. An examination of return ratios showed that spawner-to-spawner ratios had remained above replacement since the 1990 brood year as a result of higher productivity of the 1990 broodyear and sharp reductions in harvest for the subsequent broods. As of 1996, recruit-to-spawner ratios for the 1991-1994 broods were the lowest on record, except for 1988 and, possibly, 1984. The 1997 BRT considered risk of extinction for this ESU under two scenarios: first, if present conditions and existing management continued into the foreseeable future and, second, if certain aspects of the Oregon Plan for Salmon and Watersheds (1997) relating to harvest and hatchery production were implemented.

With respect to habitat, the BRT had two primary concerns: first, that the habitat capacity for coho salmon within this ESU has significantly decreased from historical levels; and second, that the Nickelson and Lawson (1998) model predicted that, during poor ocean survival, only high quality habitat is capable of sustaining coho populations, and subpopulations dependent on medium and low quality habitats would be likely to go extinct. Both of these concerns caused the BRT to consider risks from habitat loss and degradation to be relatively high for this ESU.

In 1997, the BRT concluded that, assuming that 1997 conditions continued into the future (and that proposed harvest and hatchery reforms were not implemented), this ESU was not at significant short-term risk of extinction, but that it was likely to become endangered in the foreseeable future. A minority felt that the ESU was not likely to become endangered. Of those members who concluded that this ESU was likely to become endangered, several expressed the opinion that it was near the border between this and a “not at risk” category.

The BRT generally agreed that implementation of the harvest and hatchery proposals of the Oregon Plan for Salmon and Watersheds (1997) would have a positive effect on the status of the ESU, but the BRT was about evenly split as to whether the effects would be substantial enough to move the ESU out of the “likely to become endangered” category. Some members felt that, in addition to the extinction buffer provided by the estimated 80,000 naturally-produced spawners in 1996, the proposed reforms would promote higher escapements and alleviate genetic concerns so that the ESU would not be at significant risk of extinction or endangerment. Other members saw little reason to expect that the hatchery and harvest reforms by themselves would be effective in reducing what they viewed as the most serious threat to this ESU—declining recruits-per-spawner.

If the severe declines in recruits-per-spawner of natural populations in this ESU were partly a reflection of continuing habitat degradation, then risks to this ESU might remain high even with full implementation of the hatchery and harvest reforms. While harvest and hatchery reforms may substantially reduce short-term risk of extinction, habitat protection and restoration were viewed as key to ensuring long-term survival of the ESU, especially under variable and unpredictable future climate conditions. The BRT therefore concluded that these measures would not be sufficient to alter the previous conclusion that the ESU is likely to become endangered in the foreseeable future.

The Oregon Plan for Salmon and Watersheds (1997) is the most ambitious and far-reaching program to improve watersheds and recover salmon runs in the Pacific Northwest. It is a voluntary program focused on building community involvement, habitat restoration, and monitoring. All state agencies with activities affecting watersheds are required to evaluate their operations with respect to salmon impacts and report on actions taken to reduce these impacts to the Governor on a regular basis. The original Oregon Plan was written in 1997, and has been in operation for about 5 years. As a result of the plan, watershed councils across the state have produced watershed assessments of limiting factors for anadromous salmonids on both public and private land.

The State of Oregon has dedicated about $20 million/year to implement restoration projects and is developing a system to link project development with whole-watershed assessments. The Oregon Department of Environmental Quality and the Oregon Department of Agriculture are implementing regulatory mechanisms to reduce non-point-source pollution. If these efforts are successful, Oregon could see a widespread improvement in water quality. Nonetheless, reporting of watershed assessment results, limiting factors, and identification of actions to be taken or progress made in addressing these limiting factors can be improved. While this is a significant recovery effort in the Pacific Northwest, and an extensive, coordinated monitoring program is in place, measurable results of the program will take years or decades to materialize.

The ocean regime shift in 1976 was the beginning of an extended period of poor marine survival for coho salmon in Oregon. Conditions worsened in the 1990s, and hatchery survival reached a low of 0.006 adults per smolt in 1997 (1996 ocean entry). Coastal hatcheries appear to have fared even worse, although adult counts at these facilities are often incomplete, biasing these estimates low. Following an apparent shift to a more productive climate regime in 1998, marine survival has started to improve, reaching 0.05 for adults returning in 2001. The Pacific Decadal Oscillation had been in a cold, productive phase for about 4 years and in August reversed indicating a warm, unproductive period. This reversal may be short-lived; the Pacific Decadal Oscillation historically has shown a 20 to 60 year cycle. However, the use of past decadal patterns should be used cautiously as predictive models for the future due to the rising influence of global warming (Nathan J. Mantua, personal communication, cited in BRT 2003).

A long-term understanding of the prospects for OC coho can be constructed from a simple conceptual model incorporating a trend in habitat quality and cyclical ocean survival (Lawson 1993). Short-term increases in abundance driven by marine survival cycles can mask longer-term downward trends resulting from freshwater habitat degradation or longer-term trends in marine survival that may be a consequence of global climate change. Decreases in harvest rates can increase escapements and delay ultimate extinction. Harvest rates have been reduced to the point where no further meaningful reductions are possible. The current upswing in marine survival is a good thing for OC coho, but will only provide a temporary respite unless other downward trends are reversed.

This ESU continues to present challenges to those assessing extinction risk. The BRT found several positive features compared to the previous assessment in 1997. Adult spawners for the ESU in 2001 and 2002 exceeded the number observed for any year in the past several decades, and pre-harvest run size rivaled some of the high values seen in the 1970s. Some notable increases in spawners have occurred in many streams in the northern part of the ESU, which was the most depressed area at the time of the last status review evaluation. Hatchery reforms have continued, and the fraction of natural spawners that are first-generation hatchery fish has been reduced in many areas compared to highs in the early to mid 1990s.

On the other hand, the recent years of good returns were preceded by three years of low spawner escapements—the result of three consecutive years of recruitment failure, in which the natural spawners did not replace themselves the next generation, even in the absence of any directed harvest. These three years of recruitment failure, which immediately followed the last status review in 1997, are the only such instances that have been observed in the entire time series of data collected for Oregon Coast coho salmon. Whereas the recent increases in spawner escapement have resulted in long-term trends in spawners that are generally positive, the long-term trends in productivity in this ESU are still strongly negative.

As indicated in the risk matrix results, the BRT considered the decline in productivity to be the most serious concern for this ESU with a moderate risk estimate. With all directed harvest for these populations already eliminated, harvest management can no longer compensate for declining productivity by reducing harvest rates. The BRT was concerned that if the long-term decline in productivity reflects deteriorating conditions in freshwater habitat, this ESU could face very serious risks of local extinctions during the next cycle of poor ocean conditions. With the cushion provided by strong returns in the last 2-3 years, the BRT had much less concern about short-term risks associated with abundance and assigned them a low risk estimate.

A minority of the BRT felt that the large number of spawners in the last few years demonstrate that this ESU is not currently at significant risk of extinction or likely to become endangered. Furthermore, these members felt that the recent years of high escapement, following closely on the heels of the years of recruitment failure, demonstrate that populations in this ESU have the resilience to bounce back from years of depressed runs.

The BRT votes reflected ongoing concerns for the long-term health of this ESU: a majority (56%) of the votes were cast in the "likely to become endangered" category, with a substantial minority (44%) falling in the "not likely to become endangered" category. Although the BRT considered the significantly higher returns in recent years to be encouraging, most members felt that the factors responsible for the increases were more likely to be unusually favorable marine productivity conditions than improvements in freshwater productivity. The majority of BRT members felt that to have a high degree of confidence that the ESU is healthy, high spawner escapements should be maintained for a number of years, and the freshwater habitat should demonstrate the capability of supporting high juvenile production from years of high spawner abundance.

Southern Oregon/Northern California Coasts (SONC) Coho Salmon. The SONC coho salmon ESU extends from Cape Blanco in southern Oregon to Punta Gorda in northern California (Weitkamp *et al.* 1995). The status of coho salmon coastwide, including the SONC coho ESU, was formally assessed in 1995 (Weitkamp *et al.* 1995). Two subsequent status review updates have been published by NOAA Fisheries, one addressing all West Coast coho salmon ESUs (NMFS 1996c) and a second specifically addressing the OC and SONC ESUs (NMFS 1997a).

In the 1995 status review, the BRT was unanimous in concluding that coho salmon in the SONC coho ESU were not in danger of extinction but were likely to become so in the foreseeable future if present trends continued (Weitkamp *et al.* 1995). In the 1997 status update, estimates of natural population abundance in this ESU were based on very limited information. Favorable indicators included recent increases in abundance in the Rogue River and the presence of natural populations in both large and small basins, factors that may provide some buffer against extinction of the ESU. However, large hatchery programs in the two major basins (Rogue and Klamath/Trinity) raised serious concerns about effects on, and sustainability of, natural populations.

New data on presence/absence in northern California streams that historically supported coho salmon were even more disturbing than earlier results, indicating that a smaller percentage of streams in this ESU contained coho salmon compared to the percentage presence in an earlier study. However, it was unclear whether these new data represented actual trends in local extinctions, or were biased by sampling effort. This new information did not change the BRT's conclusion regarding the status of the SONC coho ESU. Although the Oregon Plan for Salmon and Watersheds (1997) proposals were directed specifically at the Oregon portion of this ESU, the harvest proposal would affect ocean harvest of fish in the California portion as well. The proposed hatchery reforms can be expected to have a positive effect on the status of populations in the Rogue River Basin. However, the BRT concluded that these measures would not be sufficient to alter the previous conclusion that the ESU is likely to become endangered in the foreseeable future.

One effect of the Oregon Plan for Salmon and Watersheds has been increased monitoring of salmon and habitats throughout the Oregon coastal region. Besides continuation of the abundance data series analyzed in the 1997 status update, Oregon has expanded its random survey monitoring to include areas south of Cape Blanco, including monitoring of spawner abundance, juvenile densities, and habitat condition.

New data for the SONC coho salmon ESU includes expansion of presence-absence analyses, a limited analysis of juvenile abundance in the Eel River Basin, a few indices of spawner abundance in the Smith, Mad, and Eel River Basins, and substantially expanded monitoring of adults, juveniles, and habitat in southern Oregon. None of these data contradict conclusions reached previously by the BRT. Nor do any of recent data (1995 to present) suggest any marked change, either positive or negative, in the abundance or distribution of coho salmon within the SONC coho ESU. Coho salmon populations continued to be depressed relative to historical numbers, and there are strong indications that breeding groups have been lost from a significant percentage of streams within their historical range. Although the 2001 broodyear appears to be the one of the strongest perhaps of the last decade, it follows a number of relatively weak years. The Rogue River stock is an exception; there has been an average increase in spawners over the last several years, despite two low years (1998, 1999).

Risk factors identified in previous status reviews, including severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that are clearly downward, and degraded freshwater habitat and associated reduction in carrying capacity continue to be of concern to the BRT. Termination of hatchery production of coho salmon at the Mad River and Rowdy Creek facilities has eliminated potential adverse risk associated with hatchery releases from these facilities. Likewise, restrictions on recreational and commercial harvest of coho salmon since 1994 have undoubtedly had a substantial positive impact on coho salmon adult returns to SONC streams. An additional risk factor that has been identified within the SONC coho ESU is predation resulting from the illegal introduction of non-native Sacramento pikeminnow (*Ptychocheilus grandis*) to the Eel River Basin (NMFS 1998c). Sacramento pikeminnow were introduced to the Eel River via Pillsbury Lake in the early 1980s and have subsequently spread to most areas within the basin. The rapid expansion of pikeminnow populations is believed to have been facilitated by alterations in habitat conditions (particularly increased water temperatures) that favor pikeminnow (Brown *et al.* 1994, NMFS 1998c).

The BRT remained concerned about low population abundance throughout the ESU relative to historical numbers and long-term downward trends in abundance; however, the paucity of data on escapement of naturally-produced spawners in most basins continued to hinder assessment of risk. A reliable time series of adult abundance is available only for the Rogue River. These data indicate that long-term (22-year) and short-term (10-year) trends in mean spawner abundance are upward in the Rogue; however, the positive trends reflect effects of reduced harvest (rather than improved freshwater conditions) since trends in pre-harvest recruits are flat. Less-reliable indices of spawner abundance in several California populations reveal no apparent trends in some populations and suggest possible continued declines in others.

Additionally, the BRT considered the relatively low occupancy rates of historical coho salmon streams (between 37% and 61% from broodyear 1986 to 2000) as an indication of continued low abundance in the California portion of this ESU. The relatively strong 2001 broodyear, likely the result of favorable conditions in both freshwater and marine environments, was viewed as a positive sign, but was a single strong year following more than a decade of generally poor years.

The moderate risk matrix scores for spatial structure reflected a balancing of several factors. On the negative side was the modest percentage of historical streams still occupied by coho salmon (suggestive of local extirpations or depressed populations). The BRT also remains concerned about the possibility that losses of local populations have been masked in basins with high hatchery output, including the Trinity, Klamath, and Rogue systems. The extent to which strays from hatcheries in these systems are contributing to natural production remains uncertain, however, it is generally believed that hatchery fish and progeny of hatchery fish constitute the majority of production in the Trinity River, and may be a significant concern in parts of the Klamath and Rogue systems a well. On the positive side, extant populations can still be found in all major river basins within the ESU. Additionally, the relatively high occupancy rate of historical streams observed in broodyear 2001 suggests that much habitat remains accessible to coho salmon. The BRT's concern for the large number of hatchery fish in the Rogue, Klamath, and Trinity systems was also evident in the moderate risk rating for diversity.

A majority (67%) of BRT votes fell into the "likely to become endangered" category, while votes in the "endangered" category outnumbered those in the "not warranted" categories by 2-to-1. The BRT found moderately high risks for abundance and growth rate/production, with mean matrix scores of 3.5 to 3.8, respectively, for these two categories. Risks to spatial structure and diversity were judged by the BRT to be moderate.

Sockeye Salmon. Sockeye salmon spawn in North America from the Columbia River in Oregon north to the Noatak River in Alaska, and in Asia from Hokkaido, Japan north to the Anadyr River in Russia (Atkinson *et al.* 1967, Burgner 1991). The vast majority of sockeye salmon spawn in inlet or outlet streams of lakes or in lakes themselves. The juveniles of these "lake-type" sockeye salmon rear in lake environments for 1 to 3 years, migrate to sea, and return to natal lake systems to spawn after 1 to 4 years in the ocean. However, some sockeye salmon populations spawn in rivers without juvenile lake rearing habitat. Their juveniles rear in slow velocity sections of rivers for 1 or 2 years ("river-type") or migrate to sea as underyearlings and thus rear primarily in saltwater ("sea-type") (Wood 1995). As with lake-type sockeye salmon, river/sea-type sockeye salmon return to natal spawning habitat after 1 to 4 years in the ocean.

Certain self-perpetuating, nonanadromous populations of sockeye salmon that become resident in lake environments over long periods of time are called kokanee in North America. Genetic differentiation among sockeye salmon and kokanee populations indicates that kokanee are polyphyletic, having arisen from sockeye salmon on multiple independent occasions, and that kokanee may occur sympatrically or allopatrically with sockeye salmon. Numerous studies (reviewed in Gustafson *et al.* 1998) indicate that sockeye salmon and kokanee exhibit a suite of heritable differences in morphology, early development rate, seawater adaptability, growth and maturation that appear to be divergent adaptations that have arisen from different selective regimes associated with anadromous vs. nonanadromous life histories. These studies also provide evidence that sympatric populations of sockeye salmon and kokanee can be both genetically distinct and reproductively isolated (see citations in Gustafson *et al.* 1997). Occasionally, a proportion of juveniles in an anadromous sockeye population will remain in the rearing lake environment throughout life and will be observed on the spawning grounds together with their anadromous siblings. Ricker (1938) first used the terms "residual sockeye" and "residuals" to refer to these resident, non-migratory progeny of anadromous sockeye salmon.

In April 1990, NOAA Fisheries initiated a status review of sockeye salmon in the Salmon River Basin and received a petition from the Shoshone-Bannock Tribes of the Fort Hall Indian Reservation to list SR sockeye salmon as endangered under the ESA (NMFS 1990, 1991a). NOAA Fisheries BRT conducted a status review and unanimously agreed that there was insufficient information available to determine with reasonable degree of certainty the origin of the current sockeye salmon gene pool in Redfish Lake (Waples *et al*. 1991b). After some discussion, the BRT reached a strong consensus that, in this instance, obligations as resource stewards required them to proceed under the assumption that recent sockeye salmon in Redfish Lake were descended from the original sockeye salmon gene pool. Therefore, as stipulated in the Species Definition Paper (Waples 1991), the anadromous component of sockeye salmon was considered separately from the non-anadromous (kokanee) component in determining whether an ESA listing was warranted. The decision to treat Redfish Lake sockeye salmon as distinct from kokanee led the BRT to conclude that the Redfish Lake sockeye salmon were in danger of extinction (Waples *et al*. 1991b). Subsequently, a proposed rule to list SR sockeye salmon as endangered was published (NMFS 1991a). After consideration of 183 written comments and testimony from public hearings, NOAA Fisheries published its final listing determination (NMFS 1991b) that designated SR sockeye salmon as an endangered species.

In September 1994, in response to a petition seeking protection for Baker Lake, Washington, sockeye salmon under the ESA and more general concerns about the status of West Coast salmon and steelhead, NOAA Fisheries initiated a coastwide status review of sockeye salmon in Washington, Oregon, and California, and formed a BRT to conduct the review. After considering available information on genetics, phylogeny and life history, freshwater ichthyo-geography, and environmental features that may affect sockeye salmon, the BRT identified six ESUs (Ozette Lake, Okanogan River, Lake Wenatchee, Quinault Lake, Baker River, and Lake Pleasant) and one provisional ESU (Big Bear Creek). The BRT reviewed population abundance data and other risk factors for these ESUs and concluded that one (Ozette Lake) was likely to become endangered in the foreseeable future, and that the remaining ESUs were not in significant danger of becoming extinct or endangered, although there were substantial conservation concerns for some of these (Gustafson *et al*. 1998). In March 1998, NOAA Fisheries published a proposed rule to list the Ozette Lake ESU as threatened under the ESA, and to place the Baker River ESU on the candidate list. Due to the lack of natural spawning habitat and the vulnerability of the entire population to problems in artificial habitats, NOAA Fisheries proposed to add the Baker River ESU to the list of candidate species (NMFS 1998c). Subsequently, based on the updated NOAA Fisheries status review (NMFS 1999c) and other information received, NOAA Fisheries published its final listing determination (NMFS 1999d) that designated the Ozette Lake sockeye salmon ESU as threatened and removed the Baker River ESU from the candidate list.

In considering the ESU status of resident forms of sockeye salmon, the key issue is evaluating the strength and duration of reproductive isolation between resident and anadromous forms. Many kokanee populations appear to have been strongly isolated from sympatric sockeye populations for long periods of time. Since the two forms experience very different selective regimes over their life cycle, reproductive isolation provides an opportunity for adaptive divergence in sympatry. Kokanee populations that fall in this category will generally not be considered part of sockeye ESUs. On the other hand, resident fish appear to be much more closely integrated into some sockeye populations. For example, in some situations, anadromous fish may give rise to progeny that mature in freshwater (as is the case with residual sockeye), and some resident fish may have anadromous offspring. In these cases, where there is presumably some regular, or at least episodic, genetic exchange between resident and anadromous forms, they should be considered part of the same ESU. The sockeye salmon BRT met in January, March, and April 2003, to discuss new data received and to determine if the new information warranted any modification of the conclusions of the original BRTs.

Snake River (SR) Sockeye Salmon. The first formal ESA status review for salmon in the Pacific Northwest was conducted in response to a 1990 petition to list sockeye salmon from Redfish Lake in Idaho as an endangered species. The distinctiveness of this population became apparent early in the process: it spawns at a higher elevation (2,000 m), and has a longer freshwater migration (1,500 km) than any other sockeye salmon population in the world (Waples *et al*. 1991b). Nor was the precarious nature of the anadromous run in doubt; in the fall of 1990, during the course of the status review, no adults were observed at Lower Granite Dam or entering the lake, and only one fish was observed in each of the two previous years. However, a population of kokanee also existed in Redfish Lake, and the relationship between the sockeye and kokanee was not well understood. This issue was complicated by uncertainty regarding the effects of Sunbeam Dam, which stood for over two decades about 20 miles downstream from Redfish Lake. By all accounts, the dam was a serious impediment to anadromous fish, but opinions differed as to whether it was an absolute barrier. Some argued that the original sockeye population in Redfish Lake was extirpated as a result of Sunbeam Dam, and that adult returns in recent decades were simply the result of sporadic seaward drift of kokanee (Chapman *et al*. 1990). According to this hypothesis, the original sockeye gene pool was extinct and the remaining kokanee population was not at risk because of its reasonably large size (ca. 5,000-10,000 spawners per year). An alternative hypothesis held that the original sockeye salmon population managed to persist in spite of Sunbeam Dam, either by intermittent passage of adults or recolonization from holding areas downstream from the dam. The fact that the kokanee population spawns in the inlet stream (Fishhook Creek) in August-September and all the recent observations of sockeye spawning have been on the lake shore in October-November was cited as evidence that the sockeye and kokanee represent separate populations. According to this hypothesis, the sockeye population was critically endangered, and perhaps, on the brink of extinction.

At the time of the status review, the BRT unanimously agreed that there was not enough information to determine which of the above hypotheses were true (Waples 1991). Although the kokanee population had been genetically characterized and determined to be quite distinctive compared to other sockeye salmon populations in the Pacific Northwest, no adult sockeye were available for sampling, so the BRT could not evaluate whether the two forms shared a common gene pool. When pressed to make a decision regarding the ESU status of Redfish Lake sockeye salmon, the BRT concluded that, because they could not determine with any certainty that the original sockeye gene pool was extinct, they should assume that it did persist and was separate from the kokanee gene pool. This conclusion was strongly influenced by consideration of the irreversible consequences of making an error in the other direction (*i.e.*, if the species was not listed based on the assumption that kokanee and sockeye populations were a single gene pool and this later proved not to be the case, the species could easily go extinct before the error was detected).

The status review of Redfish Lake sockeye salmon is the only instance in which the BRT has been asked to apply the precautionary principle in its deliberations. In subsequent evaluations, when the "best available scientific information" was insufficient to distinguish with any certainty among competing hypotheses regarding key ESA questions, the BRT has simply reported this result and tried to characterize the degree of uncertainty in the team's conclusions. Decisions about how best to apply the precautionary principle in the face of uncertainty in making listing determinations have been left to the NOAA Fisheries management/policy arm. Based on results of the status review, NOAA Fisheries proposed a listing of Redfish Lake sockeye as endangered in April 1991. When finalized in late 1991, this represented the first ESA listing of a Pacific salmon population in the Pacific Northwest. At the time of the listing, the only population that the BRT and NOAA Fisheries were confident belonged in this ESU was the beach spawning population of sockeye from Redfish Lake. Historical records indicated that sockeye once occurred in several other lakes in the Stanley Basin, but no adults had been observed in these lakes for many decades and their relationship to the Redfish Lake ESU was uncertain.

Four adult sockeye returned to Redfish Lake in 1991; these were captured and taken into captivity to join several hundred smolts collected in spring 1991 as they outmigrated from Redfish Lake. The adults were spawned, and their progeny reared to adulthood along with the out migrants as part of a captive broodstock program, whose major goal was to perpetuate the gene pool for a short period of time (one or two generations) to give managers a chance to identify and address the most pressing threats to the population. As a result of this program and related research, a great deal of new information has been gained about the biology of Redfish Lake sockeye salmon and limnology of the lakes in the Stanley Basin. Genetic data collected from the returning adults and the out migrants showed that they were genetically similar but distinct from the Fishhook Creek kokanee. However, otolith microchemistry data (Rieman *et al*. 1994) indicated that many of the out migrants had a resident female parent. These results inspired a search of the lake for another population of resident fish that was genetically similar to the sockeye. These efforts led to discovery of a relatively small number (perhaps a few hundred) kokanee-sized fish that spawn at approximately the same time and place as the sockeye. These fish, termed "residual" sockeye salmon, are considered to be part of the listed ESU.

Subsequent genetic analysis (Winans *et al*. 1996, Waples *et al*. 1997) has established the following relationships between extant populations of sockeye salmon from the Stanley Basin and other populations in the Pacific Northwest: (1) Native populations of sockeye salmon from the Stanley Basin (including Redfish Lake sockeye and kokanee and Alturas Lake kokanee) are genetically quite divergent from all other North American sockeye salmon populations that have been examined; (2) within this group, Redfish Lake sockeye and kokanee are genetically distinct, and Alturas Lake kokanee are most similar to Redfish Lake kokanee; (3) two gene pools of sockeye salmon have been identified in Stanley Lake—one may be the remnant of a native gene pool that survived rotenone treatments in the lake, while the other can be traced to introductions from Wizard Falls Hatchery in Oregon; and (4) no trace of the original gene pool of sockeye salmon has been found in Pettit Lake. The population that has spawned in Pettit Lake in recent decades can be traced to introductions of kokanee from northern Idaho, and those populations in turn can be traced to stock transfers of Lake Whatcom (Washington) kokanee early in the last century.

Between 1991 and 1998, 16 naturally-produced adult sockeye returned to the weir at Redfish Lake and were incorporated into the captive broodstock program. This program, overseen by the

Stanley Basin Sockeye Technical Oversight Committee, has produced groundbreaking research in captive broodstock technology (Hebdon *et al*. 1999, Kline and Willard 2001, Frost *et al*. 2002) and limnology (Kohler *et al*. 2002). The program used three different rearing sites to minimize chances of catastrophic failure and has produced several hundred thousand eggs and juveniles, as well as several hundred adults, for release into the wild. A milestone was reached in 2000, when > 200 adults from the program returned to Redfish Lake. Currently, the captive broodstock program is being maintained as a short-term safety net, pending decisions about longer-term approaches to recovery of the ESU.

The Snake River Salmon Recovery Team (Bevan *et al*. 1994, NMFS 1995b) suggested that to be considered recovered under the ESA, this ESU should have viable populations in three different lakes, with at least 1,000 naturally-produced spawners per year in Redfish Lake and at least 500 in each of two other Stanley Basin lakes. As a step toward addressing this recommendation, releases of progeny from the Redfish Lake captive broodstock program have been made in Pettit Lake and Alturas Lake as well. In 1991, about 100 out migrants from Alturas Lake were collected at the same time as the Redfish Lake out migrants and reared to maturity as a separate population in captivity. However, because of funding and space limitations and uncertainties about priorities for propagating this population, the resulting adults were released into the lake rather than being kept for spawning and another generation of captive rearing. Because the Alturas Lake kokanee spawn earlier than Redfish lake sockeye and in the inlet stream, it is hoped that the introduction of Redfish Lake sockeye into Alturas Lake will not adversely affect this native gene pool.

Steelhead. Steelhead is the name commonly applied to the anadromous form of the biological species *Oncorhynchus mykiss*. The present distribution of steelhead extends from Kamchatka in Asia, east to Alaska, and down to southern California (NMFS 1999e), although the historical range of steelhead extended at least to the Mexico border (Busby *et al*. 1996). Steelhead exhibit perhaps the most complex suite of life-history traits of any species of Pacific salmonid. They can be anadromous or freshwater resident (and under some circumstances, apparently yield offspring of the opposite form). Those that are anadromous can spend up to 7 years in fresh water before smoltification, and then spend up to 3 years in salt water before first spawning. The half-pounder life-history type in Southern Oregon and Northern California spends only 2 to 4 months in salt water after smoltification, then returns to fresh water and outmigrates to sea again the following spring without spawning. This species can also spawn more than once (iteroparous), whereas all other species of *Oncorhynchus* except *O. clarki* spawn once and then die (semelparous). The anadromous form is under the jurisdiction of NOAA Fisheries, while the resident freshwater forms, usually called “rainbow” or “redband” trout, are under the jurisdiction of USFWS.

Although no subspecies are currently recognized within any of the species of Pacific salmon, Behnke (1992) has proposed that two subspecies of steelhead with anadromous life history occur in North America: *O. mykiss irideus* (the “coastal” subspecies), which includes coastal populations from Alaska to California (including the Sacramento River), and *O. mykiss gairdneri* (the “inland” subspecies), which includes populations from the interior Columbia, Snake and

Fraser Rivers. In the Columbia River, the boundary between the two subspecies occurs at approximately the Cascade Crest. A third subspecies of anadromous steelhead (*O. mykiss mykiss*) occurs in Kamchatka, and several other subspecies of steelhead are also recognized which only have resident forms (Behnke 1992).

Within the range of West Coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. In a given river basin there may be one or more peaks in migration activity; since these runs are usually named for the season in which the peak occurs, some rivers may have runs known as winter, spring, summer, or fall steelhead. For example, large rivers, such as the Columbia, Rogue, and Klamath Rivers, have migrating adult steelhead at all times of the year. Names used to identify the seasonal runs of steelhead vary locally; in Northern California, some biologists have retained the use of the terms spring and fall steelhead to describe what others would call summer steelhead.

Steelhead can be divided into two basic reproductive ecotypes, based on the state of sexual maturity at the time of river entry, and duration of spawning migration (Burgner *et al*. 1992). The stream-maturing type (summer steelhead in the Pacific Northwest and Northern California) enters fresh water in a sexually immature condition between May and October and requires several months to mature and spawn. The ocean-maturing type (winter steelhead in the Pacific Northwest and Northern California) enters fresh water between November and April with well-developed gonads and spawns shortly thereafter.

In basins with both summer and winter steelhead runs, it appears that the summer-run occurs where habitat is not fully used by the winter-run or a seasonal hydrologic barrier, such as a waterfall, separates them. Summer steelhead usually spawn farther upstream than winter steelhead (Withler 1988, Roelofs 1983, Behnke 1992). Coastal streams are dominated by winter steelhead, whereas inland steelhead of the Columbia River Basin are almost exclusively summer steelhead. Winter steelhead may have been excluded from inland areas of the Columbia River Basin by Celilo Falls or by the considerable migration distance from the ocean. The Sacramento/San Joaquin River Basin may have historically had multiple runs of steelhead that probably included both ocean-maturing and stream-maturing stocks (CDFG 1995, McEwan and Jackson 1996). These steelhead are referred to as winter steelhead by the CDFG; however, some biologists call them fall steelhead (Cramer *et. al* 1995). It is thought that hatchery practices and modifications in the hydrology of the basin caused by large-scale water diversions may have altered the migration timing of steelhead in this basin (D. McEwan, personal communication, cited in BRT 2003).

Inland steelhead of the Columbia River Basin, especially the Snake River Subbasin, are commonly referred to as either A-run or B-run. These designations are based on a bimodal migration of adult steelhead at Bonneville Dam (235 km from the mouth of the Columbia River) and differences in age (1- versus 2-ocean) and adult size observed among SR Basin steelhead. It is unclear, however, if the life-history and body size differences observed upstream are correlated back to the groups forming the bimodal migration observed at Bonneville Dam. Furthermore, the relationship between patterns observed at the dams and the distribution of adults in spawning areas throughout the Snake River Basin is not well understood. A-run steelhead are believed to occur throughout the steelhead-bearing streams of the Snake River Basin and the inland Columbia River; B-run steelhead are thought to be produced only in the Clearwater, Middle Fork Salmon, and South Fork Salmon Rivers (IDFG 1994).

The half-pounder is an immature steelhead that returns to fresh water after only 2 to 4 months in the ocean, generally overwinters in fresh water, and then outmigrates again the following spring. Half-pounders are generally less than 400 mm and are reported only from the Rogue, Klamath, Mad, and Eel Rivers of Southern Oregon and Northern California (Snyder 1925, Kesner and Barnhart 1972, Everest 1973, Barnhart 1986), however, it has been suggested that as mature steelhead, these fish may only spawn in the Rogue and Klamath River Basins (Cramer *et al*. 1995). Various explanations for this unusual life history have been proposed, but there is still no consensus as to what, if any, advantage it affords to the steelhead of these rivers.

In May 1992, NOAA Fisheries was petitioned by the Oregon Natural Resources Council (ONRC) and 10 co-petitioners to list Oregon's Illinois River winter steelhead (ONRC *et al*. 1992). NOAA Fisheries concluded that Illinois River winter steelhead by themselves did not constitute an ESA "species" (Busby *et al*. 1993, NMFS 1993). In February 1994, NOAA Fisheries received a petition seeking protection under the ESA for 178 populations of steelhead (anadromous steelhead) in Washington, Idaho, Oregon, and California. At the time, NOAA Fisheries was conducting a status review of coastal steelhead populations (*O. m. irideus*) in Washington, Oregon, and California. In response to the broader petition, NOAA Fisheries expanded the ongoing status review to include inland steelhead (*O. m. gairdneri*) occurring east of the Cascade Mountains in Washington, Idaho, and Oregon.

In 1995, the steelhead BRT met to review the biology and ecology of West Coast steelhead. After considering available information on steelhead genetics, phylogeny, and life history, freshwater ichthyogeography, and environmental features that may affect steelhead, the BRT identified 15 ESUs—12 coastal forms and three inland forms. After considering available information on population abundance and other risk factors, the BRT concluded that five steelhead ESUs (Central California Coast, South-Central California Coast, Southern California, Central Valley, and Upper Columbia River) were presently in danger of extinction, five steelhead ESUs (Lower Columbia River, Oregon Coast, Klamath Mountains Province, Northern California, and Snake River Basin) were likely to become endangered in the foreseeable future, four steelhead ESUs (Puget Sound, Olympic Peninsula, Southwest Washington, and Upper Willamette River) were not presently in significant danger of becoming extinct or endangered, although individual stocks within these ESUs may be at risk, and one steelhead ESU (Middle Columbia River) was not presently in danger of extinction but the BRT was unable to reach a conclusion as to its risk of becoming endangered in the foreseeable future.

Of the 10 steelhead ESUs identified by NOAA Fisheries and listed as threatened or endangered under the ESA, five occur in the overall action area (Table 1). The West Coast steelhead BRT met in January, March, and April 2003 to discuss new data received and to determine if the new information warranted any modification of the conclusions of the original BRT (BRT 2003).

Lower Columbia River (LCR) Steelhead. The status of LCR steelhead was initially reviewed by NOAA Fisheries in 1996 (Busby *et al*. 1996), and the most recent review occurred in 1998 (NMFS 1998d). In the 1998 review, the BRT noted several concerns for this ESU, including the low abundance relative to historical levels, the universal and often drastic declines observed since the mid-1980s, and the widespread occurrence of hatchery fish in naturally-spawning steelhead populations. Analysis also suggested that introduced summer steelhead may negatively affect winter native winter steelhead in some populations. A majority of the 1998 BRT concluded that steelhead in the LCR ESU were at risk of becoming endangered in the foreseeable future.

New data available for this update included: recent spawner data, additional data on the fraction of hatchery-origin spawners, recent harvest rates, updated hatchery release information, and a compilation of data on resident steelhead. For many of the Washington Chinook salmon populations, the WDFW has conducted analyses using the Ecosystem Diagnosis and Treatment (EDT) model (Busack and Rawding 2003). The EDT model attempts to predict fish population performance based on input information about reach-specific habitat attributes (http://www.olympus.net/community/dungenesswc/EDTprimer. pdf). New analyses for this update include the designation of demographically independent populations, recalculation of previous BRT metrics with additional years' data, estimates of median annual growth rate under different assumptions about the reproductive success of hatchery fish, and estimates of current and historically available kilometers of stream.

Based on the provisional framework discussed in the general Introduction to the BRT (2003) report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (*e.g.*, in Upper Clackamas, Sandy, and some of the small tributaries of the Columbia River Gorge) are not. Case 3 resident fish above dams on the Cowlitz, Lewis, and Sandy Rivers are of uncertain ESU status.

A large majority (over 79%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT found moderate risks in all the VSP categories, with mean risk matrix scores ranging from moderately low for spatial structure to moderately high for both abundance and growth rate/productivity. All of the major risk factors identified by previous BRTs still remain. Most populations are at relatively low abundance, and those with adequate data for modeling are estimated to have a relatively high extinction probability. Some populations, particularly summer-run, have shown higher returns in the last 2 to 3 years. The Willamette/Lower Columbia River Technical Review Team (Myers *et al*. 2002) has estimated that at least four historical populations are now extinct. The hatchery contribution to natural spawning remains high in many populations.

Upper Willamette River (UWR) Steelhead. The status of UWR steelhead was initially reviewed by NOAA Fisheries in 1996 (Busby *et al*. 1996) and the most recent review occur in 1999 (NMFS 1999e). In the 1999 review, the BRT noted several concerns for this ESU, including the relatively low abundance and steep declines since 1988. The previous BRT was also concerned about the potential negative interaction between non-native summer steelhead and wild winter steelhead. The previous BRT considered the loss of access to historical spawning grounds because of dams a major risk factor. The 1999 BRT reached a unanimous decision that the UWR steelhead ESU was at risk is of becoming endangered in the foreseeable future.

New data for UWR steelhead include redd counts and dam/weir counts through 2000, 2001, or 2002 and estimates of hatchery fraction and harvest rates through 2000. New analyses for this update include the designation of demographically independent populations, and estimates of current and historically available kilometers of stream.

As part of its effort to develop viability criteria for UWR steelhead, the Willamette/Lower Columbia Technical Recovery Team has identified historically demographically independent populations (Myers *et al*. 2002). Population boundaries are based on an application of Viable Salmonid Populations definition (McElhany *et al*. 2000). Myers *et al*. (2002) hypothesized that the ESU historically consisted of at least four populations (Mollala, North Santiam, South Santiam and Calapooia) and possibly a fifth (Coast Range). The historical existence of a population in the coast range is uncertain. The populations identified in Myers *et al*. are used as the units for the new analyses in the BRT (2003) report.

Based on the updated information provided in the BRT (2003) report, the information contained in previous UWR steelhead ESU status reviews, and preliminary analyses by the Willamette/Lower Columbia Technical Review Team, we could not conclusively identify a single population that is naturally self-sustaining. All populations are relatively small, with the recent mean abundance of the entire ESU at less than 6,000. Over the period of the available time series, most of the populations are in decline. The recent elimination of the winter-run hatchery production will allow estimation of the natural productivity of the populations in the future, but the available time series are confounded by the presence of hatchery-origin spawners. On a positive note, the counts all indicate an increase in abundance in 2001, likely at least partly as a result of improved marine conditions. The issue of changing marine conditions is discussed in the introduction to this update report, as it is an issue for may ESUs.

Because coastal cutthroat trout is a dominant species in the basin, resident steelhead are not as widespread here as in areas east of the Cascades. Resident fish below barriers are found in the Pudding/Molalla, Lower Santiam, Calapooia, and Tualatin drainages, and these would be considered part of the steelhead ESU based on the provisional framework discussed in the general Introduction. Resident fish above Big Cliff and Detroit Dams on the North Fork Santiam and above Green Peter Dam on the South Fork Santiam are of uncertain ESU affinity. Although no obvious physical barrier separates populations upstream from the Calapooia from those lower in the basin, resident steelhead in these upper reaches of the Willamette Basin are quite distinctive both phenotypically and genetically and are not considered part of the steelhead ESU.

The majority (over 76%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with small minorities falling in the “danger of extinction” and “not likely to become endangered" categories. The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories, ranging from moderately low for diversity to moderate spatial structure and growth rate/productivity. On a positive note, after a decade in which overall abundance (Willamette Falls count) hovered around the lowest levels on record, adult returns for 2001 and 2002 were up significantly, on par with levels seen in the 1980s. Still, the total abundance is small for an entire ESU, resulting in a number of populations that are each at relatively low abundance. The recent increases are encouraging but it is uncertain whether they can be sustained. The BRT considered it a positive sign that releases of the "early" winter-run hatchery population have been discontinued, but remained concerned that releases of non-native summer-run steelhead continue.

Middle Columbia River (MCR) Steelhead. The MCR steelhead ESU includes steelhead populations in Oregon and Washington drainages upstream from the Hood and Wind River systems to and including the Yakima River. The Snake River is not included in this ESU. Major drainages in this ESU are the Deschutes, John Day, Umatilla, Walla-Walla, Yakima, and Klickitat River systems. Almost all steelhead populations within this ESU are summer-run fish, the exceptions being winter-run components returning to the Klickitat, and Fifteen Mile Creek watersheds. Most of the populations within this ESU are characterized by a balance between 1- and 2-year-old smolt out migrants. Adults return after 1 or 2 years at sea.

Hatchery facilities are in a number of drainages within the geographic area of this ESU, although there are also subbasins with little or no direct hatchery influence. The John Day River system, for example, has not been outplanted with hatchery steelhead. Similarly, hatchery production of steelhead in the Yakima River system was relatively limited historically and has been phased out since the early 1990s. However, the Umatilla and the Deschutes River systems each have ongoing hatchery production programs based on locally derived broodstocks. Moreover, straying from out-of-basin production programs into the Deschutes River has been identified as a chronic occurrence. The Walla Walla River (three locations in Washington sections) historically received production releases of Lyons Ferry stock summer steelhead from the Lower Snake River Compensation Program (LSRCP). Mill Creek releases were halted after 1998 due to concerns associated with the then pending listing of MCR steelhead under the ESA. A new endemic broodstock is under development for the Touchet River release site (beginning with the 1999/2000 return year). Production levels at the Touchet and Walla Walla River release site have been reduced in recent years (WDFW, cited in BRT 2003).

Blockages have prevented access to sizable steelhead production areas in the Deschutes River and the White Salmon River. In the Deschutes River, Pelton Dam blocks access to upstream habitat historically used by steelhead. Conduit Dam, constructed in 1913, blocked access to all but 2-3 miles of habitat suitable for steelhead production in the Big White Salmon River (Rawding 2001). Substantial populations of resident trout exist in both areas.

The previous reviews (BRT 1998, 1999) identified several concerns including relatively low spawning levels in those streams for which information was available, a preponderance of negative trends (10 out of 14), and the widespread presence of hatchery fish throughout the ESU.

The 1999 BRT review specifically identified the serious declines in abundance in the John Day River Basin as a point of concern given that the John Day system had supported large populations of naturally-spawning steelhead in the recent past. Concerns were also expressed about the low abundance of returns to the Yakima River system relative to historical levels with the majority of production coming from a single stream (Satus Creek). The sharp decline in returns to the Deschutes River system was also identified as a concern.

The 1999 BRT review identified increases of stray steelhead into the Deschutes River as a "major source of concern." The review acknowledged that initial results from radio tagging studies indicated that a substantial proportion of steelhead entering the Deschutes migrated out of the system before spawning. The previous BRT review identified a set of habitat problems affecting basins within this ESU. High summer and low winter temperatures are characteristic of production or migration reaches associated with populations within this ESU. Water withdrawals have seriously reduced flow levels in several Mid-Columbia drainages, including sections of the Yakima, Walla-Walla, Umatilla, and Deschutes Rivers. Riparian vegetation and instream structure has been degraded in many areas—the previous BRT report states that of the stream segments inventoried within this ESU, riparian restoration is needed for between 37% and 84% of the riverbank in various basins.

The John Day is the only basin of substantial size in which production is clearly driven by natural spawners. For the other major basin in the ESU, the Klickitat, no quantitative abundance information is available. The other difficult issue centered on how to evaluate contribution of resident fish, which according to Kostow (2003) and other sources are very common in this ESU and may greatly outnumber anadromous fish. The BRT concluded that the relatively abundant and widely distributed resident fish somewhat mitigated extinction risk in this ESU. However, due to significant threats to the anadromous component the majority of BRT members concluded the ESU was likely to become endangered.

Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Based on the provisional framework discussed in the general Introduction to the BRT (2003), the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (*e.g.*, in Deschutes and John Day Basins) are not. Case 3 resident fish above Condit Dam in the Little White Salmon; above Pelton and Round Butte Dams (but below natural barriers) in the Deschutes; and above irrigation dams in the Umatilla Rivers are of uncertain ESU status.

A slight majority (51%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with a substantial minority (49%) falling in the "not likely to become endangered" category. The BRT did not identify any extreme risks for this ESU but found moderately risks in all the VSP categories. This ESU proved difficult to evaluate for two reasons. First, the status of different populations within the ESU varies greatly. On the one hand, the abundance in two major basins, the Deschutes and John Day, is relatively high and over the last five years is close to or slightly over the interim recovery targets (NMFS 2002a). On the other hand, steelhead in the Yakima Basin, once a large producer of steelhead, remain severely depressed (10% of the interim recovery target), in spite of increases in the last 2 years. Furthermore, in recent years escapement to spawning grounds in the Deschutes River has been dominated by stray, out-of-basin (and largely out-of-ESU) fish—which raises substantial questions about genetic integrity and productivity of the Deschutes population.

Upper Columbia River (UCR) Steelhead. The life-history patterns of UCR steelhead are complex. Adults return to the Columbia River in the late summer and early fall; most migrate relatively quickly up the mainstem to their natal tributaries. A portion of the returning run overwinters in the mainstem reservoirs, passing over the upper mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the calendar year following entry into the river. Juvenile steelhead spend 1 to 7 years rearing in freshwater before migrating to the ocean. Smolt outmigrations are predominately age 2 and age 3 juveniles. Most adult steelhead return after 1 or 2 years at sea, starting the cycle again.

Estimates of the annual returns of UCR steelhead populations are based on dam counts. Cycle counts are used to accommodate the prevalent return pattern in up-river summer steelhead (runs enter the Columbia River in late summer and fall, some fish overwinter in mainstem reservoirs—migrating past the upper dams before spawning the following spring). Counts over Wells Dam are assumed to be returns originating from natural production and hatchery outplants into the Methow and Okanogan River systems. The total returns to Wells Dam are calculated by adding annual broodstock removals at Wells to the dam counts. The annual estimated return levels above Wells Dam are broken down into hatchery and wild components by applying the ratios observed in the Wells sampling program for run years since 1982.

Harvest rates on upper river steelhead have been cut back substantially from historical levels. Direct commercial harvest of steelhead in non-Indian fisheries was eliminated by legislation in the early 1970s. Incidental impacts in fisheries directed at other species continued in the lower river, but at substantially reduced levels. In the 1970s and early 1980s, recreational fishery impacts in the Upper Columbia escalated to very high levels in response to increasing returns augmented by substantial increases in hatchery production. In 1985, steelhead recreational fisheries in this region (and in other Washington tributaries) were changed to mandate release of wild fish. Treaty harvest of summer-run steelhead (including returns to the Upper Columbia) occurs mainly in mainstem fisheries directed at up-river bright fall Chinook.

Hatchery returns predominate the estimated escapement in the Wenatchee, Methow and Okanogan River drainages. The effectiveness of hatchery spawners relative to their natural counterparts is a major uncertainty for both populations. Hatchery effectiveness can be influenced by at least three sets of factors: (1) Relative distribution of spawning adults; (2) relative timing of spawning adults; and (3) relative effectiveness of progeny. No direct information is available for the Upper Columbia River stocks. Outplanting strategies have varied over the time period the return/spawner data were collected (1976-1994 broodyears). While the return timing into the Columbia River is similar for both wild and hatchery steelhead returning to the Upper Columbia, the spawning timing in the hatchery is accelerated. The long-term effects of such acceleration on the spawning timing of returning hatchery-produced adults in nature is not known. We have no direct information on relative fitness of UCR steelhead progeny with at least one parent of hatchery origin.

The 1998 steelhead status review identified a number of concerns for the UCR steelhead ESU. While the total abundance of populations within this ESU has been relatively stable or increasing, it appears to be occurring only because of major hatchery supplementation programs. Estimates of the proportion of hatchery fish in spawning escapement are 65% (Wenatchee River) and 81% (Methow and Okanogan Rivers). The major concern for this ESU is the clear failure of natural stocks to replace themselves. The BRT members are also strongly concerned about the problems of genetic homogenization due to hatchery supplementation, apparent high harvest rates on steelhead smolts in rainbow trout fisheries and the degradation of freshwater habitats within the region, especially the effects of grazing, irrigation diversions and hydroelectric Dams. The BRT also identified two major areas of uncertainty; relationship between anadromous and resident forms, and the genetic heritage of naturally-spawning fish within this ESU.

Based on the provisional framework discussed in the general introduction to the BRT (2003) report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (*e.g.*, in the Entiat, Methow, and perhaps Okanogan Basins) are not. Resident fish potentially occur in all areas in the ESU used by steelhead. Case 3 resident fish above Conconully Dam are of uncertain ESU affinity. The BRT did not attempt to resolve the ESU status of resident fish residing above Grand Coulee Dam, as little new information is available relevant to this issue. Possible ESU scenarios for these fish include: (1) They were historically part of the ESU and many of the remnant resident populations still are part of this ESU; (2) they were historically part of the ESU but no longer are, due to either introductions of hatchery rainbow trout or rapid evolution in a novel environment; or (3) they were historically part of a separate ESU. For many BRT members, the presence of relatively numerous resident fish mitigated the assessment of extinction risk for the ESU as a whole.

A slight majority (54%) of the BRT votes for this ESU fell in the “danger of extinction” category, with most of the rest falling in the “likely to become endangered” category. The most serious risk identified for this ESU was growth rate/productivity, estimated to be high to very high; other VSP factors were also relatively high, ranging from moderate for spatial structure to moderately high for diversity. The last 2 to 3 years have seen an encouraging increase in the number of naturally-produced fish in this ESU. However, the recent mean abundance in the major basins is still only a fraction of interim recovery targets (NMFS 2002a). Furthermore, overall adult returns are still dominated by hatchery fish, and detailed information is lacking regarding productivity of natural populations. The ratio of naturally-produced adults to the number of parental spawners (including hatchery fish) remains low for UCR steelhead. The BRT did not find data to suggest that the extremely low replacement rate of naturally-spawning fish (estimated adult:adult ratio was only 0.25-0.3 at the time of the last status review update) has improved substantially.

Snake River Basin (SR) Steelhead. The SR steelhead ESU is distributed throughout the Snake River drainage system, including tributaries in southwest Washington, eastern Oregon and north/central Idaho (NMFS1997b). SR steelhead migrate a substantial distance from the ocean (up to 1,500 km) and use high elevation tributaries (typically 1,000-2,000 m above sea level) for spawning and juvenile rearing. SR steelhead occupy habitat that is considerably warmer and drier (on an annual basis) than other steelhead ESUs. SR steelhead are generally classified as summer-run, based on their adult run timing patterns. Summer steelhead enter the Columbia River from late June to October. After holding over the winter, summer steelhead spawn during the following spring (March to May). Managers classify up-river summer steelhead runs into to groups based primarily on ocean age and adult size upon return to the Columbia River. A-run steelhead are predominately age-1 ocean fish while B-run steelhead are larger, predominated by age-2 ocean fish.

With the exception of the Tucannon River and some small tributaries to the mainstem Snake River, the tributary habitat used by SR steelhead ESU is above Lower Granite Dam. Major groupings of populations and/or subpopulations can be found in: (1) The Grande Ronde River system; (2) the Imnaha River drainage; (3) the Clearwater River drainages; (4) the South Fork Salmon River; (5) the smaller mainstem tributaries before the confluence of the mainstem; (6) the Middle Fork salmon production areas, (7) the Lemhi and Pahsimeroi valley production areas; and (8) Upper Salmon River tributaries.

Resident steelhead are believed to be present in many of the drainages used by SR steelhead. Very little is known about interactions between co-occurring resident and anadromous forms within this ESU. The following review of abundance and trend information focuses on information directly related to the anadromous form.

Although direct historical estimates of production from the Snake Basin are not available, the basin is believed to have supported more than half of the total steelhead production from the Columbia Basin (Mallet 1974). Some historical estimates of returns are available for portions of the drainage. Lewiston Dam, constructed on the Lower Clearwater, began operation in 1927. Counts of steelhead passing through the adult fish ladder at the dam reached 40 to 60,000 in the early 1960s (Cichosz *et al*. 2001). Based on relative drainage areas, the Salmon River Basin likely supported substantial production as well. In the early 1960s, returns to the Grande Ronde River and the Imnaha River may have exceeded 15,000 and 4,000 steelhead per year, respectively (ODFW 1991). Extrapolations from tag/recapture data indicate that the natural steelhead return to the Tucannon River may have exceeded 3,000 adults in the mid-1950s (WDFW 1991). The previous status review noted that the aggregate trend in abundance as measured by ladder counts at the uppermost Snake River dam (Lower Granite Dam since 1972) has been upward since the mid-1970s while the aggregate return of naturally-produced steelhead was downward for the same period. The decline in natural production was especially pronounced in the later years in the series.

The primary concern regarding SR steelhead identified in the 1998 status review was a sharp decline in natural stock returns beginning in the mid-1980s. Of 13 trend indicators at that time, nine were in decline and four were increasing. In addition, Idaho Department of Fish and Game parr survey data indicated declines for both A- and B-run steelhead in wild and natural stock areas. The high proportion of hatchery fish in the run was also identified as a concern, particularly because of the lack of information on the actual contribution of hatchery fish to natural spawning. The review recognized that some wild spawning areas have relatively little hatchery spawning influence (Selway River, Lower Clearwater River, the Middle and South Forks of the Salmon River and the Lower Salmon River). In other areas, such as the Upper Salmon River, there is likely little or no natural production of locally-native steelhead. The review identified threats to genetic integrity from past and present hatchery practices as a concern. Concern for the North Fork Clearwater stock was also identified. That stock is currently maintained through the Dworshak Hatchery program but cut off from access to its native tributary by Dworshak Dam. The 1998 review also highlighted concerns for widespread habitat degradation and flow impairment throughout the Snake Basin as well as for the substantial modification of the seaward migration corridor by hydroelectric power development on the Snake and Columbia mainstems.

Estimates of annual returns to specific production areas are not available for most of the SR ESU. Estimates are available for two tributaries below Lower Granite Dam (Tucannon and Asotin Creek). Annual ladder counts at Lower Granite Dam and associated sampling information allows for an estimate of the aggregate returns to the Snake River Basin. In addition, area specific estimates are available for the Imnaha River and two major sections of the Grande Ronde River system. Returns to Lower Granite Dam remained at relatively low levels through the 1990s; the 2001 run size at Lower Granite Dam was substantially higher relative to the 1990s. The recent geometric mean abundance was down for the Tucannon River relative to the last BRT status review. Returns to the Imnaha River and to the Grande Ronde River survey areas were generally higher relative to the early 1990s.

Overall, long-term trends remained negative for four of the nine available series (including aggregate measures and specific production area estimates). Short-term trends improved relative to the period analyzed for the previous status review. The median short-term trend was +2.0% for the 1990 to 2001 period. Five out of the nine data sets showed a positive trend.

Based on the provisional framework discussed in the general introduction to the BRT (2003) report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (*e.g.*, in the Palouse and Malad Rivers) are not. Recent genetic data suggest that native resident steelhead above Dworshak Dam on the North Fork Clearwater River should be considered part of this ESU, but hatchery rainbow trout that have been introduced to that and other areas would not. The BRT did not attempt to resolve the ESU status of resident fish residing above the Hell's Canyon Dam complex, as little new information is available relevant to this issue. However, Kostow (2003) suggested that, based on substantial ecological differences in habitat, the anadromous steelhead that historically occupied basins upstream from Hells Canyon (*e.g.*, Powder, Burnt, Malheur, Owhyee Rivers) may have been in a separate ESU. For many BRT members, the presence of relatively numerous resident fish mitigated the assessment of extinction risk for the ESU as a whole.

On a more positive note, sharp upturns in 2000 and 2001 in adult returns in some populations and evidence for high smolt-adult survival indicate that populations in this ESU are still capable of responding to favorable environmental conditions. In spite of the recent increases, however, abundance in most populations for which there are adequate data are well below interim recovery targets (NMFS 2002a).

A majority (over 70%) of the BRT votes for this ESU fell in the "likely to become endangered" category, with small minorities falling in the "danger of extinction" and "not likely to become endangered" categories. The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories, ranging from moderately low risk for spatial structure to moderate risk for growth rate/productivity. The continuing depressed status of B-run populations was a particular concern. Paucity of information on adult spawning escapements to specific tributary production areas makes a quantitative assessment of viability for this ESU difficult. As indicated in previous status reviews, the BRT remained concerned about the replacement of naturally-produced fish by hatchery fish in this ESU; naturally produced fish now make up only a small fraction of the total adult run. Again, lack of key information considerably complicates the risk analysis. Although several large production hatcheries for steelhead occur throughout this ESU, relatively few data exist regarding the numbers and relative distribution of hatchery fish that spawn naturally, or the consequences of such spawnings when they do occur.

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 C.F.R. 402.02). For projects that are ongoing actions, the effects of all past actions are part of the environmental baseline and the effects of future actions over which the Federal agency has discretionary involvement or control will be analyzed as "effects of the action."

Analysis of the environmental baseline is guided by the specific habitat components necessary to support salmon and steelhead within the action area. When the environmental baseline departs from conditions that support those biological requirements, it becomes more likely that additional risk to the ESU resulting from the effects of the proposed action on the ESU or its habitat will result in jeopardy (NMFS 1999f). The biological requirements of salmon and steelhead in the action area vary depending on the life history stage present and the natural range of variation present within that system (Groot and Margolis 1991, NRC 1996, Spence *et al*. 1996).

Generally, during spawning migrations, adult salmon require clean water with cool temperatures or thermal refugia, dissolved oxygen near 100%, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Spawning areas are selected based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (*e.g.*, gravel size, porosity, permeability, oxygen levels), substrate stability during high flows, and, for most species, water temperatures of 13˚C or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires unobstructed access to these habitats. Physical, chemical, and thermal conditions may all impede migrations of adult or juvenile fish.

Each ESU considered in this Opinion resides in or migrates through the action area. Thus, for this action area, the biological requirements for salmon and steelhead are the habitat characteristics that would support successful juvenile rearing, juvenile migration, juvenile growth and development to adulthood, adult migration, and adult spawning.

The analysis presented here is based primarily on the *Oregon State of the Environment Report 2000* (the *Report)*, published by the Oregon Progress Board in September 2000 (Risser 2000) and the Programmatic Biological Evaluation produced for this Consultation (USACE 2002). Additional information on implementation of SLOPES is presented above, in the Background and Consultation History section.

The *Report* provides a comprehensive review of Oregon's environmental baseline in terms of all of its interrelated parts and natural processes. It was developed using a combination of analyses of existing data and best professional scientific judgment. Aquatic ecosystems, marine ecosystems, estuarine ecosystems, freshwater wetlands, and riparian ecosystems were among the resources considered. A set of indicators of ecosystem health was proposed for each resource system and as benchmarks for the State's use in evaluating past decisions and for planning future policies to improve Oregon's environment and economy. The *Report* also included findings regarding the environmental health of Oregon's eight ecoregions and conclusions about future resource management needs. Highlights of the *Report* follow.

State of Oregon. Oregon's currently available water supplies are often fully or over-allocated during low flow months of summer and fall. In the Columbia Plateau ecoregion, less that 20% of instream water rights can expect to receive their full allocation nine months of the year. In the Willamette Valley and Cascades ecoregions, more than 80% of the instream water rights can expect to receive their full allocation in the winter, but only about 25% in the early fall. Increased demand for water is linked to the projected 34% increase in human population over the next 25 years in the state. Depletion and storage of natural flows have altered natural hydrological cycles in basins occupied by listed ESUs. This may cause juvenile salmon mortality through: (1) Migration delay resulting from insufficient flows or habitat blockages; (2) loss of sufficient habitat due to dewatering and blockage; (3) stranding of fish resulting from rapid flow fluctuations; (4) entrainment of juveniles into poorly screened or unscreened diversions; and
(5) increased juvenile mortality resulting from increased water temperatures (Spence *et al.* 1996). Reduced flows also negatively affected fish habitats due to increased deposition of fine sediments in spawning gravels, decreased recruitment of new spawning gravels, and

encroachment of riparian and exotic vegetation into spawning and rearing areas. Further, some climate models predict 10 to 25% reductions in late spring-summer-early fall runoff amounts in the coming decades.

Water quality in Oregon was categorized using the Oregon Water Quality Index (OWQI). The OWQI is a large, consistent and reliable data set that covers the state. It is based on a combination of measurements of temperature, dissolved oxygen, biochemical oxygen demand, pH, ammonia and nitrate nitrogen, total phosphorus, total solids and fecal coliform. Because water quality is influenced by streamflow, water quality indices are measured during high and low flow periods. Two key water quality factors affecting salmon are water temperature and fine sediment. Summer temperatures above 16ºC puts fish at greater risk through effects that range from the individual organism to the aquatic community level. These effects impair salmon productivity from the reach to the stream network scale by reducing the area of usable habitat and reducing the diversity of coldwater fish assemblages. The loss of vegetative shading is the predominant cause of elevated summer water temperature. Smaller streams with naturally lower temperatures that are critical to maintaining downstream water temperatures are most vulnerable to this effect. The same factors that elevate summer water temperature can decreases winter water temperatures and put salmon at additional risk. Widespread channel widening and reduced base flows further exacerbate seasonal water temperature extremes.

Sedimentation from logging, mining, urban development, and agriculture are a primary cause of salmon habitat degradation. In general, effects of sedimentation on salmons are well documented and include: (1) Clogging and abrasion of gills and other respiratory surfaces; (2) adhering to the chorion of eggs; (3) providing conditions conducive to entry and persistence of disease-related organisms; (4) inducing behavioral modifications; (5) entombing different life stages; (6) altering water chemistry by the absorption of chemicals; (7) affecting useable habitat by scouring and filling pools and riffles and changing bedload composition; (8) reducing photosynthetic growth and primary production; and (9) affecting intergravel permeability and dissolved oxygen levels (Spence *et al*. 1996).

Generally, water quality in Oregon is poor for salmon during low flow periods, except in mountainous areas. Instances of excellent or good water quality occur most often in the forested uplands. Poor or very poor water quality occurs most often in the non forested lowlands where land has been converted to agricultural and urban uses. Most ecoregions include some rivers and streams with excellent water quality and other with very poor water quality. Only the Cascades ecoregion has excellent water quality overall as shown by average OWQI measurements. The Willamette Valley, Columbia Plateau, Northern Basin and Range, and southern end of the Eastern Cascade Slope ecoregions have poor water quality indices. The effects of pesticides and fertilizers, especially nitrates, on water supplies and aquatic habitats are a significant concern. Almost all categories of water pollution are growing, as are hazardous waste emissions, air pollution, toxic releases, and waste generation.

Depending on the species, salmon spend from a few days to one or two years in an estuary before migrating out to the ocean. Natural variability and extremes in temperature, salinity, tides and river flow make estuarine ecosystems and organisms relatively resilient to disturbance. However, alterations such as filling, dredging, the introduction of nonnative species, and excessive waste disposal have changed Oregon's estuaries, reducing their natural resiliency and functional capacity. The most significant historical changes in Oregon's estuaries are the diking, draining and filling of wetlands and the stabilization, dredging and maintenance of navigation channels. Between 1870 and 1970, approximately 50,000 acres or 68% of the original tidal wetland areas in Oregon estuaries were lost. Despite these significant historical wetland conversions and continuing degradation by pollutants, nuisance species, and navigational improvement, much of the original habitat that existed in the mid-1800s is still relatively intact and under protection of local zoning plans. Hundreds of acres of former estuarine marshes are now being restored.

Nonnative species now comprise a significant portion of Oregon's estuarine flora and fauna. Some, such as the European green crab, pose serious threats to native estuarine communities necessary to support healthy salmon populations. Consumptive use of fresh water in the upper watersheds has reduced freshwater inflow to estuaries by as much as 60 to 80%, thus reducing the natural dilution and flushing of pollutants. Other significant concerns include excessive sediment and runoff pollution from local and watershed source, and pressures associated with population and tourism growth.

Oregon contains approximately 114,500 miles of rivers and streams. No statewide measurements exist of the area of riparian vegetation, although some estimates have been made for more localized regions. Using the conservative estimate of a 100-yard riparian corridor on each side of the stream, the total area of riparian habitats for flowing water in Oregon may be 22,900 square miles. That is equal to approximately 15% of the total area of the state. With the exception of fall Chinook, which generally spawn and rear in the mainstem, salmon and steelhead spawning and rearing habitat is found in tributaries where riparian areas are a major habitat component. Healthy riparian areas retain the structure and function of natural landscapes as they were before the intensive land use and land conversion that has occurred over the last 150 to 200 years. However, land use activities have reduced the numbers of large trees, the amount of closed-canopy forests, and the proportion of older forests in riparian areas. In western Oregon, riparian plan communities have been altered along almost all streams and rivers.

In the western Cascades, Willamette Valley, Coast Range, and Klamath Mountains, riparian areas on privately-owned land are dominated by younger forests because of timber harvest, whereas riparian areas on public lands have more mature conifers. Old coniferous forests now comprise approximately 20% of the riparian forests in the Cascades, but only 3% in the Coast Range. Older forests historically occurred along most of the McKenzie River, but now account for less than 15% of its riparian forests. Along the mainstem of the Upper Willamette River, channel complexity has been reduced by 80% and the total area of riparian forest has been reduced by more than 80% since the 1850s. Downstream portions of the Willamette River have experienced little channel change, but more than 80% of the historical riparian forest has been lost.

Beginning in the early 1800s, riparian areas in eastern and southern Oregon were extensively changed by trapping beaver, logging, mining, livestock grazing, agricultural activities, and associated water diversion projects. Very little of the once extensive riparian vegetation remains to maintain water quality and provide habitats for threatened salmon. Dams have affected flow, sediment, and gravel patterns, which in turn have diminished regeneration and natural succession of riparian vegetation along downstream rivers. Introduced plant species pose a risk to some riparian habitat by dominating local habitats and reducing the diversity of native species. Improper grazing in riparian areas is another significant threat.

Sixty-three species or recognized subspecies of native freshwater fish occur in Oregon. Currently, 14 of those species or subspecies are listed under the ESA as threatened or endangered. An additional 15 species are considered potentially at-risk and are listed as candidate species. Thus, 45% of Oregon's freshwater fish species have declined and are at some risk of extinction. Among the 50 states, Oregon ranks fifth for the greatest number of listed fish species. In response to concern about the health of salmon populations, commercial and sport harvests have been sharply curtailed, and fishing for coastal coho salmon was eliminated entirely from 1994 to 1998.

Occurrence of tumors, lesions, and deformities in fish is a direct measure of fish health. Systematic data regarding this problem are not available statewide. In the Willamette River, skeletal deformities comprised less than 5% of the sampled population upstream from Corvallis, 20% between Corvallis and Newberg, and 56% of the sampled population in the Newberg pool.

More than 32 species of freshwater fish have been introduced into Oregon, and are now self-sustaining, making up approximately one-third of Oregon's freshwater fish fauna. Introduced species are frequently predators on native species, compete for food resources, and alter freshwater habitats. In 1998, introduced species were found to comprise 5% of the number of species found in the Upper Willamette River, but accounted for 60% of the observed species in the lower river near Portland.

In summary, the *Report* makes it clear that environmental baseline conditions are most critical in lowlands of major river basins, where most Oregonians live and work. Flow conditions and water quality are poor and riparian structure and function has been significantly degraded from historical conditions. These and other problems reflect the aggregate effects of many small, diffuse, individual decisions and actions.

State of Washington. For the purposes of programmatic consultations, Seattle District Corps has separated Washington State into five geographic regions: (1) Coastal Washington Watersheds; (2) Puget Sound, Hood Canal, Strait of Juan de Fuca, and Strait of Georgia Watersheds; (3) Lower Columbia River Watersheds; (4) Middle and Upper Columbia River Watersheds; and (5) Snake River Watersheds. This programmatic consultation applies only to the mainstem Columbia River from McNary Dam to the river mouth. This area encompasses the Lower Columbia River Region 3 (Clark, Cowlitz, Lewis, Pacific, Skamania and Wahkiakum

Counties), and the southern portion of the Middle Columbia River Region 4 (Klickitat and Benton Counties).

In Region 3, the majority of the upper watersheds have experienced some levels of timber harvesting with most of the timber production focused in Wahkiakum County, the eastern portions Lewis, Cowlitz, and Clark Counties, and Skamania County. Waterbody impairments are often associated with areas where the timber has been over harvested. Some watersheds, such as the Upper Grays River in Wahkiakum County, which have experienced expansive timber harvest and increased flows due to lack of runoff retention have flooding problems throughout the basin. Flooding can cause streambank erosion, deposition of fines, shallowing of streambeds and subsequent temperature warming downstream.

Many of the waterbodies exceed Washington State Water Quality Standards for temperature, sedimentation, and dissolved oxygen (WDOE 2000). A limiting factors analysis has identified problems of excessive fine sediments, lack of LWD in streams and in LWD recruitment areas, and elevated summer water temperatures. These factors are associated with high forest road densities, removal of riparian habitat, and road construction in riparian areas.

Significant agricultural production occurs throughout the Lower and Middle Columbia River watersheds. Conversion of habitat to agricultural lands has resulted in loss of riparian habitat, unstable streambanks due to poor cattle exclusion devices, excessive chemical levels in the water associated with pesticides and herbicides, high water temperatures, low dissolved oxygen levels and high levels of fecal coliform (WDOE 2000). Many streams exceed appropriate width/depth ratios, resulting in high temperatures, sheet flow at high waters, and inadequate velocity levels at low flows. Agricultural production has also increased disturbance related to invasive plant species. Within the watersheds, several waterbodies have issues with fish passage either due to road crossing or small dams constructed for irrigation of agricultural lands.

Several hydropower projects including the Bonneville Dam on the mainstem Columbia River have caused adverse effects directly to listed species and to habitat along the Lower Columbia River. The series of dams along the Columbia River have blocked an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia, replenishing the shorelines along the Washington and Oregon Coasts.

Industrial harbor and port development have been significant within the Lower Columbia River watersheds, and along the mainstem Columbia River. One hundred 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 Corps since 1878. Originally dredged to a depth of 20 feet minimum in 1878, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 40 feet and a width of 600 feet. The average amount dredged each year is 5.5 million cubic yards of material (NMFS 2002b). The Lower Columbia River supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. These ports primarily focus on the transport of timber and agricultural commodities. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, several sediment chemical exceedances, 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 activities

The most extensive urban development in the Lower Columbia River Watershed occurs in the Vancouver/Camas area. Outside of this major urban area, the majority of residential development relies on septic systems. Common water contaminants associated with urban development and residential septic systems include excessive water temperatures, lowered dissolved oxygen levels, fecal coliform, and chemicals associated with pesticides and urban runoff.

Lower Columbia River watersheds have also been significantly altered by sand and gravel mining activities both in the past and at present. Many streams and rivers have excessive sediment levels and unstable riparian areas due to instream mining or upland mining with poor sediment and erosion control measures.

Summary. NOAA Fisheries concludes that not all of the biological requirements of the species within the action area are being met under current conditions, based on the best available information on the status of the affected species; information regarding population status, trends, and genetics; and the environmental baseline conditions within the action area. Significant improvement in habitat conditions over those currently available under the environmental baseline is needed to meet the biological requirements for survival and recovery of these species.

Effects of the Action

"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 C.F.R. 402.02). If the proposed action includes offsite measures to reduce net adverse impacts by improving habitat conditions and survival, NOAA Fisheries will evaluate the net combined effects of the proposed action and the offsite measures as interrelated actions.

"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 (50 C.F.R. 402.02). Future Federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this Opinion.

"Indirect effects" are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 C.F.R. 402.02). Indirect effects may occur outside the area directly affected by the action, and may include other Federal actions that have not undergone section 7 consultation but will result from the action under consideration.

The effects of the proposed action will vary depending on the individual projects approved using SLOPES. Thus, the effects of the proposed action, taken as a whole, are the combined effects of these projects. The proposed conservation measures apply to both the administration of SLOPES and to the individual projects authorized using SLOPES, and are intended to avoid or minimize adverse effects resulting from these individual projects. Effects likely to occur after the proposed conservation measures have been fully applied at the program and project scale will be analyzed in this Opinion. The effects discussion will first describe the relationship between the proposed action and the terms and conditions and how program administration will ensure that all likely project scale effects will be constrained to those analyzed in this Opinion.

The conservation measures will be followed by all projects approved using SLOPES, and will be provided to all applicants who choose to have their permits approved in this manner. NOAA Fisheries regards these conservation measures as integral components of the SLOPES program and consider them part of the action.

Activities that are authorized using SLOPES and completed according to the conservation measures described below and the Reasonable and Prudent Measures and Terms and Conditions described in the Incidental Take Statement do not require further consultation. However, activities identified within the Opinion as "exclusions" have a greater likelihood of adverse impacts to listed species and their habitats and require individual consultation. These exclusions include, but are not limited to, actions such as:

- Exploration or construction activities, including surface water diversion and release of construction discharge water, within 300 feet upstream from any occupied redd until fry emerge, or within 300 feet of native submerged aquatic vegetation.
- Use of pesticides.
- Temporary roads or drilling pads built on steep slopes, where grade, soil types, or other features suggest a likelihood of excessive erosion or failure.
- Exploratory drilling in estuaries that cannot be conducted from a work barge, or an existing bridge, dock, or wharf.
- Installation of a fish screen on any permanent water diversion or intake that is not already screened.
- Any projects that require in-water installation of hollow steel piling that is larger than 24-inches in diameter, or use of H-pile larger than designation HP24.
- Drilling or sampling in an Environmental Protection Agency (EPA)-designated Superfund Site, a state-designated clean up area, or the likely impact zone of a significant contaminant source, as identified by historical information or the Corps' best professional judgment.
- Compensatory mitigation actions that require construction of permanent structures, maintenance beyond the establishment period or after the performance standards have been met, creation of habitat functions where they did not historically exist, or that simply preserve existing functions.
- Permits for site preparation for construction of buildings and related features inside the riparian management area are not authorized by this Opinion.

- Use of dikes, groins, buried groins, drop structures, porous weirs, weirs, riprap, rock toes, and similar structures to stabilize streambanks, are not authorized by this Opinion, despite the addition of large wood. Use of concrete logs or cable (wire rope) or chains to anchor an engineered log jam are not authorized by this Opinion, unless otherwise approved in writing by NOAA Fisheries.
- Permits for new or upgraded water control structures are not authorized by this Opinion. Tide gate repairs, maintenance or replacement, other than full removal, are not authorized by this Opinion.
- Channel[9] maintenance.
- A baffled culvert or fishway.
- A new or replacement bridge pier or abutment below ordinary high water.
- A new, permanent road inside the riparian management area that is not a bridge approach.
- Trash rack cleaning more than 20 feet upstream or downstream from the trash rack.
- Culvert cleaning more than 20 feet upstream or downstream from the culvert apron.
- A replacement bridge without full removal of the existing bridge, support structures and approach fills.
- A new bridge approach within the 100-year floodplain that will require embankment fills that impair floodplain hydraulic capacity.
- Maintenance activities that do not return all large wood, cobbles and gravels to the stream channel.
- Maintenance activities that are likely to affect fish passage conditions adversely.
- Construction or upgrading of a gas, sewer or water line to support a new or expanded service area.
- A new or expanded boat house, boat ramps made of asphalt, a buoy or float in an inactive anchorage and fleeting area, covered moorage, floating storage unit, houseboats, marinas, or non-water-related facilities (*e.g.*, parking lots, picnic areas, restrooms) inside the riparian management area.
- Any other over-water structures more than 6 feet wide, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.
- A new or expanded over-water structure that is in an estuary or other saltwater area,[10] an area with insufficient flow to dissipate fuels and other pollutants from vessels, within 0.5 miles downstream from the confluence of a spawning tributary, where a floating dock is likely to ground out or where moored boats will prop wash the bottom, or that requires pre-construction excavation, routine maintenance dredging (*e.g.*, alcoves, backwater sloughs, side channels, other shallow-water areas), or construction of a breakwater, jetty, or groin.

---

[9] A channel is different from a ditch in that a channel is a facility that collects drainage water, can be parallel or perpendicular to the roadway, and may or may not also contain a natural stream.

[10] "Estuary or other saltwater area" means an area with maximum intrusion of more than 0.5 ppt measured at depth; in the Columbia River, this includes all areas downstream from Jim Crow Sands (river mile 27).

- Minor discharge and excavation of any channel for a water intake that does not have a fish screen installed, operated and maintained according to NOAA Fisheries' fish screen criteria.

NOAA Fisheries further believes that full achievement of the SLOPES program is likely to make a substantial contribution to the conservation listed species covered by this Opinion. Nonetheless, the NOAA Fisheries also believes that certain site-specific actions associated with projects approved using SLOPES are still likely to result in a small amount of incidental take that will usually be local and short-term in extent. Accordingly, NOAA Fisheries provides a set of nondiscretionary Reasonable and Prudent Measures in the accompanying Incidental Take Statement that are necessary to minimize the likelihood that SLOPES will result in taking of listed species.

Program Administration. The Corps proposed to evaluate each permit for compliance with the proposed conservation measures and Reasonable and Prudent Measures and Terms and Conditions, as described in this Opinion. Experience with previous versions of SLOPES has shown that some proposed projects do not fit precisely into one category of action. In these cases, the Corps determines whether the project is eligible for approval using SLOPES through informal discussions with NOAA Fisheries staff. Before the Corps authorizes a permit under this proposed program, it will submit an electronic project notification form to NOAA Fisheries with the information necessary to track the progress of projects approved under this Opinion and their effects on the environmental baseline. The proposed action will ensure that the following conservation measures are applied during each permit review:

- The Corps will confirm that each project authorized under this Opinion is within the present or historic range of a listed species or designated critical habitat.
- Each project will be individually reviewed by the Corps to ensure that all adverse effects to ESA-listed salmon and steelhead and their designated critical habitats are within the range of effects considered in this Opinion.
- For regulatory projects, each applicable term and condition in this Incidental Take Statement will be included as an enforceable part of the permit document. For the projects carried out by the Corps, each applicable term and condition will be included as a final project specification.
- Individual project notification and reporting information will be regularly collected and forwarded to NOAA Fisheries.
- The Corps will complete an annual monitoring report describing its efforts to carry out this Opinion, and meet with NOAA Fisheries each year to discuss the annual monitoring report and any actions that will improve conservation or make the program more efficient or more accountable.
- If the Corps chooses to continue programmatic coverage under this Opinion, formal consultation on SLOPES will be reinitiated within three years of the date of issuance.
- Any Statewide Programmatic General Permit (SPGP) issued to the State of Oregon to defer regulatory review and evaluation of permits under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act must ensure compliance with this

Opinion, including all applicable permit terms and conditions, and limit the scope of the deferral to review of applications for projects that: (1) Affect 0.5 acres or less of fill in a wetland and one thousand cubic yards or less of fill and removal below ordinary high water; and (2) are among the following types of actions as authorized by this Opinion – streambank stabilization; road construction, repairs and improvements; site preparation for buildings and related features; stream and wetland restoration; minor fills and removals; utility lines; or piling installation and removal.

Project Level Effects. Each project proposed for authorization under this Opinion requires one or more actions related to pre-construction, construction, operation and maintenance, and restoration and mitigation, of a structure or the action area that is likely to adversely affect an ESA-listed species or a designated critical habitat. The direct physical and chemical effects of these activities typically begin with pre-construction activity, such as surveying, minor vegetation clearing, placement of stakes and flagging guides, and minor movements of machines and personnel over the action area. The next stage, site preparation, typically requires development of access roads, construction staging areas, and materials storage areas that affect more of the project area and clear vegetation that will allow rainfall to strike the bare land surface. Additional earthwork follows to clear, excavate, fill and shape the site for its eventual use removes still more vegetation and topsoil, exposes deeper soil layers, extends operations into the active channel, and reshapes banks as necessary for successful revegetation. The set of effects associated with construction, operation or maintenance depends on the purpose and location of each type of structure and will be analyzed in subsequent sections. The final stage is site restoration and compensatory mitigation, if necessary, that consists of actions necessary to restore ecological recovery mechanisms and stimulate habitat forming precesses, to maintain or promote the site along a trajectory toward conditions supporting functional aquatic habitats, such as soil stability, energy and nutrient distribution, channel fluvial geomorophology, and vegetation succession.

Pre-construction Activity. Pre-construction activity includes planning, design, permit acquisition, exploratory drilling and survey, and site preparation. For the purposes of this Opinion, only effects to the action area from exploratory drilling and to the extent that vegetation and fluvial geomorphic processes at a project site are providing for natural creation and maintenance of habitat function, such as channel morphology, delivery of large wood, particulate organic matter or shade to a riparian area and stream, root strength for slope and bank stability, and sediment filtering and nutrient absorption from runoff, and pre-construction activity that results in removal of that vegetation will reduce or eliminate those habitat values (Darnell 1976, Spence *et al*. 1996). Denuded areas lose organic matter and dissolved minerals, such as nitrates and phosphates. Microclimate can become drier and warmer with corresponding increases in wind speed, and soil and water temperature. Water tables and spring flow can be reduced. Loose soil can temporarily accumulate in the construction area. In dry weather, this soil can be dispersed as dust. In wet weather, loose soil is transported to streams by erosion and runoff, particularly in steep areas. Erosion and runoff increase the supply of soil to lowland drainage areas and eventually to aquatic habitats where they increase water turbidity and sedimentation.

Turbidity may have beneficial or detrimental effects on fish, depending on the intensity, duration and frequency of exposure (Newcombe and MacDonald 1991). Salmonids have evolved in systems that periodically experience short-term pulses (days to weeks) of high suspended sediment loads, often associated with flood events, and are adapted to such high pulse exposures. Adult and larger juvenile salmonids may be little affected by the high concentrations of suspended sediments that occur during storm and snowmelt runoff episodes (Bjorn and Reiser 1991), although these events may produce behavioral effects, such as gill flaring and feeding changes (Berg and Northcote 1985).

Deposition of fine sediments reduces incubation success (Bell 1991), interferes with primary and secondary productivity (Spence *et al*. 1996), and degrades cover for juvenile salmonids (Bjornn and Reiser 1991). Chronic, moderate turbidity can harm newly-emerged salmonid fry, juveniles, and even adults by causing physiological stress that reduces feeding and growth and increases basal metabolic requirements (Redding *et al*. 1987, Lloyd 1987, Bjornn and Reiser 1991, Servizi and Martens 1991, Spence *et al*. 1996). Juveniles avoid chronically turbid streams, such as glacial streams or those disturbed by human activities, unless those streams must be traversed along a migration route (Lloyd *et al*. 1987). Older salmonids typically move laterally and downstream to avoid turbid plumes (McLeay *et al*. 1984, 1987, Sigler *et al*. 1984, Lloyd 1987, Scannell 1988, Servizi and Martens 1991). On the other hand, predation on salmonids may be reduced in waters with turbidity equivalent to 23 Nephalometric Turbidity Units (NTU) (Gregory 1993, Gregory and Levings 1998), an effect that may improve overall survival.

During and after wet weather, increased runoff can suspend and transport more sediment to receiving waters. This increases turbidity and stream fertility. Increased runoff also increases the frequency and duration of high stream flows and wetland inundation in construction areas. Higher stream flows increase stream energy that can scour stream bottoms and transport greater sediment loads farther downstream that would otherwise occur. Sediments in the water column reduce light penetration, increase water temperature, and modify water chemistry. Once deposited, sediments can alter the distribution and abundance of important instream habitats, such as pool and riffle areas. During dry weather, the physical effects of increased runoff appear as reduced ground water storage, lowered stream flows, and lowered wetland water levels.

The combination of erosion and mineral loss can reduce soil quality and site fertility in upland and riparian areas. Concurrent in-water work can compact or dislodge channel sediments, thus increasing turbidity and allowing currents to transport sediment downstream where it is eventually redeposited. Continued operations when the construction site is inundated can significantly increase the likelihood of severe erosion and contamination.

Surveying or exploration that requires the use of drilling equipment typically has more significant effects. Auger drilling produces on average 1.5 to 11.5 cubic meters of spoils that must be stabilized or removed from the site. Erosion control berms and ditching sometimes used to manage runoff from an active drill site may themselves may themselves cause erosion, sedimentation from drilling mud, or other temporary site disturbances. Similarly, untreated drilling fluids can sometimes travel along a subsurface soil layer and exit in a stream or wetland to cause turbidity and other water quality degradation.

Excavating test pits removes vegetation in the excavated area and may cause soil compaction along wheel tracks and in excavated spoils placement areas. Typically, spoils do not erode into streams or wetlands since this material is placed back into the test pit once the investigation or sampling has been completed, usually within a two-hour time period, and the disturbed area is stabilized by seeding and mulching. In cases where test pits are left open for longer time periods, rainfall may wash sediment from the spoils piles into nearby streams or wetlands. Effects from soils testing are similar to those described above for drilling operations.

Air rotary drilling produces dust, flying sand-sized rock particles, foaming additives, and fine water spray that must be collected to prevent deposition in a stream or wetland. The distance that cuttings and liquids (*e.g.*, water, foaming additives) can be ejected out of the boring depend on the size of the drilling equipment. Unrestrained, larger equipment will disperse particles up to 6.1 m, while smaller equipment will typically expel particles up to 3 m. As with any heavy equipment, drilling rigs are subject to accidental spills of fuel, lubricants, hydraulic fluid and other contaminants that, if unconfined, may harm the riparian zone or aquatic habitats.

When borings are abandoned near streams or wetlands, excess grout must be contained to prevent pollution, especially during rainy periods. In some cases, boring abandonment may not occur for months or even years after the drilling has been completed. Then, soils and vegetation are subjected to additional disturbance when workers re-enter the site. Sometimes, instruments must be drilled out. When this occurs, effects are similar to those described above drilling.

Excavating test pits eliminates vegetation in the excavated area and can cause vegetation compaction along wheel tracks and in excavated spoils placement areas. However, spoils do not typically erode into streams or wetlands because this material is placed back into the test pit once the investigation or sampling has been completed, usually within a two-hour time period, and the disturbed area is stabilized by seeding and mulching. When test pits are left open longer, sediments washed from the spoils piles can enter nearby streams or wetlands, especially during the winter rainy season. Effects from soils testing are similar to those described above for drilling operations.

Use of the following conservation measures, as proposed, will avoid or minimize the adverse effects of pre-construction activities:

- All construction impacts must be confined to the minimum area necessary to complete the project and boundaries of clearing limits associated with site access and construction will be marked to avoid or minimize disturbance of riparian vegetation, wetlands and other sensitive sites.
- Project operations must cease under high flow conditions that may result in inundation of the project area, except for efforts to avoid or minimize resource damage.

- All work below ordinary high water will be completed using the preferred in-water work period, as appropriate for the project area.
- Exploratory survey and drilling activities will be completed as follows: (1) Survey or drilling actions, including release of construction discharge water, will not occur within 300 feet upstream from known or suspected spawning areas, unless a biologist verifies that no redds are present at th site, or areas with native submerged aquatic vegetation; (2) construction of new access roads will be avoided by using a crane to lower drilling equipment and a spider hoe to excavate test pits, whenever feasible; (3) drilling pads will be designed to contain any spills that may occur and use the same conservation measures required for access road construction; (4) drilling will be completed in the dry, whenever feasible; (5) drilling pads and fluids will be isolated using fluid recirculation, bio-bags, swale filtration, silt fencing, straw bails, sediment ponds, ditches or berms, as appropriate for site conditions; (6) any contaminated material collected at a drilling site will be stored securely until it can be safely removed for off-site disposal, including water produced during drilling or used for decontamination; and (7) all water produced during drilling will be contained until decontaminated.

Pre-construction and Site Preparation. The proposed action includes site preparation for construction of buildings and related features outside of the riparian management area. Most direct and indirect effects of this type of site preparation are the same as those for general construction discussed above, and these site preparation actions will follow the conservation measures for general construction as applicable. However, the effects of this type of site preparation are likely to be less intense than those discussed above because all actions will occur outside of the riparian management area. An additional indirect effect of this activity, which includes site preparation for commercial buildings, houses, and parking lots, can be intentional or opportunistic human access to riparian or instream areas. Once in the riparian zone or instream area, people may walk or hike, thus trampling soils and channel materials, and disturbing vegetation in ways that can increase runoff and reduce plant growth. They may also start fires, dump trash, or otherwise adversely alter environmental conditions. However, with due diligence for the full range of conservation measures outlined above, including the requirement that fencing will be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons, it is unlikely that environmental changes caused by these indirect effects at any single construction site associated with the proposed action, or that any likely combination such construction sites in proximity, could cause chronic trampling or vegetation removal over a large habitat area sufficient to cause more than transitory indirect affects to salmon or steelhead.

Besides conservation measures listed above, the effects of heavy equipment operation associated with site preparation activities will be further minimized or avoided by the following conservation measures:

- Heavy equipment will be limited to that with the least adverse effects on the environment (*e.g.*, minimally-sized, rubber-tired).

- All heavy equipments will be stored, fueled, and maintained in a vehicle staging area placed 150 feet or more from any stream, waterbody or wetland, unless otherwise approved in writing by NOAA Fisheries.
- Vehicles operated within 150 feet of any stream, waterbody or wetland will be inspected daily for fluid leaks before leaving the vehicle staging area.
- Before operations begin and as often as necessary during operation, all equipment used below ordinary high water will be steam-cleaned.
- All stationary power equipment (*e.g.*, generators, cranes, stationary drilling equipment) operated within 150 feet of any stream, waterbody or wetland to prevent leaks, will be covered or otherwise suitably contained to prevent likely spills.
- To the extent feasible, work requiring use of heavy equipment will be completed by working from the top of the bank, unless work area isolation would result in less habitat disturbance.

Construction, Operation and Maintenance Activities. The effects of construction, operation, and maintenance activities are similar to those described above for pre-construction, but involve significantly more use of heavy equipment for vegetation removal and earthwork associated with access road construction and materials staging. Heavy equipment can compact soil, thus reducing soil permeability and infiltration. Use of heavy equipment also creates a risk that accidental spills of fuel, lubricants, hydraulic fluid, and similar contaminants may occur. Discharge of construction water used for vehicle washing, concrete washout, pumping for work area isolation, and other purposes can carry sediments and a variety of contaminants to the riparian area and stream. Heavy equipment used instream in spawning areas may disturb or compact gravel and other channel materials, thus making it harder for fish to excavate redds, and decreasing redd aeration. Cederholm *et al*. (1997) recommend that heavy equipment work should be performed from the bank and that work within bedrock or boulder/cobble bedded channels should be viewed as a last resort and that least impacting equipment such as spider harvesters/log loaders be used. Heavy equipment or material used instream in any occupied habitat may inhibit fish passage or kill or injure individual fish.

Pilings. Pilings made of concrete, plastic, steel, treated wood, or untreated wood are used in many construction projects in riparian and aquatic areas. Vibratory or impact hammers are commonly used to drive piles into the substrate. An impact hammer is a heavy weight that is repeatedly dropped onto the top of the pile. A vibratory hammer uses a combination of a stationary, heavy weight and vibration, in the plane perpendicular to the long axis of the pile. The choice of hammer type depends on pile material, substrate type, and other factors. Impact hammers can drive piles into most substrates, including hardpan and glacial till, while vibratory hammers are limited to softer, unconsolidated substrates. However, over-water structures must often meet seismic stability criteria. This requires that the supporting piles be attached to, or driven into, a hard substrate and this often means that at least some impact driving is necessary. Further, the bearing capacity of a pile driven with vibration is unknown unless an impact hammer is used to “proof” the pile by striking it pile several times to ensure it meets the designed bearing capacity. Temporary piles, fender piles, and some dolphin piles do not need to be seismically stable can be driven with a vibratory hammer only, providing the pile type and sediments are appropriate.

Piles are removed using a vibratory hammer, direct pull, clam shell grab, or cutting/breaking the pile below the mudline. Vibratory pile removal causes sediments to slough off at the mudline, resulting in some suspension of sediments and, possibly, contaminants. Old and brittle piles may break under the vibrations and require use of another method. The direct pull method involves placing a choker around the pile and pulling upward with a crane or other equipment. When the piling is pulled from the substrate, sediments clinging to the piling slough off as it is raised through the water column, producing a plume of turbidity, contaminants, or both. The use of a clamshell may suspend additional sediment if it penetrates the substrate while grabbing the piling. If a piling breaks, the stub is often removed with a clam shell and crane. Sometimes, pilings are cut, broken, or driven below the mudline, and the buried section left in place. This may suspend a small amounts of sediment, providing the stub is left in place and little digging is required to reach the pile. Direct pull or use of a clamshell to remove broken piles is likely suspend more sediment and contaminants.

Turbidity generated from pile driving or removal is temporary and confined to the area close to the operation. NOAA Fisheries expects that some individual Chinook salmon and steelhead, both adult and juvenile, may be harassed by turbidity plumes resulting from pile driving or removal. Indirect lethal take can occur if individual juvenile fish are preyed on when the leave the work area to avoid temporary turbidity plumes. The proposed requirements for completing the work during the preferred in-water work window will minimize the effects of turbidity on listed species.

Benthic invertebrates in shallow water habitats are key food sources for juvenile salmonids during their out migration. New pilings may reduce the substrate available to benthic aquatic organisms and, therefore, the food available for juvenile salmonids in the project area. NOAA Fisheries believes that some effect on salmon and steelhead productivity may occur due to suppression of benthic prey species. Most existing commercial dock structures have a high density of existing piles and are not likely to provide significant habitat for listed salmonids. Further, listed salmonids must migrate by such structures. This likely takes place in an area of diminished light intensity and deeper water along the outer margin of the structure, where they may have higher predation.

Pile driving often generates intense sound pressure waves that can injure or kill fish (Reyff 2003, Abbott and Bing-Sawyer 2002, Caltrans 2001, Longmuir and Lively 2001, Stotz and Colby 2001). The type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water, and the type and size of the pile-driving hammer all influence the sounds produced during pile driving. Sound pressure is positively correlated with the size of the pile because more energy is required to drive larger piles. Wood and concrete piles produce lower sound pressures than hollow steel piles of a similar size, and may be less harmful to fishes. Firmer substrates require more energy to drive piles and produce more intense sound pressures. Sound attenuates more rapidly with distance from the source in shallow than in deep water

(Rogers and Cox 1988). Impact hammers produce intense, sharp spikes of sound that can easily reach levels that harm fishes, and the larger hammers produce more intense sounds. Vibratory hammers, on the other hand, produce sounds of lower intensity, with a rapid repetition rate.

Sound pressure levels (SPLs) greater than 150 decibels (dB) root mean square (RMS) produced when using an impact hammer to drive a pile have been shown to affect fish behavior and cause physical harm when peak SPLs exceed 180 dB (re: 1 microPascal). Surrounding the pile with a bubble curtain can attenuate the peak SPLs by approximately 20 dB and is equivalent to a 90% reduction in sound energy. However, a bubble curtain may not bring the peak and RMS SPLs below the established thresholds, and take may still occur. Without a bubble curtain, SPLs from driving 12 inch diameter steel pilings, measured at 10 m, will be approximately 205 dB_{peak} (Pentec Environmental 2003) and 185 dB_{rms}. With a bubble curtain, SPLs are approximately 185 dB_{peak} and 165 dBrms. Using the spherical spreading model to calculate attenuation of the pressure wave (TL = 50*log(R1/R2)), physical injury to sensitive species and life-history stages may occur up to 18 m from the pile driver, and behavioral effects up to 56 m. Studies on pile driving and underwater explosions suggest that, besides attenuating peak pressure, bubble curtains also reduce the impulse energy and, therefore, the likelihood of injury (Keevin 1998). Because sound pressure attenuates more rapidly in shallow water (Rogers and Cox 1988), it may have fewer deleterious effects there.

Fish respond differently to sounds produced by impact hammers than to sounds produced by vibratory hammers. Fish consistently avoid sounds like those of a vibratory hammer (Enger *et al*. 1993; Dolat 1997; Knudsen *et al*. 1997; Sand *et al*. 2000) and appear not to habituate to these sounds, even after repeated exposure (Dolat, 1997; Knudsen *et al*. 1997). On the other hand, fish may respond to the first few strikes of an impact hammer with a "startle" response, but then the startle response wanes and some fish remain within the potentially-harmful area (Dolat 1997). Compared to impact hammers, vibratory hammers make sounds that have a longer duration (minutes vs. milliseconds) and have more energy in the lower frequencies (15-26 Hz vs. 100-800 Hz) (Würsig, *et al*. 2000; Carlson *et al*. 2001; Nedwell and Edwards 2002).

Air bubble systems can reduce the adverse effects of underwater sound pressure levels on fish. Whether confined inside a sleeve made of metal or fabric or unconfined, these systems have been shown to reduce underwater sound pressure (Würsig *et al*. 2000; Longmuir and Lively 2001; Christopherson and Wilson 2002; Reyff and Donovan 2003). Unconfined bubble curtains lower sound pressure by as much as 17 dB (85%) (Würsig *et al*. 2000, Longmuir and Lively 2001), while bubble curtains contained between two layers of fabric reduce sound pressure up to 22 dB (93%) (Christopherson and Wilson, 2002). However, an unconfined bubble curtain can be disrupted and rendered ineffective by currents greater than 1.15 miles per hour (Christopherson and Wilson, 2002). When using an unconfined air bubble system in areas of strong currents, it is essential that the pile be fully contained within the bubble curtain, and that the curtain have adequate air flow, and horizontal and vertical ring spacing around the pile.

Juvenile salmonids occur year round in waters covered by this Opinion. However, the likelihood of take resulting from pile driving and removal will be minimized by completing the work during preferred in-water work windows, using a vibratory hammer where possible, and using sound attenuators where an impact hammer is necessary.

Besides conservation measures listed above, the proposed action will avoid or minimize the adverse effects of pile installation and removal with the following conservation measures:

- Projects that require in-water installation of hollow steel piling greater than 24 inches in diameter, or use of H-pile larger than designation HP24, are not authorized by this Opinion.
- The number and diameter of pilings will be minimized, as appropriate, without reducing structural integrity.
- No more than five single piles or one dolphin consisting of three to five piles may be replaced or added to an existing structure or marina per in-water construction period.
- Sound attenuation measures, including vibration dampeners, and unconfined or confined bubble curtains, will be used when impact driving steel pilings.
- Piles will be removed with a vibratory hammer.
- If a treated wood piling breaks during removal, either remove the stump by breaking or cutting 3 feet below the sediment surface or push the stump in to that depth, then cover it with a cap of clean substrate appropriate for the site.
- Holes left by each piling removed will be filled with clean, native sediments, whenever feasible.
- Whenever submerged large wood must be moved to install or remove a pile, the wood will be moved downstream where it will continue to function as part of the aquatic environment.

Pesticide-Treated Wood. Pesticide treatments in common use include water-based wood preservatives, such as chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), alkaline copper quat (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 (FPL 2000). Acid copper chromate (ACC) and copper HDO (CX-A) are more recent compounds not yet in wide use (Lebow 2004a). Withdrawal of CCA from most residential applications has increased interest in arsenic-free preservative systems that all rely on copper as their primary active ingredient (FPL 2003, Lebow 2004a) with the proportion of preservative component ranging from 17% copper oxide in some CDDC formulations, to 96% copper oxide in CA-B (Lebow 2004a).

A pesticide-treated wood structure placed in or over flowing water will leach copper and a variety of other toxic compounds directly into the stream (Weis and Weis 1996, Hingston *et al*. 2001, Poston 2001, NOAA 2003). Although the likelihood of leaching pesticides, including copper, from wood used above or over the water is different than splash zone or in-water applications (WWPI 1996), these accumulated materials add to the background loads of receiving streams. Movements of leached preservative components are generally limited in soil but is greater in soils with high permeability and low organic content. Mass flow with a water front is probably most responsible for moving metals appreciable distances in soil, especially in permeable, porous soils. Preservatives leached into water are more likely to migrate downstream compared with preservative leached into soil, with much or the mobility occurring in the form of suspended sediment.

If treated wood sawdust or shavings generated during construction are allowed to enter soil or water below at treated structure, they make a disproportionately large contribution to environmental contamination, with leaching of construction debris immersed in water being vastly greater than from solid wood (FPL 2001b, Lebow and Tippie 2001, Lebow *et al*. 2004). Because construction debris may release 30 to 100 times more preservative than leaching, collection of construction debris should be stressed during project planning and budgeting. Storing treated wood shipped to the project area out of contact with standing water and wet soil, and protected from precipitation also significantly reduces the likelihood of chemical leaching during construction (Lebow and Tippie 2001, FPL 2001b).

Wooden bridges built without a wearing surface where vehicles ride directly on a creosote-treated wood deck show wear from vehicle tracking and debris abrasion that will wear away the preservative treatment envelope over time and expose new surfaces of the wood to leaching (Brooks 2000, Ritter *et al*. 1996a and 1996b). Similarly, foot traffic will abrade treated wood used in pedestrian bridges unless prevented by a wearing surface such as synthetic mats, coatings, metal sheets, or sacrificial plywood sheets (DeVenzio undated, Lebow 2004). Cleaning and maintenance activities, such as aggressive scrubbing, power-washing, or sanding can also remove particles of treated wood and deposit them in soil or water beneath a treated wood structure (Lebow *et al*. 2004).

Application of finishes, such as semi-transparent penetrating stains, latex paint, oil-based paint, decrease environmental releases (FPL 2001a and 2001b, Lebow *et al*. 2004). Coatings minimize the loss of metals by forming a barrier between the treated wood and the environment (Stilwell and Musante 2004). In general, opaque polyurethane and acrylic finishes form the most durable coatings, presumably because of their ability to protect wood from ultraviolet radiation, although for some surfaces, particularly horizontal ones subjected to foot traffic, use of a penetrating stain that results in a slow wearing of the coating may be preferable (Stilwell and Musante 2004). Experiments to test the ability of coatings to minimize leaching from CCA-treated wood found that one coat of latex primer followed by one coat of oil-based paint or two coats of penetrating, water-repellent deck stain were both effective for reducing the leaching of copper, arsenic and chromium by more than 99% (FPL 2001a). Coatings and any paint-on field treatment must be carefully applied and contained to reduce contamination (Lebow and Tippie 2001, FPL 2001b).

Few wharves and other large structures are being constructed on wooden piling today because concrete and steel have greater load bearing capacity (Brooks 2003). Most projects involving treated wood pilings, such as rural bridges, small ferry terminals, marinas, and personal use docks, involve two to five piling bents spaced at least four meters apart (Brooks 2003). These pilings are also subject to abrasion when they are allowed to come into direct contact with boats, float rings, debris, *etc*., although the degree of abrasion is difficult to predict and therefore not susceptible to risk assessment (Brooks 2004). Nonetheless, pilings may be easily protected from abrasion by, for example, using half-inch thick polyethylene strips installed down the length of the piling to serve as wearing surfaces, thus improving environmental performance and extending the life of the piling (Brooks 2004).

Evaluation of in-service structures show that leaching rates vary by wood dimensions, wood species, treatment practices, fixation, age of the structure, type of exposure, construction and maintenance practices, and site-specific conditions (Lebow 1996, Lebow *et al*. 2004). Brooks (2004) reported significantly more copper (13.9 micrograms per gram of dry sediment) below the center of an ACZA four-piling dolphin placed in a rural area than at the subtidal reference site (6.4 micrograms per gram of dry sediment). Three other sites tested did not show significant differences. That amount of copper meets Washington State sediment quality standards but exceeds 8.2 micrograms per gram of dry sediment, the amount where, according to NOAA Screening Quick Reference Table for Inorganic Solids ("SQuiRTS"), toxic effects in sensitive species may be expected.

Copper is a widespread source of water pollution in salmon habitat where it is deposited by mines, urban stormwater runoff, treated wood leachate, and from algicides used in waterways and as fungicides applied to cropland (WWPI 1996, Weis and Weis 1996, Baldwin *et al*. 2003, Weis and Weis 2004). Copper is the most frequently detected trace element at agricultural and mixed use sites in the Willamette River Basin (Wentz *et al*. 1998). Metals leached into sediments near CCA-treated wood in aquatic environments have been shown to accumulate in organisms, including epibiota and benthic organisms (Weis and Weis 2004). Other animals can acquire elevated levels of these metals indirectly through trophic transfer, and may exhibit toxic effects at the cellular level (DNA damage), tissue level (pathology), organismal level (reduced growth, altered behavior and mortality) and community level (reduced abundance, reduced species richness, and reduced diversity) (Weis *et al*. 1998, Weis and Weis 2004). Effects are more severe in poorly flushed areas and in areas where the wood is relatively new, and reduces after the wood has leached a few months (Weis and Weis 2004).

Wood impregnated with other chemicals such as copper, zinc, arsenic and chromium may directly affect salmon that spawn, rear, or migrate by those structures, or indirectly when the salmon ingest contaminated prey (Posten 2001). Copper has been shown to impair the olfactory nervous system and olfactory-mediated behaviors in salmonids (Hara *et al*. 1975, Winberg *et al*. 1992, Hansen *et al*. 1999a and 1999b, Baldwin *et al*. 2003). Salmon will actively avoid copper (Hansen *et al*. 1999a and 1999b), suggesting that low levels of copper present in distinct gradients, such as near a point-source discharges, may act as migratory barriers to salmon. However, behavioral avoidance is not likely to be an adequate defense against non-point sources of copper in lakes, rivers and estuaries (Baldwin *et al*. 2003).

Even transient exposure lasting just a few minutes to copper at levels typical for surface waters from urban and agricultural watersheds, and within the U.S. Environmental Agency water quality criterion for copper, will cause greater than 50% loss of sensory capacity among resident coho in freshwater habitats (Baldwin *et al*. 2003). While that loss may be at least partially reversible, longer exposures lasting hours have caused cell death in the olfactory receptor neurons of other salmonid species (Julliard *et al*. 1996, Hansen *et al*. 1999b, Moran *et al*. 1992). Therefore, olfactory function will be impaired if salmon are unable to avoid copper pollution within the first few minutes of exposure and, if copper levels subsequently exceed a threshold for sensory cell death, it may take weeks before the functional properties of the olfactory system recover (Baldwin *et al*. 2003). Because olfactory cues convey important information about habitat quality (*e.g.*, pollution), predators, conspecifics, mates, and the animal's natal stream, substantial copper-induced loss of olfactory capacity is likely to impair behaviors essential for the survival or reproductive success of salmon and steelhead (Baldwin *et al*. 2003).

PAHs are commonly released from wood treated with creosote. PAHs may cause cancer, reproductive anomalies, immune dysfunction, growth and development impairment, and other impairments to exposed fish (Johnson *et al*. 1999, Johnson 2000, Stehr *et al*. 2000, Collier *et al*. 2002, Johnson *et al*. 2002).

Alternatives are available to for most applications involving pesticide treated wood. These include the use of wood products produced from naturally durable species, such as redwood and cedar, or alternative materials such as fiberglass, steel, or plastic.

Besides conservation measures listed above, the proposed action will avoid or minimize the adverse effects of pesticide treated wood installation with the following conservation measures:

- Use of lumber, pilings, or other wood products that are treated or preserved with pesticidal compounds, including, but not limited to, alkaline copper quaternary, ammoniacal copper arsenate, ammoniacal copper zinc arsenate, copper boron azole, chromated copper arsenate, copper naphthenate, creosote, and pentachlorophenol, may not be used below ordinary high water, or as part of an in-water or over-water structure, except as described below.
- Treated wood shipped to the project area must be stored out of contact with standing water and wet soil, and protected from precipitation.
- Each load and piece of treated wood must be visually inspected and rejected for use in or above aquatic environments if visible residues, bleeding of preservative, preservative-saturated sawdust, contaminated soil, or other matter is present.
- Pilings treated with ammoniacal copper zinc arsenate, chromated copper arsenate, or creosote may be installed below ordinary high water according to NOAA Fisheries' guidelines,[11] provided that no more than 50 piles are used. Note, also, that these guidelines do not apply to pilings treated with any other preservative, and do not authorize use of treated wood for any other purpose.

[11] Letter from Steve Morris, National Marine Fisheries Service, to W.B. Paynter, Portland District, U.S. Army Corps of Engineers (December 9, 1998) (transmitting a document titled Position Document for the Use of Treated Wood in Areas within Oregon Occupied by Endangered Species Act Proposed and Listed Anadromous Fish Species, National Marine Fisheries Service, December 1998).

- Use prefabrication to the extent feasible to ensure that cutting, drilling, and field preservative treatment is minimized. When field fabrication is necessary, all cutting and drilling of treated wood, and field preservative treatment of wood exposed by cutting and drilling, will occur above ordinary high water to minimize discharge of sawdust, drill shavings, excess preservative other debris in riparian or aquatic habitats. Use tarps, plastic tubs or similar devices to contain the bulk of any fabrication debris, and wipe off any excess field preservative.
- All treated wood structures, including pilings, must have design features to avoid or minimize impacts and abrasion by livestock, pedestrians, vehicles, vessels, floats, *etc*., to prevent the deposition of treated wood debris and dust in riparian or aquatic habitats.
- Treated wood may be used to construct a bridge, over-water structure or an in-water structure, provided that all surfaces exposed to leaching by precipitation, overtopping waves, or submersion are coated with a water-proof seal or barrier that will be maintained for the life of the project. Coatings and any paint-on field treatment must be carefully applied and contained to reduce contamination. Surfaces that are not exposed to precipitation or wave attack, such as parts of a timber bridge completely covered by the roadway wearing surface of the bridge deck, are exempt from this requirement.
- Projects that require removal of treated wood must use the following precautions: (1) Ensure that, to the extent feasible, no treated wood debris falls into the water. If treated wood debris does fall into the water, remove it immediately; (2) After removal, place treated wood debris in an appropriate dry storage site until it can be removed from the project area. Do not leave treated wood construction debris in the water or stacked on the streambank at or below the ordinary high water; (3) Evaluate treated wood construction debris removed during a project, including treated wood pilings, to ensure that debris is properly disposed of.

New Impervious Surfaces. Construction of pavement and other permanent soil coverings to build water-dependent structures (*e.g.*, bridges, boat ramps), roads linking those structures to the transportation system, and road upgrades can also reduce site permeability and infiltration. Permeability and infiltration are inversely related to the rate and volume of runoff. The effects of reduced soil permeability and infiltration are most significant in upland areas where runoff processes and the overall storm hydrograph are controlled mainly by groundwater recharge and subsurface flows. These effects are less significant in riparian areas, where saturated soils and high water tables are more common and runoff processes are dominated by direct precipitation and Horton overland flow (Dunne and Leopold 1978).

Besides conservation measures listed above, the proposed action will avoid or minimize the adverse effects of constructing impervious surfaces with the following conservation measures:

- Any project that will produce any new impervious surface or a land cover conversion that will slow the entry of water into the soil will include a stormwater management plan, commensurate to the size of the project, to maintain or restore natural runoff conditions.

- Compensatory mitigation will be provided for the unavoidable adverse effects of new impervious surfaces, such as planting additional riparian trees and shrubs or restoration of near shore habitats.

In-Water Work. Effects from in-water work are generally avoided and minimized through use of in-water work isolation strategies that often involve capture and release of trapped fish and other aquatic invertebrates. Although the most lethal biological effects of the proposed actions on individual listed salmon and steelhead will likely be caused by the isolation of in-water areas, lethal and sublethal effects would be greater than without isolation. In-water work area isolation is itself a conservation measure intended to reduce the adverse effects of erosion and runoff on the population. Any individual fish present in the work isolation area will be captured and released. 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 2002b). The primary contributing factors to stress and death from handling are differences in water temperatures (between the river 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 salmonids increases rapidly from handling if the water temperature exceeds 18°C (64°F) or dissolved oxygen is below saturation. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps, if the traps are not emptied on a regular basis. Debris buildup at traps can also kill or injure fish if the traps are not monitored and cleared on a regular basis.

Besides conservation measures listed above, the proposed action will avoid or minimize the adverse effects of in-water work with the following conservation measures:

- Work below ordinary high water will be completed during preferred in-water work windows, when listed fish are least likely to be present in the action area, unless otherwise approved in writing by NOAA Fisheries.
- Fish passage will be provided for any adult or juvenile salmonid species that may be present in the project area during construction, unless otherwise approved in writing by NOAA Fisheries, and after construction for the life of the project. Upstream passage is not required during construction if it did not previously exist.
- The in-water work area will be isolated if it is within 300 feet of a known or suspected spawning area.
- A Work Area Isolation Plan will be prepared for all work below ordinary high water that requires flow diversion that will describe the sequence and schedule for dewatering and rewatering activities, a plan view of all isolation elements, and a list of equipment and materials that will be used to provide back-up for key plan functions (*e.g.* an operational, properly-sized backup pumps and/or generators). Pile driving may occur without isolation during the in-water work period, provided that hydro-acoustic sound pressure attenuation requirements and all other relevant conservation measures are met.

- Any water intakes used for the project – including pumps used to dewater the work isolation area – will have a fish screen installed, operated and maintained according to NOAA Fisheries' fish screen criteria.
- Any listed fish that may be trapped within the isolated work area will be captured and released using methods approved by NOAA Fisheries, including supervision by a fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish.

Streambank Stabilization. Continuous rock riprap revetments and concrete bulkhead can prevent erosion of bank features at a single site, but simultaneously destroy or degrade other habitat features (Beamer and Henderson 1998, Peters *et al*. 1998). By design, riprap and bulkheads transfer and focus hydraulic forces to other areas. Nearshore topography is scoured, critical fish habitats are often degraded or destroyed, terrestrial habitat is lost, and erosion of neighboring property can be accelerated. At the reach scale, riparian vegetation, streambed substrate, habitat complexity, stream and floodplain interactions, and other stream processes essential to support listed fish are lost. The adverse effects of riprap accumulate at the watershed or basin scale although these effects can be offset with compensatory mitigation that restores streambank function at other sites within the watershed.

The primary proposed streambank stabilization action is the use of large wood and vegetation to increase bank strength and resistance to erosion in an ecological approach to engineering streambank stabilization (Mitsch 1996; WDFW *et al*. 2003). Construction of "hard" scour protection for specific public infrastructure and construction of barbs to redirect flow are also proposed. The proposed actions explicitly do not include any other type of structure built entirely of rock, concrete, steel or similar materials, other streamflow control structures, or any type of channel-spanning structure. Except as noted below, most direct and indirect effects of proposed streambank stabilization actions are the same as those for general construction discussed above, and streambank stabilization restoration actions will follow the conservation measures for general construction as applicable. The primary means of streambank stabilization proposed is the use of large wood and vegetation to increase resistance to bank erosion (bioengineering). This approach protects banks by using natural materials to increase erosion resistance and bank roughness to disrupt stream energy. Roots and other small and large pieces of vegetation are used to collect and bind bank sediments. This helps to avoid or minimize loss of riparian function associated with more traditional approaches to streambank stabilization that rely primarily on rock, cement, steel, and other hard materials. Bioengineered bank treatments develop root systems that are flexible and regenerative, and respond more favorably to hydraulic disturbance than conventional hard alternatives.

Besides conservation measures listed above, the proposed action will avoid or minimize the adverse effects of streambank stabilization by the following conservation measures:

- All streambank stabilization actions will provide the greatest degree of natural stream and floodplain function achievable through application of an integrated, ecological approach by requiring the selection of protection measures to be constrained by an analysis of the mechanisms and causes of streambank failure, reach conditions, and habitat impacts.

- Large wood will be included as an integral component of all streambank stabilization treatments. The wood will be intact, hard, and undecayed to partly decaying with untrimmed root wads to provide functional refugia habitat for fish.

Scour Protection. The proposed use of "hard" scour protection is limited to construction of a footing, facing, headwall, or other structure necessary to prevent scouring or downcutting of an existing culvert, utility line, or bridge support. Direct and indirect effects of these scour protection actions are similar to the effects of general construction discussed above, including production of new impervious surface. Besides conservation measures listed above, the effects of scour protection will be further minimized or avoided by the following conservation measures:

- Rock used to fill of scour holes will be limited to that necessary to protect the integrity of the project and will not extend above the channel bed to avoid or minimize any effects on flow and channel forming processes.
- Rock used to prevent scouring, downcutting, or fill slope erosion or other failure at an existing culvert, water intake, utility line, or bridge support will be limited to that necessary to construct a footing, facing, head wall, or other similar feature that will protect the integrity of the project while avoiding or minimizing and effects of flow and channel forming processes.

Proposed streambank stabilization actions also include construction of a barb to redirect low flows believed to be causing certain kinds of bank erosion. A barb is a low elevation projection from a bank that is built primarily of stone and angled upstream to redirect flow away from the bank and control flow alignment. Most direct and indirect effects of constructing a barb are similar to those of general construction described above, and barb construction actions will follow the conservation measures for general construction as applicable. The direct effects of a barb also include redirection of instream flow away from the bank and toward the thalweg. This is believed to improve bank stability along smoothed channel or bends, especially when used in combination with bioengineering techniques (WDFW *et al*. 2000). This combination is most effective for reducing bank erosion along the outer edge of the channel migration zone in reaches where sedimentation and flows remain relatively constant over time. Barbs are designed to be overtopped by channel forming flows. This ensures that any direct effect they may have on channel forming processes or floodplain connectivity are avoided or minimized. Besides conservation measures listed above, the direct effects of barbs will be further minimized or avoiding by the following conservation measures:

- Woody riparian planting will be included as part of every streambank stabilization action.
- No part of the barb structure may exceed bank full elevation, including all rock buried in the bank key.
- The trench excavated for the bank key above ordinary high water will be filled with soil and topped with native vegetation.

- The barb itself will incorporate large wood near the tip of the structure.
- Maximum barb length will not exceed 1/4 of the bankfull channel width.
- Rock will be individually placed without end dumping.
- If two or more barbs are built in a series, the barb farthest upstream will be placed within 150 feet or 2.5 bankfull channel widths, whichever is less, from the barb farthest downstream.

The indirect environmental effects of proposed bioengineered bank treatments are similar to those discussed above for general construction, particularly those related to ecological recovery. The indirect effects of scour protection for public infrastructures are similar, with the area occupied by the hard structure itself being analogous to an area of new impervious surface. However, this effect will be offset with the requirement of offset with additional planting of riparian trees and shrubs or restoration of nearshore habitats. The indirect effects of construction of a barb are also similar, but can also include the beneficial effects due to development of scour holes, deepened pools, and other low energy habitats useful as juvenile rearing areas down-gradient of the barb (USEPA 1998, Piper *et al*. 2001, cf., Rosgen, undated, describing hydrological problems caused by improperly designed barbs and other flow controls).

Stream and Wetland Restoration. Stream and wetland habitat restoration activities proposed for authorization under SLOPES are limited to the following: (1) Road decommissioning; (2) set-back of levees, dikes and berms; (3) removal of levees, dikes, berms, weirs, or other water control structures; (4) removal of trash and other artificial debris dams that block fish passage; (5) stormwater management that restores natural or normative hydrology; (6) streambank sloping, shaping, planting, and stabilization, as authorized by this Opinion, when completed for a restoration purpose; (7) culvert replacement and bridge replacement, as authorized by this Opinion, when completed for a restoration purpose; and (8) removal of sediment bars or terraces that block fish passage within 50 feet of a tributary mouth.

These actions range from minor adjustments of a single physical habitat feature to major changes in landscape and flow regimes, and have corresponding effects to riparian and aquatic habitat conditions that support ESA-listed fish. Large projects affecting a larger geographic area and complex projects have less certain results. Each type of restoration project authorized by this Opinion requires careful planning and evaluation, but are expected to result in long-term improvement in the conservation value of aquatic habitats.

In the short term, in-water work associated with restoration activities can create turbidity, noise, contact (or near-contact) with equipment, compaction and disturbance of instream gravel from heavy equipment, and modification to adjacent riparian areas that displace salmonids, particularly any juvenile fish that may be rearing in the action area, although limiting work to the in-water work period will reduce the number of fish likely to be present. In the long term, stream and wetland restoration projects are likely to have a deleterious effect on a stream system if the project is not well planned, designed and implemented properly. Projects that are not well planned may fail with subsequent impacts to stream channels and banks.

Cederholm *et al*. (1997) found that although hundreds to thousands of restoration projects have been undertaken in the Pacific Northwest, their effectiveness is not well documented. Slaney and Martin (1997) state that "project evaluation is essential to improve our effectiveness." Restoration projects often concentrate on instream habitat without addressing the processes that led to the loss of the habitat (Roper *et al*. 1997). House (1996) recommends that a limiting factors be identified and watershed plans be completed before undertaking restoration projects. Reeves *et al*. (1991) indicate that stream hydraulics, hydrology and geomorphology are important and must be carefully evaluated before any instream work is started, and that care must be taken to identify aspects of habitat that limit production.

Roper *et al*. (1997) recommend that professionals from numerous disciplines such as range ecology, silviculture, ecology, engineering and geology be part of the planning process for restoration projects. Carlson *et al*. (1990) also stressed the importance of considering all aspects of a watershed for its potential capacity for fish production. Kershner *et al*. (1991) state that to manage a stream as a viable place for fish, an understanding of the dynamics of the watershed and the resultant effects on the stream is required. Moreover, monitoring of the effectiveness of a stream rehabilitation project is important and "any habitat manipulation proposal should specify procedures for pre-construction and post-construction studies so resulting physical and biological changes can be evaluated" (Reeves *et al*. 1991). Roper *et al*. (1997) state that only through monitoring can specific restoration activities be evaluated as to their effect in overall watershed restoration.

While the desire to actively restore estuarine habitat is understandable, the process is a difficult one. The success of a restoration project is not readily predictable and the benefits are hard to quantify (Fox 1992, Zedler 1996, Simenstad and Thom 1996). Our ability to re-create a "natural" portion of an estuary is limited. Current ecological understanding does not allow easy prediction of how a site will perform (Zedler 1996). Simenstad and Thom (1996), reporting on the success of a created estuarine wetland in the Puget Sound region, found that sedimentation altered the hydrology of the constructed site - changing the planted vegetation to a more naturally occurring plant community. While the constructed site is not functioning as envisioned, it is functioning in a productive manner.

Mitsch and Wilson (1996) propose that wetlands restoration projects fail when three general concepts are ignored: (1) Understanding wetland function, (2) giving the system time, and (3) allowing for the self-design capacity of nature. Fox (1992) suggests that restoration projects are individual in nature and usually require tailored and innovative design approaches if they are to have any chance of success. In addition, the involved parties often disagree on how to conduct the restoration (National Research Council 1996). Designed wetlands are expensive to construct and they may not succeed (Mitsch and Wilson 1996). For this reason, only passive forms of estuarine restoration are covered under this consultation.

Passive restoration requires only that the anthropogenic disturbance be removed from the system (National Research Council 1996, Kauffman *et al*. 1997). The intent of this form of restoration is to allow natural physical, chemical, and biological processes to restore the system to a level dictated by its local capability (National Research Council 1996). Activities should emphasize ecological processes and functions, not artificial habitat creation (National Research Council 1996). Because estuarine areas are dynamic, trying to restore areas to a "natural," pre-existing condition may be an improper response to the current conditions of the estuary, and it may curtail or prohibit actual restoration (Winfield 1986). Passive restoration will require a substantial amount of time to recruit plants, establish organic sedimentation levels, and allow the site to function as salmonid habitat. As Mitsch and Wilson (1996) state: "Nature remains the chief agent of both self-design and ecosystem development; humans are not the only participants in the design process."

Like restoration of other types of salmonid habitat, estuarine restoration requires a watershed approach that takes into account hydrologic and hydraulic regimes. Such an approach can determine the factors limiting salmonid production within the watershed and show where best to improve salmonid habitat (Kauffman *et al*. 1997, Roper *et al*. 1997, Nelson 1997). Rumrill and Cornu (1995) recommend that "restoration projects should not be planned and undertaken piecemeal, but within the broader context" and that "experimental efforts to restore upland, riparian and wetland habitats are undertaken in the context of the entire coastal watershed landscape." After restoration, it is necessary to monitor the site to determine if the restoration project goals and objectives are being met (Winfield 1986, Ray and Woodroof 1986).

Breaching or removing dikes is a common practice along the West Coast (Frenkel and Morlan 1991). It is also among the easiest of estuarine restoration methods. Once a dike is breached - allowing tidal exchange - native plants will begin to invade and colonize. This method will require a substantial amount of time to fully develop, but it should have a high rate of success. Maintaining a wetland area through time requires a hydrologic interaction with the landscape (Bedford 1996). Problems are likely to arise if the breach is not properly designed to allow tidal exchange, or site elevations cause ponding (Ray and Woodroof 1986). Surface elevation controls the hydrology of the site and thusly the plant community (Frenkel and Morlan 1991). Areas that have been previously diked off may have experienced subsidence or soil compaction. These areas need further evaluation of their ability to naturally revert to wetlands without human intervention. Good (1987) recommended that careful consideration be given to the site's energy regime and that site manipulation be minimized. Caution must also be exercised to protect freshwater habitats from saltwater intrusion. In addition, adjacent upland areas that may have been modified by human activities buffer restoration sites and should therefore also be considered in planning (Good 1987, Steinke 1986, Zedler 1996). Adjacent upland areas also allow organic material (leaves and LWD) to be introduced to the project site, and provide habitat for birds, reptiles, amphibians, and mammals that use estuarine marshes.

Another estuary restoration method involves removal of existing fill material and allow natural recolonization to take place. Areas of an estuary that have been filled should readily transform back to a more "natural" state. As with dike breaching, the area should be allowed to recolonize through natural recruitment. Proper site hydrology is critical for establishing native vegetation in these removal areas (Ray and Woodroof 1986, Pacific Estuarine Research Laboratory 1990).

A final method would involve removing or permanently opening tide gates to create a salt marsh usable by emigrating salmonids and estuarine-dependent species. For this method to succeed, tidal flows must provide adequate water exchange and thus prevent fish stranding.

Most direct and indirect effects of stream and wetland restoration actions are the same as those for general construction discussed above, and stream and wetland restoration actions will follow the conservation measures for general construction as applicable. Further direct physical and chemical effects of trash and debris removal can include resuspension and deposition of sediment and contaminants contained in or buried under the trash and debris. Land uses practices such as agriculture and urban development have contributed increased sediment in streams. Sometimes this sediment can accumulate at the stream mouth, forming a bar or terrace. The bar or terrace can spread the streamflow into finely braided or sheet flow patterns, forming temporal or complete passage barriers to fish. While removal of sediment bars that block fish passage would normally be beneficial to anadromous fish in the long term, excessive amounts of removal may lead to ancillary effects to streambed and banks that impair habitat formation and stream processes.

The Corps proposes to use conservation measures for construction and streambank stabilization, as described above, to avoid or minimize the adverse effects of stream and wetland restoration.

Water Control Structures. The proposed water control actions are limited to repair of existing water control structures and improvements to those structures as necessary to provide or improve fish passage. Maintenance dredging for flow access to existing intake structures is not covered by this Opinion. Because these preexisting structures have independent utility apart from fish passage, the only effects of the proposed actions are those related to repairs and modifications necessary for fish passage. Therefore, most direct and indirect effects of these actions are similar to the effects of general construction discussed above, and will follow the conservation measures for general construction as applicable. Additional biological effects of providing or improving removing fish passage are an increase in the total available habitat area.

Road Construction, Repairs, Maintenance and Improvements. The proposed action for road construction, repairs, maintenance and improvements does not include construction of a new road within the riparian management area, a new bridge pier or abutment below the ordinary high water, a new bridge approach within the Federal Emergency Management Agency (FEMA)-designated floodway that will require embankment fills that significantly impair floodplain function, or a baffled culvert or fishway. Most direct and indirect effects of the proposed road construction, repairs, maintenance, and improvements are the same as those for general construction discussed above, and these road actions will follow the conservation measures for general construction as applicable. However, the adverse effects of roads can be more severe and more intense than those of general construction because roads, bridges and their associated drainage systems, and traffic accidents can cause accelerated runoff of sediment and contaminated water. Additional biological effects can include accelerating the introduction of alien plant and animal species that can make ecological recovery more uncertain (Gucinski *et al*. 2001).

Besides conservation measures listed above, the proposed action will avoid or minimize the adverse effects of road construction, repair and improvement actions with the following conservation measures:

- Permanent stream crossings will be designed in the following priority: (1) Road realignments to avoid crossing the stream, (2) streambed simulation, and (3) active channel design culverts. If the crossing will occur near a known or suspected spawning area, only full span bridges or streambed simulation may be used.
- Fill width will be limited to the minimum necessary to complete the crossing, and will not reduce existing stream width.
- Suitable grade controls will be included to prevent culvert failure caused by changes in stream elevation.
- Culverts and trash racks will be cleaned by working from the top of the bank, unless culvert access using work area isolation would result in less habitat take. Cleaning will only remove the minimum amount of wood, sediment and other natural debris necessary to maintain culvert function without disturbing spawning gravel. All large wood recovered during cleaning will be placed downstream. All routine work will be done in the dry, using work area isolation if necessary.
- All large wood, cobbles and gravels recovered during cleaning must be placed downstream.
- Drift will be removed from structures by working from the top of the bank, unless access using work area isolation would result in less habitat disturbance. Remove only the minimum amount of wood, sediment and other natural debris necessary to maintain structure function without disturbing spawning gravel. Perform drift removal in following order of priority as feasible: (1) Pull and release whole logs or trees downstream; (2) pull whole logs and trees and place in the riparian area; (3) remove whole logs or trees for replacement within the same stream subbasin; and (4) pull, cut only as necessary and release logs and trees downstream.
- Ditch cleaning, maintenance, or structural changes will be limited to those that only maintain original design function or improves water quality and quantity characteristics at the receiving stream, waterbody, or wetland.
- Road maintenance will comply with ODOT (1999) practices or the most current version of the Regional Road Maintenance Endangered Species Act Program Guidelines.

Utility Lines. Proposed utility line action consists of stream crossings for pipes, pipelines, cables, and wires. Most direct and indirect effects of utility line actions are similar to the effects of general construction discussed above, and will follow the conservation measures for general construction as applicable. Additional direct effects can include the production of spoils, contaminated lubricants, and other drilling waste produced by boring that can kill or injure fish if introduced into the water. Construction of new utility lines are likely to enable other interrelated activities, such as commercial and residential development, which may affect individuals of the ESA-listed species or their designated critical habitat through a variety of pathways (*e.g.*, alteration of floodplains, alteration of the volume or timing of water introduction into streams, water withdrawals). In the context of this programmatic consultation, it is not possible for NOAA Fisheries to anticipate all the possible circumstances where the Corps' permitting of new utility line crossings might lead to such indirect effects, nor is NOAA Fisheries able to analyze the general effects of possible interrelated and interdependent activities. Accordingly, new utility line crossings that entail indirect effects to ESA-listed species or their designated critical habitats are not covered by this Opinion, and require individual consultation.

Excavation, stockpiling, vegetation manipulation, and construction within the channel or bed of a waterbody or in its adjacent riparian area are likely to change the bottom characteristics (*e.g.*, the substrate or gradient) of the waterbody and/or to destabilize the banks of waterbodies. For example, depending on the substrate composition and the fill type and procedure, the excavation and subsequent filling of a trench in the dry channel or bank of a stream may make the area of the trench more or less resistant to erosion. If the trench area is less resistant to erosion (through loosening of the substrate or through the use of fill with smaller substrate particles than were originally present), then high stream flows are likely to erode the disturbed substrate, thus mobilizing sediment or abruptly altering the bottom contours or bank stability of the stream. If the trench area is more resistant to erosion (through compaction of the substrate or through the use of fill with larger substrate particles than were originally present) then high stream flows may be less likely to erode the disturbed substrate than the remainder of the streambed or bank, possibly creating hydraulic control points which could alter fluvial geomorphological processes. Stockpiled excavated material, if not removed from streambeds or banks, could also affect stream morphology, as could vegetation and large wood manipulation which destabilizes streambeds and banks. Finally, pipelines, cables, and materials used to armor them may, if exposed by streambed or bank erosion, create hydraulic control points or otherwise affect stream channel stability.

The modification of bank and substrate stability caused by the construction of utility lines through waterbodies and riparian area can have adverse effects on salmonids because of increased sedimentation (discussed above) and because of likely effects on riparian vegetation (discussed below). Aside from effects on sedimentation and vegetation, bank and substrate stability influence structural elements of instream habitat such as pool depth, channel roughness, and bank slope. Because these structural habitat elements are related to key factors in the distribution of water velocity and the amount of overhead cover, changes in the type and structure of substrate and banks can affect predation risk, energy expenditure, invertebrate production, and feeding efficiency. A particularly adverse effect of utility line crossings is the likelihood that they will produce hydraulic jumps if a stream channel degrades while the utility line and/or its armoring remains at a fixed elevation. Such a hydraulic jump can impede upstream passage by fish (particularly juvenile salmonids) and other organisms and may have substantial influence on fish abundance well upstream from the project site.

Besides conservation measures listed above, the proposed action will avoid or minimize the adverse effects of utility line activities with the following conservation measures:

- Utility stream crossings will be perpendicular to the watercourse, or nearly so, and designed in the following priority: (1) Aerial lines, including lines hung from existing bridges; (2) directional drilling, boring and jacking; and (3) dry trenching or plowing.
- If directional drilling, boring, or jacking is used, the drill, bore, or jack hole will span the channel migration zone and any associated wetland, and pits and any associated waste will be completely isolated from surface waters. If drilling fluid or waste is visible in the water, all drilling activity will cease pending written approval from NOAA Fisheries to resume drilling.
- Trenching or plowing may only be used in a naturally (seasonally) dewatered stream or adjacent wetland where the work area can be completely isolated with using silt screens and without the need for any fish salvage. Trenches will be backfilled below the ordinary high water line with native material, then capped with clean gravel suitable for fish use in the project area, unless otherwise approved in writing by NOAA Fisheries.
- Large wood displaced by trenching or plowing will be returned to its original position, wherever feasible.
- Utility lines will not cause lateral migration, head cutting, general scour, or debris loading.

Over and In-Water Structures. Over-water and in-water structures include recreational boating facilities and dock and wharf facilities operated by ports and other commercial entities. Recreational boating requires construction and maintenance of a variety of types and sizes of structures. Some are water dependent, and will be placed in riparian, nearshore, and over-water areas. Others are "related facilities" (*e.g.*, parking lots, picnic areas) that are not water dependent. For purposes of this consultation, actions proposed to support recreational boating facilities are construction of boat ramps; maintenance, repair and relocation of structures within an existing marina; structures in fleeting and anchorage areas; installation of small temporary floats; and repair of navigational aids. Commercial dock and wharf facilities also entail many different types and sizes of structures, often installed and operated over large areas. For purposes of this consultation, however, the proposed action includes the following work: (1) Replacement of existing pilings, fender piles, group pilings, walers, and fender pads; (2) installation of new mooring dolphins and structural pilings; (3) height extension of existing pilings; and
(4) recycling of large wood obstructions that limit the usefulness of dock and wharf facilities.

Juvenile salmonid species such as spring Chinook, sockeye, and coho salmon, and up-river steelhead usually move downriver relatively quickly and in the main channel. This would aid in predator avoidance (Gray and Rondorf 1986). Fall and summer Chinook salmon are found in nearshore, littoral habitats and are particularly vulnerable to predation (Gray and Rondorf 1986). Juvenile Chinook and coho salmon use backwater areas during their outmigration (Parente and Smith 1981). In addition, the presence of predators may force smaller prey fish species into less desirable habitats, disrupting foraging behavior, resulting in less growth (Dunsmoor *et al*. 1991).

When a salmon stock suffers from low abundance, predation can contribute significantly to its extinction (Larkin 1979). Further, providing temporary respite from predation may contribute to increasing Pacific salmon (Larkin 1979). A substantial reduction in predators will generally result in an increase in prey (in this case, salmonids) abundance (Campbell 1979). Gray and Rondorf (1986), in evaluating predation in the Columbia River Basin, state that "the most effective management program may be to reduce the susceptibility of juvenile salmonids to predation by providing maximum protection during their downstream migration." Campbell (1979), discussing management of large rivers and predator/prey relations, advocates that a "do nothing" approach (as opposed to predator manipulations) coupled with a strong habitat protectionist policy, should receive serious consideration.

Predator species such as northern pikeminnow (*Ptychocheilus oregonensis*), and introduced predators such as largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), black crappie (*Pomoxis nigromaculatus*) white crappie (*P. annularis*) and, potentially, walleye (*Stizostedion vitreum*) (Ward *et al*. 1994, Poe *et al*. 1991, Beamesderfer and Rieman 1991, Rieman and Beamesderfer 1991, Pflug and Pauley 1984, and Collis *et al*. 1995) may utilize habitat created by over-water structures (Ward and Nigro 1992, Pflug and Pauley 1984) such as piers, float houses, floats and docks (Phillips 1990). However, the extent of increase in predation on salmonids in the Lower Columbia River resulting from over-water structures is not well known.

Major habitat types utilized by largemouth bass include vegetated areas, open water and areas with cover such as docks and submerged trees (Mesing and Wicker 1986). During the summer, bass prefer pilings, rock formations, areas beneath moored boats, and alongside docks. Colle *et al*. (1989) found that, in lakes lacking vegetation, largemouth bass distinctly preferred habitat associated with piers, a situation analogous to the Columbia River. Marinas also provide wintering habitat for largemouth bass out of mainstem current velocities (Raibley *et al*. 1997). Bevelhimer (1996), in studies on smallmouth bass, indicates that ambush cover and low light intensities create a predation advantage for predators and can also increase foraging efficiency. Wanjala *et al*. (1986) found that adult largemouth bass (*Micropterus salmoides*) in a lake were generally found near submerged structures suitable for ambush feeding. The slower currents found in Canoe Bay make this area conducive to largemouth bass.

Black crappie and white crappie are known to prey on juvenile salmonids (Ward *et al*. 1991). Ward *et al*. (1991), in their studies of crappies within the Willamette River, found that the highest density of crappies at their sampling sites occurred at a wharf supported by closely spaced pilings. They further indicated that suitable habitat for crappies includes pilings and riprap areas. Walters *et al*. (1991) also found that crappie were attracted to in-water structures and recommended placement of structures as attractants in lake environs.

Ward (1992) found that stomachs of northern pikeminnow in developed areas of Portland Harbor contained 30% more salmonids than those in undeveloped areas, although undeveloped areas contained more northern pikeminnow.

There are four major predatory strategies utilized by piscivorous fish: They run down prey; ambush prey; habituate prey to a non-aggressive illusion; or stalk prey (Hobson 1979). Ambush predation is probably the most common strategy; predators lie-in-wait, then dart out at the prey in an explosive rush (Gerking 1994). Predators may use sheltered areas that provide slack water to ambush prey fish in faster currents (Bell 1991).

Light plays an important role in defense from predation. Prey species are better able to see predators under high light intensity, thus providing the prey species with an advantage (Hobson 1979, Helfman 1981). Petersen and Gadomski (1994) found that predator success was higher at lower light intensities. Prey fish lose their ability to school at low light intensities, making them vulnerable to predation (Petersen and Gadomski 1994). Howick and O'Brien (1983) found that in high light intensities prey species (bluegill) can locate largemouth bass before they are seen by the bass. However, in low light intensities, the bass can locate the prey before they are seen. Walters *et al*. (1991) indicate that high light intensities may result in increased use of shade-producing structures. Helfman (1981) found that shade, in conjunction with water clarity, sunlight and vision, is a factor in attraction of temperate lake fishes to overhead structure.

An effect of over-water structures is the creation of a light/dark interface that allows ambush predators to remain in a darkened area (barely visible to prey) and watch for prey to swim by against a bright background (high visibility). Prey species moving around the structure are unable to see predators in the dark area under the structure and are more susceptible to predation. The incorporation of grating into all of the docks allows for more light penetration and diffuses the light/dark interface. This will minimize the susceptibility of juvenile salmonids to piscivorous predation resulting from these types of projects.

In addition to piscivorous predation, in-water structures (tops of pilings) also provide perching platforms for avian predators such as double-crested cormorants (*Phalacrocorax auritis*), from which they can launch feeding forays or dry plumage. Their high energy demands associated with flying and swimming create a need for voracious predation on live prey (Ainley 1984). Cormorants are underwater pursuit swimmers (Harrison 1983) that typically feed on mid-water schooling fish (Ainley 1984), but they are known to be highly opportunistic feeders (Derby and Lovvorn 1997; Blackwell *et al*. 1997; Duffy 1995. Double-crested cormorants are known to fish cooperatively in shallow water areas, herding fish before them (Ainley 1984). Krohn *et al*. (1995) indicate that cormorants can reduce fish populations in forage areas, thus possibly affecting adult returns as a result of smolt consumption. Because their plumage becomes wet when diving, cormorants spend considerable time drying out feathers (Harrison 1983) on pilings and other structures near feeding grounds (Harrison 1984). Placement of piles to support the dock structures will likely provide for some usage by cormorants. Placement of anti-perching devices on the top of the pilings would preclude their use by any likely avian predators.

The placement of a boat ramp will generally result in permanent loss of some riparian habitat. The extent of area of that loss associated with a ramp is usually small. Upland parking lots, picnic areas, walking trails, and toilet facilities will also result in losses to critical habitat if placed close to the waters edge. In addition, construction activities associated with ramp construction will also result in impacts to the riparian area. These effects can be offset with compensatory mitigation.

Riparian habitats are one of the most ecologically productive and diverse terrestrial environments (Kondolf *et al*. 1996, Naiman *et al*. 1993). Vegetation in riparian areas influences channel processes through stabilizing bank lines, and providing LW, terrestrial food sources rather than autochthonous food production, and regulating light and temperature regimes (Kondolf *et al*. 1996, Naiman *et al*. 1993). Revegetation of any riparian areas disturbed by construction activities in time is likely to maintain or improve habitat conditions for salmonids within the action area by increasing plant densities in degraded areas or changing plant species at the site to those that are more beneficial to aquatic species.

Many direct and indirect effects of recreational boating activities are similar to those of general construction described above. Among those are construction of new impervious surfaces for a boat ramp or other water-dependent structure that will be offset by an action like planting additional riparian trees and shrubs or restoration of nearshore habitats. Other direct physical and chemical effects are unique to over-water structures. These are disruption of nearshore habitat, shading and ambient light changes, water flow pattern, and energy disruption (Carrasquero 2001), although these effects have been avoided or minimized by conservation measures described above. Over-water structures can alter predator prey relationships by improving predator success (Hobson 1979, Bell 1991, Metcalfe *et al*. 1997), although the environmental conditions created by over-water structures that can increase predation on salmon can be avoided or minimized using project design criteria that reduce shaded area and avoid placement in shallow water and other low velocity locations (Carrasquero 2001).

Poor flushing in areas with marinas has been associated with increased water temperature, phytoplankton populations with nocturnal dissolved oxygen level declines resulting in organism hypoxia, and increased pollutant levels (Cardwell *et al*. 1980a). Water stagnation and fuel oil, paint and gasoline spills pose a serious hazard to juveniles in marinas (Heiser and Finn 1970). Elevated residues of heavy metals may be leaching from antifouling paint on vessels moored in marinas (Cardwell *et al*. 1980b). Chlorine-based cleaning solutions are sometimes discharged into marinas.

Residential docks and especially marinas are likely to have high levels of boating activity in their immediate vicinity, particularly next to floats. Specifically, docks may serve as a mooring area for boats or a staging platform for recreational boating activities. Boating activities may adversely affect listed salmonids and aquatic habitats directly through engine noise or prop movement, and the physical presence of a boat hull may disrupt or displace nearby fishes (Mueller 1980, Warrington 1999a).

The obvious indirect effects of recreational boating facilities are those associated with boating activities. Boating can result in discharges of many pollutants from boats and related facilities, and physical disruption to wetland, riparian and benthic communities and ecosystems through the actions of a boat hull, propeller, anchor, or wakes (USEPA 1993, Carrasquero 2001). These effects, too, have been avoided or minimized to the extent possible using boating facility design criteria in the conservation measures described above. The intensity and magnitude of the remaining effects depend on the knowledge and discretion of boat operators as they pursue their boating activity. Boat traffic may also increase turbidity in shallow waters, uproot aquatic macrophytes in shallow waters, or cause pollution through exhaust, fuel spills, or release of petroleum lubricants (Warrington 1999b). Nordstrom (1989) says that boat wakes may also play a significant role in creating erosion in narrow creeks entering an estuary (areas extensively used by rearing juvenile salmonids). These boating impacts indirectly affect listed fish in many ways. Turbidity may injure or stress affected fishes (see above). The loss of aquatic macrophytes may expose salmonids to predation, decrease littoral productivity, or alter local species assemblages and trophic interactions. Despite a general lack of data specifically for salmonids, pollution from boats may cause short-term injury, physiological stress, decreased reproductive success, cancer, or death for fishes. Further, pollution may also affect fishes by affecting likely prey species or aquatic vegetation.

Boat docks, marinas, and associated structures in estuarine environments also may adversely affect anadromous fish. Salmon have evolved several life-history strategies for using estuaries (Williams *et al*. 1996). Five anadromous fish species (pink, chum, coho, and Chinook salmon and sea-run cutthroat trout) are found in association with eelgrass meadows (Phillips 1984). Coho salmon, yearling Chinook salmon, and sockeye salmon spend little time in the estuary; pink salmon traverse the estuary quickly; and chum salmon and subyearling Chinook salmon use the estuary quite extensively (Pearcy 1992, Fisher and Pearcy 1996). Pearcy (1992) says that chum salmon in Netarts Bay, Oregon, make extensive use of shallow marshes, sloughs, and tidal creeks in the upper reaches during high tides in the spring. During low tides they move into deep water channels. As the fish grew in size, they began to use the lower portions of the estuary.

Habitat degradation and loss adversely affect inshore and riverine ecosystems critical to living marine resources. Furthermore, degradation and loss of estuarine habitat reduce salmon carrying capacity in these areas. The cumulative effects of small changes in many estuaries may have a large systematic impact on estuarine and coastal oceanic carrying capacity. Fox (1992) states “the ability of habitats to support high productivity levels of marine resources is diminishing, while pressures for their conversion to other uses are continuing.” Point and non-point discharges, waste dumps, eutrophication, acid rain, and other human impacts reduce this ability (Fox 1992). Population growth and demands for international business trade along the Pacific Rim exert pressure to expand coastal towns and port facilities - resulting in net estuary losses.

Estuarine habitats fulfill fish and wildlife needs for reproduction, feeding, refuge, and other physiological necessities (Simenstad *et al*. 1991, Good 1987, Phillips 1984). Coastal fish populations depend upon both the quantity and quality of the available habitat (Peters and Cross 1992). Almost all marine and intertidal waters, wetlands, swamps and marshes are critical to fish (Fedler and Crookshank 1992). For example, seagrass beds protect young fish from predators, provide habitat for fish and wildlife, improve water quality, and control sediments (Lockwood 1990, Thayer *et al*. 1984, Hoss and Thayer 1993, Phillips 1984). In addition, seagrass beds are critical to nearshore food web dynamics (Wyllie-Echeverria and Phillips 1994). For example, some invertebrates that are principal prey items for fish of commercial and ecological importance (*e.g.* chum salmon, Pacific herring, Pacific sand lance) in the Pacific Northwest are found only in eelgrass beds (Simenstad *et al*. 1982, Simenstad 1994).

Seagrass beds are among the areas of highest primary productivity in the world (Ferguson *et al*. 1980, Emmett *et al*. 1991, Hoss and Thayer 1993, Herke and Rogers 1993). This primary production, combined with other nutrients, provide high rates of secondary production in the form of fish (Good 1987, Sogard and Able 1991, Emmett *et al*. 1991, Herke and Rogers 1993). Filling, dredging, and construction of in-water structures can damage seagrass beds through burying, removal, or shading (Thayer *et al*. 1984, Lockwood 1990, Burdick and Short 1998, Fonseca *et al*. 1998). Also, boat operation above or within seagrass beds can damage the beds through vessel wakes, and propeller washing (Peterson *et al*. 1987, Lockwood 1990, Fonseca *et al*. 1998). Deep, long-term scarring results when propellers churn through the substrate, severing rhizomes (Zieman 1976, Fonseca 1989). Methodologies to reduce effects of docks and other structures on seagrass beds are provided in Lockwood (1990), Burdick and Short (1998), and Fonseca *et al*. (1998).

The exact times when juvenile salmonids enter the estuary and how long they stay depend on numerous abiotic and biotic factors such as stream temperatures, fry size and condition, food resources, stream discharge and turbidity, tidal cycles, and photoperiod (Simenstad *et al*. 1982). Simenstad *et al*. (1997), in their monitoring studies of an "engineered" slough, found that coho salmon use these areas as rearing habitat. In addition, sea-run cutthroat trout also spend substantial periods in the estuary (Giger 1972). Palmisano (1997), discussing factors for the decline of Umpqua River cutthroat trout, states that sea-run cutthroat make extensive use of estuaries, embayments, and sheltered shorelines, with some cutthroat residing in an estuary for up to 18 months. The National Research Council (1996) states that "loss of estuarine and riverine habitat can potentially affect all salmon."

Estuaries serve as essential rearing grounds and provide a transitional area for salmonids moving from fresh to salt water and vice-versa (Botkin *et al*. 1995). Estuaries also play a key role in regulating overall survival and abundance (Williams *et al*. 1996) and changes in estuarine food webs may constrain salmon production. Avoiding placement of boat docks and moorages in areas with aquatic vegetation will minimize impacts associated with these structures.

Besides conservation measures listed above for construction and streambank stabilization, the proposed action will avoid or minimize the adverse effects of over and in-water structures with the following conservation measures:

- No new marinas, floating storage units, boat houses, houseboats, or piers are authorized.
- No new boat ramps, docks, piers, or other over-water facilities are authorized in an estuary or other saltwater areas, an exposed area requiring a breakwater, an area within 0.5 miles downstream from the mouth of a tributary, a shallow water area requiring significant excavation, or a deposition area likely to need routine maintenance dredging.

- No new over-water facilities wider than 6 feet are authorized, unless current velocity is greater than 0.7 feet per second during the low flow period or the structure is more than 50 feet from the shoreline and in water more than 20 feet deep.
- Modifications of existing marinas will be made within the existing footprint of the moorage, or in water more than 50 feet from the shoreline and more than 20 feet deep.
- All related facilities, such as parking lots and picnic areas, will be outside the riparian management area, and signs are required at public boating facilities to minimize the indirect adverse effects of boating by educating the public about pollution and its prevention.
- All synthetic flotation material will be permanently encapsulated to prevent the breakup into small pieces and dispersal in water.
- Mooring buoys, small temporary floats, and floats for crab and shrimp traps will be installed more than 300 feet from native submerged aquatic vegetation, more than 50 feet from the shoreline, in water more than 20 feet deep, and otherwise as necessary to ensure that moored boats do not ground out or propeller wash the bottom.
- Small temporary floats will also be installed less than 7 days before a scheduled event, removed five days after a scheduled event is concluded, and not left in longer than 21 days total.
- All pilings, mooring buoys, and navigational aids (*e.g.*, channel markers) will be fitted with devices to prevent perching by piscivorus birds.
- Because the best way to minimize adverse effects caused by boating is to educate the public about pollution and its prevention, post a permanent sign that will be maintained at each permitted facility used by the general public describing measures to minimize boating impacts.

Access Maintenance. "Access maintenance" refers to dredging as proposed to remove sediments necessary to maintain existing marinas, port terminals, and industrial docks and wharfs. Dredging and disposal of the dredged material speed up the natural processes of sediment erosion, transportation, and deposition (Morton 1977). Dredging and disposal temporarily increase turbidity, change bottom topography with resultant changes in water circulation, and change in the mechanical properties of the sediment at the dredge and disposal sites (Morton 1977). The effects of turbidity on salmonids is discussed above. These effects are significant in proportion to the ratio of the size of the dredged area to the size of the bottom area and water volume (Morton 1977).

Direct effects to fish are likely to include entrainment of juvenile fish (Dutta and Sookachoff 1975a, Boyd 1975, Armstrong *et al*. 1982, Tutty 1976) and mortality from exposure to suspended sediments (turbidity). The likely indirect effects of dredging include: (1) Behavioral changes (Sigler *et al*. 1984, Berg and Northcote 1985, Whitman *et al*. 1982, Gregory 1988) and sub-lethal impacts from exposure to increased turbidity (Sigler 1988, Sigler *et al*. 1984, Kirn *et al*. 1986, Emmett *et al*. 1988, Servizi 1988); (2) mortality from predatory species that benefit from activities associated with dredged material disposal; (3) mortality resulting from stranding as a result of vessel wakes; (4) modifications to nearshore habitat resulting from erosion as a result of vessel wakes or dredging itself; (5) loss of benthic food sources resulting from dredging and disposal of dredged material (Morton 1977); and (6) cumulative effects of increased industrialization at port facilities along the river.

NOAA Fisheries does not expect clamshell dredging to entrain juvenile salmonids. The action of the bucket passing through the water column should allow for salmonids to avoid it. However, hydraulic suction dredging may entrain juvenile salmonids. When juvenile salmonids come within the “zone of influence” of the cutter head, they may be drawn into the suction pipe (Dutta 1976, Dutta and Sookachoff 1975a). Dutta (1976) reported that salmon fry were entrained by suction dredging in the Fraser River and that suction dredging during juvenile migration should be controlled. Braun (1974a, 1974b), in testing mortality of entrained salmonids, found that 98.8% of entrained juveniles were killed. Dutta and Sookachoff (1975b) found that suction dredging operations “cause a partial destruction of the anadromous salmon fishery resource of the Fraser River.” Boyd (1975) noted that suction pipeline dredges operating in the Fraser River during fry migration took substantial numbers of juveniles. As a result of these studies, the Canadian government issued dredging guidelines for the Fraser River to minimize the likelihood of entrainment (Boyd 1975). Further testing in 1980 by Arseneault (1981) resulted in entrainment of chum and pink salmon but in low numbers relative to the total of salmonids outmigrating (.0001 to .0099%).

The Portland District Corps of Engineers conducted extensive sampling within the Columbia River in 1985-88 (Larson and Moehl 1990) and again in 1997 and 1998. In the 1985-88 study no juvenile salmon were entrained, and the 1997-98 study resulted in entrainment of only two juvenile salmon. McGraw and Armstrong’s (1990) examination of fish entrainment rates in Grays Harbor from 1978 to 1989 resulted in only one juvenile salmon being entrained. Dredging was conducted outside peak migration times. Stickney (1973) also found no evidence of fish mortality while monitoring dredging activities along the Atlantic Intracoastal Waterway. These studies were on deep water areas associated with main channels. Few data are available on the extent of entrainment in shallow water areas, such as those associated with the side channels proposed as part of maintenance dredging.

In areas of coarse sand, NOAA Fisheries expects the turbidity generated from the dredging process to be very small and confined to the area close to the draghead. Issues involving turbidity associated with flow lane disposal were addressed in the 1993 biological opinion with Corps for navigation channel maintenance dredging. NOAA Fisheries did not believe that mortality resulting from turbidity was an issue of concern during that consultation and has no information that would change that belief for this Opinion.

In all areas, resuspension of toxic sediments may be a problem. Adequate testing of sediments prior to dredging to limit resuspension of toxic materials is necessary. Many areas within the action area have substantial contaminated sediments. NOAA Fisheries is working with the other resource and regulatory agencies on development of testing protocols and screening levels. Until these protocols can be developed, any maintenance dredging beyond minor projects necessary to maintain access to residential boat docks, boat ramps, and culverts is excluded from this consultation.

In addition to conservation measures for general construction described above, the Corps proposes the following conservation measures for dredging of sediment or other debris, including large wood, that obstructs or interferes with normal use of an over-water or in-water structure:

- The materials to be dredged must all be naturally-occurring sediments consisting of more than 80% sand, gravel, or other naturally-occurring bottom material.
- The area to be excavated must not be within an EPA-designated Superfund Site, a state-designated clean-up area, or other type of area that is likely to be within the impact zone of a significant contaminant source, as identified by historical information or the Corps' best professional judgment.
- Only the minimum amount of sediment and debris necessary to restore normal use may be removed or excavated.
- All sediment and debris must be side cast or returned to the water downstream from the structure where it will continue to provide aquatic habitat function.

Maintenance of Port, Industrial, and Marina Facilities. This activity includes replacing existing pilings, fender piles, group pilings, walers, and fender pads. It also includes the installation of new mooring dolphins and structural pilings, height extension of existing pilings and the relocation of floats within an existing marina. NOAA Fisheries believes that with the proposed timing restrictions and the requirement for the use of treated wood meeting NOAA Fisheries' guidelines, the activities of extending the height of existing pilings and the replacement of walers and fender pads are not likely to adversely affect ESA-listed salmonids. Possible impacts to ESA-listed species and designated critical habitat from the remaining proposed activities are detailed below. They include increased turbidity, avoidance behavior risks, decreased food supplies, increased predation, decreased water quality, and loss of vegetative cover.

Minor Discharge and Excavation. Minor discharge and excavation refers to maintenance and repairs of previously authorized structures such as intakes, culverts, boat ramps, and boat docks. The effects of these actions are similar to those discussed above for the construction effects for road maintenance, and over-water and in-water structures. Beyond conservation measures listed for those actions above, the effects of minor discharge and excavation will be further minimized or avoided by the following conservation measures:

- Minor discharge or excavation will not be authorized for any water intake channel for a water intake that does not have a fish screen that is installed, operated and maintained according to NOAA Fisheries fish screen criteria.
- The volume of material moved must be limited to the minimum amount necessary to restore normal use and may not exceed 25 cubic yards.
- All naturally-occurring sediment and debris, including large wood, must be side cast or returned to the water downstream from the structure where it will continue to provide aquatic habitat function.

Site Restoration and Compensatory Mitigation. The direct physical and chemical effects of post-construction site restoration included as part of the proposed actions are essentially the reverse of the construction activities that go before it. Bare earth is protected by seeding, planting woody shrubs and trees, and mulching. This immediately dissipates erosive energy associated with precipitation and increases soil infiltration. It also accelerates vegetative succession necessary to restore the delivery of large wood to the riparian area and stream, root strength necessary for slope and bank stability, leaf and other particulate organic matter input, sediment filtering and nutrient absorption from runoff, and shade. Microclimate will become cooler and more moist, and wind speed will decrease. When projects result in a net loss of functional aquatic habitat after construction and site restoration is complete, off-site compensatory mitigation similar to site restoration is required and will have similar effects to those discussed above.

In addition to conservation measures for general construction and streambank stabilization described above, the Corps proposes the following conservation measures for site restoration and compensatory mitigation:

- All temporary access roads will be obliterated when the project is completed, the soil will be stabilized and the site will be revegetated.
- Temporary roads in wet or flooded areas will be abandoned and restored by the end of the in-water work period.
- Any large wood, native vegetation, weed-free topsoil, and native channel material displaced by construction will be stockpiled for use during site restoration.
- When construction is finished, all streambanks, soils, and vegetation will be cleaned up and restored as necessary to renew ecosystem processes that form and maintain productive fish habitats.
- No pesticide application will be allowed.
- Fencing will be installed as necessary to prevent access to revegetated sites by livestock or unauthorized persons.
- An unavoidable adverse effect, such as construction of a new impervious surface for a water-dependent structure, will be offset by compensatory mitigation actions.

<u>**Effects on Listed Species and Their Habitat**</u>. The direct biological effects of construction included as part of the proposed action are primarily the result of physical and chemical changes in the environment caused by that construction. These effects are complex and vary in magnitude and severity between the individual organism, population, ESU and community scales.

Construction actions may also have direct biological effects on individual salmon and steelhead by altering development, bioenergetics, growth, and behavior. Actions that increase flows can disturb gravel in salmon or steelhead redds and can also agitate or dislodge developing young and cause their damage or loss. Similarly, actions that reduce subsurface or surface flows, reduce shade, deposit silt in streams, or otherwise reduce the velocity, temperature, or oxygen concentration of surface water as it cycles through a redd can adversely affect the survival, timing, and size of emerging fry (Warren 1971). Salmon that survive the redd but emerge later and smaller than other fry also appear to be weaker, less dominant, and less capable of maintaining their position in the environment (Mason and Chapman 1965). Once adult salmon or steelhead arrive at a spawning area, their successful reproduction is dependent on the same environmental conditions that affect survival of embryos in the redd. Environmental conditions in estuarine areas with native submerged aquatic vegetation, in particular, are important to all species of salmon and to estuarine fishes.

Many environmental conditions can cause incremental differences in feeding, growth, movements, and survival of salmon and steelhead during the juvenile life stage. Construction actions that reduce the input of particulate organic matter to streams, add fine sediment to channels, or disturb shallow-water habitats, can adversely affect the ability of salmon and steelhead to obtain food necessary for growth and maintenance. Salmon and steelhead are generally able to avoid the adverse conditions created by construction if those conditions are limited to areas that are small or local compared to the total habitat area, and if the system can recover before the next disturbance. This means juvenile and adult salmon and steelhead will, to the maximum extent possible, readily move out of a construction area to obtain a more favorable position within their range of tolerance along a complex gradient of temperature, turbidity, flow, noise, contaminants, and other environmental features. The degree and effectiveness of the avoidance response varies with life stage, season, the frequency and duration of exposure to the unfavorable condition, and the ability of the individual to balance other behavioral needs for feeding, growth, migration, and territory. Chronic or unavoidable exposure heightens physiological stress thus increasing maintenance energy demands (Redding *et al*. 1987, Servizi and Martens 1991). This reduces the feeding and growth rates of juveniles and can interfere with juvenile migration, growth to maturity in estuaries, and adult migration. However, with due diligence for the full range of conservation measures outlined above, the threat is negligible that the environmental changes caused by events at any single construction site associated with the proposed action, or even any likely combination of such construction sites in proximity, could cause chronic or unavoidable exposure over a large habitat area sufficient to cause more than transitory direct affects to individual salmon or steelhead.

At the population level, the effects of the environment are understood to be the integrated response of individual organisms to environmental change. Thus, 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). Lethal take associated with work area isolation, if any, is expected to amount to no more than a few individual juveniles (Table 3). That is too few to influence population abundance. Similarly, small to intermediate reductions in juvenile population density in the action areas caused by individuals moving out of the construction area to avoid short-term physical and chemical effects of the proposed construction are expected to be transitory and are not expected alter juvenile survival rates.

Because adult salmon and steelhead are larger and more mobile than juveniles, it is unlikely that any will be killed during work area isolation although adults may move laterally or stop briefly during migration to avoid noise or other construction disturbances (Feist *et al*. 1996, Gregory 1988, Servizi and Martens 1991, Sigler 1988). However, with due diligence for the full range of conservation measures outlined above, it is unlikely that physical and chemical changes caused by construction events at any single construction site associated with the proposed action, or even any likely combination of such construction sites in proximity, will cause delays severe enough to reduce spawning success and alter population growth rate, or cause straying that might alter the spatial structure or genetic diversity of populations. Thus, it is unlikely that the direct biological effects of construction associated with the proposed action will affect the characteristics of salmon or steelhead populations.

At the ESU level, direct 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). As described above, it is unlikely that the direct biological effects of construction associated with the proposed action will affect the characteristics of salmon or steelhead populations, therefore it is also unlikely that salmon or steelhead will be affected at the ESU level.

Indirect effects that are reasonably certain to occur after the proposed construction is complete include human activity and ecological recovery in the construction area. The human activity will vary with the type and purpose of the structure or activity completed, and will be discussed below in sections analyzing specific types of actions. "Ecological recovery" means the establishment or restoration of environmental conditions necessary for proper functioning condition in the construction area. Many proposed actions are likely to occur in areas where productive habitat functions and recovery mechanisms were absent or degraded before construction took place. These sites are only likely to achieve proper functioning condition if the pre-construction environment retains the ecological potential to function properly[12] (*e.g.*, residual productivity of riparian soils, channel conditions with balanced scour and fill processes). The prospect for ecological recovery will be further limited by ecological and social factors at the watershed and landscape scales, or site capacity. For example, ecological recovery of a project site surrounded by intensive land use and severe upstream disturbance is likely to be less stable and less resilient than the recovery of a site surrounded by wildlands where the headwaters are protected. To some extent, control of undesirable vegetation, limiting anthropogenic disturbance, and other proposed conservation measures described above will help to compensate for low residual ecological potential and accelerate recovery. However, they are unlikely to fully overcome severe site constraints imposed by low site capacity.

---

[12] "Properly functioning," "properly functioning condition," and "properly functioning habitat condition" refers to the habitat component of a species' biological requirements and means the sustained presence of natural habitat-forming processes in a watershed necessary for the long-term survival of the species through the full range of environmental variation. (NMFS 1999b).

The time necessary for recovery of functional habitat attributes will vary by attribute. Recovery mechanisms such as soil stability, sediment filtering and nutrient absorption, and vegetation succession may recover quickly (months, years) after completion of the proposed action. Recovery of functions related to large wood and microclimate may require decades or longer. Functions related to shading of the riparian area and stream, root strength for bank stabilization, and organic matter input may require intermediate lengths of time. Thus, ecological recovery that includes all important functional habitat attributes, within the limits of site potential and capability, may require many decades although substantial or full recovery of most attributes is likely to occur much sooner. This is well within the 100-year time frame used to evaluate the role of local environmental variation in the long-term survival of salmon and steelhead populations (McElhaney *et al*. 2000). Habitat areas associated with new pavement and other new permanent soil cover, if any, will not be part of this recovery trajectory. However, other riparian and in-water areas will be selected for concurrent habitat improvement using quantitative criteria developed for each project as necessary to offset any permanent habitat loss caused by construction.

The indirect biological effects of construction can be understood as the integrated response of individuals and populations of many, interrelated species at the community level. All populations are dependent on the physical and chemical conditions and resources at their locations, and together with these conditions and resources form ecosystems. A persistent change in the environmental conditions or resources of an ecosystem can lead to a change in the abundance of many, if not all, populations in the ecosystem and lead to development of a new community. Differences in riparian and instream habitat quality, including water chemistry, can alter trophic and competitive relationships in ways that support or weaken the populations of salmon and steelhead in relation to other more pollution tolerant species (Wentz *et al*. 1998; Williamson *et al*. 1998). However, with due diligence for the full range of proposed conservation measures outlined above, it is unlikely that physical and chemical changes due to construction activities associated with the proposed action will cause a persistent change in the conditions or resources available relative to the total habitat area. Thus, it is unlikely that the indirect biological effects of construction associated with the proposed action will affect the characteristics of individuals and populations at the biological community level.

Effects on Critical Habitat. ESA section 3(5)(a) defines “critical habitat” as the specific areas within the geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features essential to the conservation of the species and which may require special management considerations or protection, and specific areas outside the geographical area occupied by the species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species. Therefore, this analysis of the effects of the proposed action on critical habitat focuses on the role that designated critical habitat must play in the action area with respect to the survival or recovery of SONC coho salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, and SR sockeye salmon, and does not rely on the regulatory definition of “adverse modification or destruction” of critical habitat recently at issue in the 9th Circuit Court of Appeals case *Gifford Pinchot Task Force, et. al, vs. U.S. Fish and Wildlife Service,* No. 03-35279, August 6, 2004.

Essential habitat for SONC coho juvenile summer and winter rearing areas, juvenile migration corridors, areas for growth and development to adulthood, and adult migration corridors, and spawning areas. Juvenile summer and winter rearing areas and spawning areas are often in small headwater streams and side channels, while juvenile migration corridors and adult migration corridors include these tributaries, mainstem reaches and estuarine areas. Growth and development to adulthood occurs primarily in near- and off-shore marine water, although final maturation takes place in freshwater tributaries when the adults return to spawn. Essential habitat for SR salmon consists of spawning and rearing areas, juvenile migration corridors, areas for growth and development to adulthood, and adult migration corridors. Of these, the action area has been designated as essential for spawning and rearing, juvenile migration, and adult migration. The Pacific Ocean areas used by listed salmon for growth and development to adulthood are not well understood, and essential areas and features have not been identified for this life stage.

The essential features of critical habitat for SONC coho salmon are substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. The essential features of spawning and rearing habitat for SR spring/summer-run and fall-run Chinook salmon are spawning gravel, water quality, water quantity, water temperature, cover/shelter, food, riparian vegetation, and space. Essential features of spawning and rearing areas for SR sockeye salmon are similar, but also include access and do not include cover/shelter or space. Essential features of juvenile and adult migration habitats for all three SR salmon are the same and consist of substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food (juvenile life stages only), riparian vegetation, and safe passage conditions.

Projects authorized by this Opinion may occur in each of these essential habitats. Special management consideration for these essential habitats and features is necessary to ensure that they are maintained or restored. As described in the Environmental Baseline section of this Opinion, the status of these ESUs is such that, to meet their biological requirements, a significant improvement is needed in the environmental conditions that SONC coho salmon, SR spring/summer-run and fall-run Chinook salmon encounter in their juvenile rearing areas, and that SONC coho salmon, SR spring/summer-run and fall-run Chinook salmon and SR sockeye salmon encounter in their juvenile migration corridors. Any further degradation of these conditions would have a significant impact due to the amount of risk they presently face under the environmental baseline. However, as noted in the Effects of the Action section of this Opinion, the effects of the proposed action on these conditions are likely to be short-term, minor, and local, or else offset through a combination of conservation measures and compensatory mitigation such that conditions necessary for SONC coho salmon and these SR salmon to complete life history requirements for survival or recovery will not be diminished.

Because the proposed action will not have a significant adverse effect on the essential features of critical habitat, and thus will not reduce the value of affected essential habitat for spawning, rearing or migration, or reduce the likelihood of survival or recovery of these ESUs, NOAA

Fisheries finds that the proposed action is not likely to destroy or adversely modify critical habitat.

Synthesis of All Action Effects. The scope of activity allowed under each type of proposed action is narrowly proscribed, and is further limited by conservation measures tailored to avoid direct and indirect adverse effects of those actions on properly functioning habitat conditions. Due diligence for the scope of actions allowed and conservation measures required will probably limit direct lethal effects on listed fish to a few deaths associated with isolation of in-water work areas, an action necessary to avoid greater environmental harm. All other direct adverse effects will likely be transitory and within the ability of both juveniles and adults to avoid by bypassing or temporarily leaving the proposed action area. Such behavioral avoidance will probably be the only significant biological response of salmon and steelhead to the proposed actions. This is because action areas are likely to be widely distributed and small compared with the total habitat area; the intensity and severity of environmental effects within the action areas have been comprehensively minimized; and proper functioning habitat conditions are likely to recover within the action areas inside the time span used to evaluate local environmental variation in the long-term survival of salmon and steelhead populations. Completion of proposed restoration activities at a degraded site that retains the capability for proper functioning at the site, watershed and landscape scale, will likely result in an increase in the total area of properly functioning habitats available.

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 C.F.R. 402.02). Cumulative effects that reduce the capacity of listed ESUs to meet their biological requirements in the action area increase the risk to the ESU that the effects of the proposed action on the ESU or its habitat will result in jeopardy (NMFS 1999f).

Between 1990 and 2000, the population of the State of Oregon increased by 20.4% and in increased in the State of Washington by 21.1%.[13] Thus, NOAA Fisheries assumes that future private and state actions will continue within the action area, increasing as population density rises. As the human population in the action area continues to grow, demand for agricultural, commercial, or residential development is also likely to grow. The effects that new development have that are caused by that demand are likely to further reduce the conservation value of habitat within the action area.

Although quantifying an incremental change in survival for the ESUs considered in this consultation due to the cumulative effects is not possible, it is reasonably likely that those effects

[13] U.S. Census Bureau, State and County QuickFacts, Oregon and Washington. Available at http://quickfacts.census.gov/qfd/states/41000.html and http://quickfacts.census.gov/qfd/states/53000.html, respectively.

within the action area will have a small, long-term, negative effect on the likelihood of their survival and recovery.

Conclusion

After reviewing the best available scientific and commercial information available regarding the current status of the 15 ESUs considered in this consultation, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NOAA Fisheries' opinion that the action, as proposed, is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify critical habitat designated for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SONC coho salmon, or SR sockeye salmon.

Our conclusions are based on the following considerations: (1) Individual review is required of each project that will be covered by SLOPES to ensure that it is within the range of actions analyzed in this Opinion, and that each applicable conservation measure (reiterated here as Reasonable and Prudent Measures and Terms and Conditions) is included as an enforceable condition of the permit document; (2) taken together, the conservation measures applied to each project will ensure that any short-term effects to water quality, habitat access, habitat elements, channel conditions and dynamics, flows, and watershed conditions will be brief, minor, and scheduled to occur at times that are least sensitive for the species' life-cycle; (3) the underlying requirement of an ecological design approach that protects and stimulates natural habitat forming processes is expected to result in authorization of many projects that will have beneficial long-term effects; and (4) the individual and combined effects of all actions permitted in this way are not expected to impair currently properly functioning habitats, appreciably reduce the functioning of already impaired habitats, or retard the long-term progress of impaired habitats toward proper functioning condition essential to the long-term survival and recovery at the population or ESU scale.

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 threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitats, or to develop additional information. NOAA Fisheries has no conservation recommendations to make at this time.

Reinitiation of Consultation

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the Incidental Take Statement is exceeded; (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) If the identified action is subsequently modified in a manner that has an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) If a new species is listed or critical habitat designated that may be affected by the identified action (50 C.F.R. 402.16).

If the Corps fails to provide specified monitoring information annually by February 15, NOAA Fisheries will consider that a modification of the action that causes an effect on listed species not previously considered and causes the Incidental Take Statement of the Opinion to expire. Consultation also must be reinitiated 3 years after the date this Opinion is signed. To reinitiate consultation, contact the Oregon State Habitat Office of NOAA Fisheries.

Incidental Take Statement

Section 9(a)(1) of the ESA prohibits the taking of listed species without a specific permit or exemption. Protective regulations adopted pursuant to section 4(d) extends the prohibition to threatened species. Among other things, an action that harasses, wounds, or kills an individual of a listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 C.F.R. 222.102). Incidental take refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 C.F.R. 402.02). Section 7(o)(2) exempts any taking that meets the terms and conditions of a written incidental take statement from the taking prohibition.

This Incidental Take Statement does not become effective for OC coho salmon or LCR coho salmon until the conference opinion for those ESUs is adopted as a biological opinion, after the listing is final. Prohibitions of the ESA will not apply to OC coho salmon or LCR coho salmon until they are listed.

Amount or Extent of Take

Individuals of one or more of the 15 ESUs considered in this consultation are likely to be present in the action area during part of the year when at least some effects of each proposed action will occur. Because these effects will injure or kill, or increase the likelihood that individuals will be injured or killed, take is reasonably certain to occur. The relationship between habitat conditions and the distribution and abundance of those individuals in the action area is imprecise such that a specific number of individuals taken cannot be practically obtained. In such circumstances, NOAA Fisheries uses the causal link established between the activity and a change in habitat conditions affecting the species to describe the extent of take as a numerical level of habitat disturbance.

Construction related activities completed instream and on the streambank will cause short-term, minor, and local increases in sediment, turbidity, noise, and other pollutants in the water, and decrease dissolved oxygen and flow. In spawning areas, this will cause adverse changes in substrate characteristics (flow, water quality, and substrate size), decrease spawning success, and reduce embryo survival and fry emergence. In juvenile rearing areas, these effects will limit seasonal microhabitats necessary for holding, feeding and resting. The physical, chemical, and thermal conditions created by projects completed during migration periods are likely to make migrations of adult and juvenile more difficult.

These effects will cause most fish to avoid the action area, although some juvenile and adult fish are likely to be injured or killed by a combination of physical injury and impaired migration. Vegetation and streambank conditions damaged by project construction will require many years to recover characteristics that are favorable for rearing and migration. Specific aquatic habitat below the ordinary high water line where the channel will be filled, and riparian and nearshore areas that will be covered by new structures, are unlikely to recover preferred habitat characteristics or provide any other significant conservation value during the life of the project.

Take caused by these habitat-related effects cannot be accurately quantified as a number of fish. This is because the relationship between habitat conditions and the distribution and abundance of those individuals in the action area is imprecise. Moreover, the loss of habitat conservation value that will be caused by each project authorized under SLOPES, although it will be short-term, minor, and local, will result in the indirect injury or death of individuals for the life of the project is more deleterious than the direct loss of a certain number of individuals. In such circumstances, NOAA Fisheries uses the causal link established between the activity and a change in habitat conditions affecting the species to describe the extent of take as a numerical level of habitat disturbance.

In this case, the extent of take will be described as a limit on the number of projects each year that may be authorized, or a limit on the total number of river miles that may be altered by those projects, whichever comes first (Table 4). NOAA Fisheries estimated the extent of take using the following assumptions: (1) The geographic distribution and number of Corps regulatory actions covered by this Opinion each year will be similar to the distribution observed in 2003; (2) the number of actions authorized each year using SLOPES will continue to increase at approximately the same rate as they have since 2001, but will not exceed 450 project approvals by 2005; and, (3) on average, each project is likely to result in 200 feet or less of waterway alteration,[14] or a total of 17 miles. Thus, for projects authorized using SLOPES, the extent of take will be limited to that caused either by: (1) No more than 450 projects per year, the number of actions that are likely to be eligible for SLOPES as this consultation reaches its mandatory reinitiation date; or (2) no more than 17 stream miles of waterway alteration in occupied habitat per year; whichever comes first.

[14] "Waterway alteration" means any action that will result in excavation, dredging, filling, rechannelization, construction, or any other type of modification of an aquatic habitat areas occupied by ESA-listed species considered in this Opinion that will affect the conservation value of that habitat.

Table 4. Estimate of Amount and Extent of Take Associated with Projects Proposed for Authorization Using SLOPES. Consultation must be reinitiated if the amount or extent of take is exceeded for any geographic area.

Geographic Area	Projects Authorized Per Year	Total River Miles Waterway Alteration	Capture and Release ESA-Listed Fish
Willamette/Lower Columbia	220	8.33	2200
Interior Columbia	45	4.25	450
Oregon Coast	113	1.70	1130
S. Oregon/N. California Coasts	72	2.72	720

Further, NOAA Fisheries anticipates that up to 9,000 juvenile individuals of the ESUs considered in the consultation will be captured, injured or killed as a result of work necessary to isolate in-water construction areas. Because the individual fish that are likely to be captured, injured, or killed by this action are from different ESUs 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 ESUs. This estimate is based on the following assumptions: (1) Approximately 10% of all actions will require isolation of the in-water work area; (2) each project requiring in-water work area isolation is likely to capture fewer than 20 juvenile salmonids; (3) of the ESA-listed fish to be captured and handled in this way, 98% or more are expected to survive with no long-term effects and 1 to 2% are expected to be injured or killed, including delayed mortality because of injury. Nonetheless, the more conservative estimate of 5% lethal take will be used here to allow for variations in experience and work conditions. Capture and release of adult fish is not expected to occur as part of the proposed isolation of in-water work areas. Thus, NOAA Fisheries does not anticipate that any adult fish will be taken.

The extent of habitat affected by the action and the estimated number of fish taken by work area isolation and the removal of fish are thresholds for reinitiating consultation. Should any of these limits be exceeded during project activities, the reinitiation provisions of this Opinion apply.

Reasonable and Prudent Measures

Reasonable and Prudent Measures are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The Corps has the continuing duty to regulate the activities covered in this Incidental Take Statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the Corps fails to exercise its discretion to require adherence to Terms and Conditions of the Incidental Take Statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these Terms and Conditions. Similarly, if any applicant fails to act in accordance with the Terms and

Conditions of the Incidental Take Statement, protective coverage may lapse. The following Reasonable and Prudent Measures are necessary and appropriate to minimize the impact on listed species of incidental taking caused by take of listed species resulting from completion of the proposed action.

The Corps shall:

1. Minimize incidental take from administration of the regulatory program for section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act of 1899, by ensuring effective administration of standard local operating procedures for endangered species (SLOPES), including completion of a comprehensive monitoring and reporting program.

2. Minimize incidental take from the authorization of survey and exploration, and construction, operation and maintenance of permitted facilities, by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.
3. Minimize incidental take from the authorization of site preparation for the construction of buildings and related features by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.

4. Minimize incidental take from the authorization of streambank stabilization by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.

5. Minimize incidental take from the authorization of stream and wetland restoration by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.

6. Minimize incidental take from the authorization of repairs to water control structures by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.

7. Minimize incidental take from the authorization of road construction, repairs, maintenance, and improvements by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.

8. Minimize incidental take from the authorization of utility lines by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.

9. Minimize incidental take from the authorization of over-water and in-water structures by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.

10. Minimize incidental take from the authorization of minor discharge and excavation by excluding actions from authorization under SLOPES that are not approved by this Opinion, and applying permit conditions or project specifications that avoid or minimize adverse effects to riparian and aquatic systems.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Corps must comply with the following Terms and Conditions, which implement the Reasonable and Prudent Measures described above. These Terms and Conditions are non-discretionary and are applicable to more than one category of activity. Therefore, Terms and Conditions listed for one type of activity are also Terms and Conditions of any category in which they would also minimize take of listed species or their habitats.

1. To implement Reasonable and Prudent Measure #1 (standard local operating procedures for endangered species; SLOPES III), the Corps shall ensure that:

a. Statewide Programmatic General Permit (SPGP). Any SPGP issued to the State of Oregon to defer regulatory review and evaluation of permits under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act must meet the following criteria.

i. Applicable terms and conditions. Any permit issued by the State pursuant to the SPGP must include each applicable term and condition of this Incidental Take Statement as an enforceable part of that permit, including, but not limited to, those that are relevant to monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, piling installation and removal, treated wood, temporary access roads, work area isolation, stormwater management, site restoration, compensatory mitigation).

ii. Scope of actions under SPGP. The Corps' deferral under the SPGP must be limited to applications for projects that: (1) Affect 0.5 acres or less of fill in a wetland and one thousand cubic yards or less of fill and removal below ordinary high water;[15] and (2) are among the following types of actions as authorized by this Opinion.

(1) Piling installation and removal.
(2) Site preparation for buildings and related features.
(3) Streambank stabilization.
(4) Stream and wetland restoration.
(5) Water control structures.
(6) Road construction, repairs and improvements.
(7) Utility lines.
(8) Other minor discharges and excavations.

b. Confirmation of fish presence. Contact a fish biologist from the NOAA Fisheries, ODFW or WDFW, as appropriate for the action area, if necessary to confirm that a project is within the present or historic range of a listed species or designated critical habitat.

c. Individual project review. Each project must be individually reviewed by the Corps to ensure that all adverse effects to ESA-listed salmon and steelhead and their designated critical habitats are within the range of effects considered in this Opinion.

i. Full implementation required. For regulatory projects, each applicable term and condition in this Incidental Take Statement must be included as an enforceable part of the permit document. For the projects carried out by the Corps, each applicable term and condition must be included as a final project specification. Failure to comply with all applicable terms and conditions may invalidate protective coverage of ESA section 7(o)(2) regarding "take" of listed species, and may lead NOAA Fisheries to a different conclusion regarding the effects of a specific project.

ii. Project access. Ensure reasonable access[16] to projects authorized by this Opinion to monitor the use and effectiveness permit conditions.

iii. Salvage notice. Include the following notice as part of each permit issued using this Opinion and, for projects completed by the Corps, provide the notice in writing to the project supervisor.

---

[15] "Ordinary high water," or bankfull elevation, means the bank height or elevation inundated by a 1.5 to 2-year average recurrence interval and may be estimated by morphological features such average bank height, scour lines and vegetation limits. Compare, 33 C.F.R. 329.11(a)(1)(The "ordinary high water mark" on non-tidal rivers is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas).

[16] "Reasonable access" means with prior notice to the applicant, the Corps and NOAA Fisheries may at reasonable times and in a safe manner, enter and inspect authorized projects to ensure compliance with the Reasonable and Prudent Measures and Terms and Conditions in this Opinion.

NOTICE. If a sick, injured or dead specimen of a threatened or endangered species is found, the finder must notify the Vancouver Field Office of NOAA Fisheries Law Enforcement at 360/ 418-4246. The finder must take care in handling of sick or injured specimens to ensure effective treatment, and in handling dead specimens to preserve biological material in the best possible condition for later analysis of cause of death. The finder also has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not disturbed unnecessarily.

d. <u>Failure to provide timely reporting may cause Incidental Take Statement to expire</u>. The following project notification and reporting information must be collected and forwarded to NOAA Fisheries, as necessary, and that the annual coordination meeting between NOAA Fisheries and the Corps must take place, or NOAA Fisheries may assume the action has been modified in a way that invalidates this Incidental Take Statement.

e. <u>Project notification form</u>. Before issuing a permit under this Opinion, the Corps must submit an electronic Project Notification Form (Appendix A) to NOAA Fisheries at: slopes.nwr@noaa.gov, including an electronic copy of any plan these terms and conditions require for that project (*i.e.*, pollution and erosion control, work area isolation, stormwater management, site restoration, and/or compensatory mitigation).

f. <u>Request for variance</u>. A request for approval of an alternative conservation measure that is identified in these terms and conditions as appropriate for "approval in writing by NOAA Fisheries" may be included in the Project Notification Form or other appropriate means. The request must be in writing and include the following information. Any variance that will result in greater effects or greater take than provided in the biological opinion is not authorized by this Opinion. NOAA Fisheries will approve or disapprove the request, in writing, within 30 calendar days of receipt of the variance request.

   i. Justification for the proposed variance.
   ii. Description of additional actions necessary to offset any likely adverse effects of the variance, as appropriate.
   iii. An explanation of how the resulting effects are within the range of effects considered in this Opinion.

g. <u>Project completion report or memo to file</u>. Each permit issued by the Corps under this Opinion must require the applicant to submit a project completion report to the Corps within 60 days of finishing work below ordinary high water; for each project carried out by the Corps, the project supervisor must prepare a project completion memo to file. Each report or memo must contain the following information and be available for inspection on request by NOAA Fisheries.

   i. Applicant's name and permit number (if any).
   ii. Corps contact person.

iii. Project name.
iv. Type of activity.
v. Project site, including any compensatory mitigation site, by 5th field HUC
vi. Start and end dates for work completed.
vii. Photos of habitat conditions at the project site, including any compensatory mitigation site, before, during, and after project completion.[17]
viii. Projects with the following work elements must include these data.
    (1) Work cessation – Dates work ceased due to high flows.[18]
    (2) Fish screen – Proof of compliance with NOAA Fisheries fish screen criteria.[19]
    (3) Pollution control – A summary of pollution and erosion control inspections, including any erosion control failure, contaminant release, and correction effort.
    (4) Drilling – Describe the drilling method and steps taken to isolate drilling operations, fluids, slurry and spoils from flowing water.
    (5) Pilings – The number, type, and diameter of pilings removed, broken during removal, and installed; and any sound attenuation measures used.
    (6) Site preparation – Riparian area cleared within 150 feet of ordinary high water; upland area cleared; new impervious area created.
    (7) Streambank stabilization – Type and amount of materials used; project size (one bank or two, width and linear feet).
    (8) Road construction, repairs and improvements – Rationale for any new permanent road crossing design.
    (9) In-water and over-water structures – Area of new in-water or over-water structure.

h. Site restoration and/or compensatory mitigation report, Each applicant must submit a site restoration and/or compensatory mitigation report by December 31 each year after the project is completed until the Corps approves that the site restoration and/or compensatory mitigation performance standards have been met. This report must describe the date and purpose of each visit to a restoration and/or

---

17 Relevant habitat conditions may include characteristics of channels, eroding and stable streambanks in the project area, riparian vegetation, water quality, flows at base, bankfull and over-bankfull stages, and other visually discernable environmental conditions at the project area, and upstream and downstream from the project. Include general views and close-ups of the project and project area, including pre- and post-construction. Label each photo with date, time, project name, photographer's name, and a comment about the subject.

18 "High flows" means any flow likely to rise above the top of an work isolation area or otherwise inundate a work area that would normally be dry.

19 National Marine Fisheries Service, Juvenile Fish Screen Criteria (revised February 16, 1995) and Addendum: Juvenile Fish Screen Criteria for Pump Intakes (May 9, 1996) (guidelines and criteria for migrant fish passage facilities, and new pump intakes and existing inadequate pump intake screens), or as amended (http://www.nwr.noaa.gov/1hydrop/hydroweb/ferc.htm).

compensatory mitigation site, site conditions observed during that visit, and any corrective action planned or taken.

i. Annual program report. An annual monitoring report must be completed by February 15 each year that describes the Corps' efforts to carry out this Opinion. The report must include an assessment of overall program activity, cumulative effects, and any other data or analyses the Corps deems necessary or helpful to assess habitat trends as a result of actions authorized by this Opinion. Submit an electronic copy of the annual report to: slopes.nwr@noaa.gov.

j. Annual coordination meeting. A coordination meeting must take place with NOAA Fisheries by March 31 each year to discuss the annual monitoring report and any actions that will improve conservation or make the program more efficient or more accountable.

k. Reinitiation. If the Corps chooses to continue programmatic coverage under this Opinion, formal consultation on SLOPES must be reinitiated within three years of the date of issuance. This term and condition is in addition to reinitiation requirements described in the Reinitiation of Consultation section of this Opinion.

2. To implement Reasonable and Prudent Measure #2 (general conditions for surveying, exploration, construction, operation and maintenance), the Corps shall ensure that:

a. Exclusions. Any exploration or construction activity, including surface water diversion and release of construction discharge water, within 300 feet upstream from any occupied redd until fry emerge, or within 300 feet of native submerged aquatic vegetation is not authorized by this Opinion, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form. Permits for the following types of exploration, construction, and mitigation actions are not authorized by this Opinion.

   i. Use of pesticides.
   ii. Use of short pieces of plastic ribbon to determine flow patterns.
   iii. Temporary roads or drilling pads built on steep slopes, where grade, soil types, or other features suggest a likelihood of excessive erosion or failure.
   iv. Exploratory drilling in estuaries that cannot be conducted from a work barge, or an existing bridge, dock, or wharf.
   v. Installation of a fish screen on any permanent water diversion or intake that is not already screened.
   vi. Any projects that require in-water installation of hollow steel piling greater than 24-inches in diameter, or use of H-pile larger than designation HP24.
   vii. Drilling or sampling in an EPA-designated Superfund Site, a state-designated clean-up area, or the likely impact zone of a significant contaminant source, as identified by historical information or the Corps' best professional judgment.

viii. Compensatory mitigation actions that require construction of permanent structures, maintenance beyond the establishment period or after the performance standards have been met, or creation of habitat functions where they did not historically exist, or that simply preserve existing functions.

b. Pollution and erosion control plan. A pollution and erosion control plan must be prepared and carried out to prevent pollution caused by surveying or construction operations. The pollution and erosion control plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to avoid or minimize the adverse effects of pollution and erosion by limiting soil disturbance, scheduling work when the fewest number of fish are likely to be present, managing likely pollutants, and limiting the harm that may be caused by accidental discharges of pollutants and sediment.

ii. Responsible party. The name, address, and telephone number of the person responsible for accomplishment of the pollution and erosion control plan.

iii. Minimum area. Practices to confine vegetation removal and soil disturbance to the minimum area necessary to complete the project, and otherwise prevent erosion and sedimentation associated with access roads, stream crossings, drilling sites, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations, staging areas, and roads being decommissioned.

iv. In-water work timing. Develop a schedule to complete all work below ordinary high water, except hydraulic and topographic measurements within the wetted channel,[20] inside the most recent ODFW or the Corps Seattle District preferred in-water work period,[21] as appropriate for the project area, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

v. Cease work during high flows. Project operations must cease under high flow conditions that may inundate the project area, except for efforts to avoid or minimize resource damage.

---

[20] Hydraulic and topographic measurements within the wetted channel may be completed anytime except during the spawning period, unless a fisheries biologist verifies that no redds are occupied within 300 feet downstream from the measurement site.

[21] ODFW, Oregon Guidelines for Timing of In-Water Work to Protect Fish and Wildlife Resources (June 2000), at http://www.dfw.state.or.us/ODFWhtml/InfoCntrHbt/0600_inwtrguide.pdf, and US Army Corps of Engineers, Seattle District Regulatory Branch, Allowable Work Windows, at http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=REG&pagename=work_windows, or as amended.

vi. Concrete, cement, and grout. Practices to confine, remove and dispose of excess concrete, cement, grout, and other mortars or bonding agents, including measures for washout facilities.

vii. Construction debris. Practices to prevent construction debris from dropping into any stream or waterbody, and to remove any material that does drop with a minimum disturbance to the streambed and water quality.

viii. Hazardous materials. A description of any regulated or hazardous products or materials that will be used for the project, including procedures for inventory, storage, handling, and monitoring.

ix. Spill containment. A spill containment and control plan with notification procedures, specific cleanup and disposal instructions for different products, a description of quick response containment and cleanup supplies that will be available on the site, including a supply of sediment control materials (*e.g.*, a silt fence, straw bales,[22] an oil-absorbing, floating boom whenever surface water is present), proposed methods for disposal of spilled materials, and employee training for spill containment.

c. Work area isolation plan. Except for piling installation,[23] completed in compliance with all other relevant terms and conditions, a work area isolation plan must be prepared and carried out for any project that requires work below ordinary high water where adult or juvenile fish are reasonably certain to be present or 300 feet or less upstream from spawning habitats, unless otherwise approved in writing by NOAA Fisheries. The work area isolation plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to minimize the adverse effects of erosion and other types of pollution by removing from flowing water and fish from the work area.

ii. Responsible party. The name and address of the person responsible for meeting each component of the work area isolation plan, including a fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish that will be responsible for the capture and release operation.

iii. Flow conditions. An estimate of the range of flows likely to occur during isolation.

iv. Plan view. A plan view of all isolation elements and fish release areas.

v. Equipment and materials list. A list of equipment and materials that are necessary to complete work area isolation, including a fish screen for any pump used to dewater the isolation area, and that will be available on site

[22] When available, certified weed-free straw or hay bales must be used to prevent introduction of noxious weeds.

[23] Pilings may be installed without work area isolation, provided all other relevant terms and conditions are met.

to provide appropriate redundancy of key plan functions (*e.g.*, operational, properly-sized, back-up pumps and generators).

vi. Sequence and schedule. The sequence and schedule of dewatering and rewatering activities.

d. Capture and release. Before and intermittently during isolation of an in-water work area, fish trapped in the area must be captured using a trap, seine, electrofishing, or other methods as are prudent to minimize risk of injury, then released at a safe release site.

i. Do not use electrofishing if water temperatures exceed 18ºC, or are expected to rise above 18ºC, unless no other method of capture is available.

ii. If electrofishing equipment is used to capture fish, comply with NOAA Fisheries' electrofishing guidelines.[24]

iii. Handle ESA-listed fish with extreme care, keeping fish in water to the maximum extent possible during seining and transfer procedures to prevent the added stress of out-of-water handling.

iv. Ensure water quality conditions are adequate in buckets or tanks used to transport fish by providing circulation of clean, cold water, using aerators to provide dissolved oxygen, and minimizing holding times.

v. Release fish into a safe release site as quickly as possible, and as near as possible to capture sites.

vi. Do not transfer ESA-listed fish to anyone except NOAA Fisheries personnel, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

vii. Obtain all other Federal, state, and local permits necessary to conduct the capture and release activity.

viii. Allow NOAA Fisheries or its designated representative to accompany the capture team during the capture and release activity, and to inspect the team's capture and release records and facilities.

ix. Submit an electronic copy of the Salvage Report Form (Appendix B) to NOAA Fisheries at: slopes.nwr@noaa.gov within 10 calendar days of completion of the salvage operation.

e. Fish passage. Safe passage around or through the project area must be provided for any adult and juvenile salmon or steelhead species present during construction, unless passage did not previously exist, or as otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

i. Fish ladders (*e.g.*, pools and weirs, vertical slots, Denil fishways) and fish trapping systems are not authorized by this Opinion.

---

[24] National Marine Fisheries Service Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act (June 2000) (http://www.nwr.noaa.gov/1salmon/salmesa/4ddocs/final4d/electro2000.pdf).

ii. After project completion, adult and juvenile passage upstream and downstream must not be impaired for the life of the project.

f. Stormwater management plan. A stormwater management plan must be prepared and carried out for any project that will produce any new impervious surface or a land cover conversion that will slow the entry of water into the soil. The stormwater management plan must be commensurate with the scale of the projects, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to minimize adverse effects due to the quantity and quality of stormwater runoff for the life of the project by maintaining or restoring natural runoff conditions.

ii. Responsible party. The name, address, and telephone number of the person responsible for accomplishment of the stormwater management plan.

iii. Management practices and facilities. A system of management practices and, if necessary, structural facilities, designed to complete the following functions.

(1) Minimize, disperse and infiltrate stormwater runoff onsite using sheet flow across permeable vegetated areas to the maximum extent possible without causing flooding, erosion impacts, or long-term adverse effects to groundwater.

(2) Pre-treat stormwater from pollution generating surfaces, including bridge decks, before infiltration or discharge into a freshwater system, as necessary to minimize any nonpoint source pollutant (*e.g.*, debris, sediment, nutrients, petroleum hydrocarbons, metals) likely to be present in the volume of runoff predicted from a 6-month, 24-hour storm.[25]

(3) Ensure that the duration of post project discharge matches the pre-developed discharge rates from 50% of the 2-year peak flow up to the 50-year peak flow.

iv. Continuous rainfall/runoff model. For projects that require engineered water quality or detention facilities to meet stormwater requirements, use a continuous rainfall/runoff model, if available for the project area, to calculate stormwater facility water quality and flow control rates.

v. Permeable pavements. Use permeable pavements for load-bearing surfaces, including multiple-use trails, to the maximum extent feasible based on soil, slope, and traffic conditions.

[25] A 6-month, 24-hour storm may be assumed to be 72% of the 2-year, 24-hour amount. See, Washington State Department of Ecology (2001), Appendix I-B-1.

vi. Facilities inside the riparian management area. Install structural facilities outside wetlands or the riparian management area[26] whenever feasible, otherwise, provide compensatory mitigation to offset any long-term adverse effects. Identify the location of all stormwater facilities relative to the riparian management area.

vii. Record keeping. Document completion of the following activities according to a regular schedule for the operation, inspection and maintenance of all structural facilities and conveyance systems, in a log available for inspection on request by the Corps and NOAA Fisheries.

   (1) Inspect and clean each facility as necessary to ensure that the design capacity is not exceeded, heavy sediment discharges are prevented, and whether improvements in operation and maintenance are needed.

   (2) Promptly repair any deterioration threatening the effectiveness of any facility.

   (3) Post and maintain a warning sign on or next to any storm drain inlet that says, as appropriate for the receiving water, "Dump No Waste - Drains to Ground Water, Streams, or Lakes."

   (4) Only dispose of sediment and liquid from any catch basin in an approved facility.

viii. Runoff/discharge into a freshwater system. When stormwater runoff will be discharged directly into surface water or a wetland, or indirectly through a conveyance system, the following requirements apply.

   (1) Maintain natural drainage patterns and, whenever possible, ensure that discharges from the project site occur at the natural location.

   (2) Use a conveyance system comprised entirely of manufactured elements (*e.g.*, pipes, ditches, outfall protection) that extends to the ordinary high water line of the receiving water, unless existing topography and vegetative site conditions will provide adequate biofiltration to remove likely sediment and other pollutants.

   (3) Stabilize any erodible elements of this system as necessary to prevent erosion.

   (4) Do not divert surface water from, or increase discharge to, an existing wetland if that will cause a measurable or detectable adverse effect to wetland hydrology, soils or vegetation.

---

[26] "Riparian management area" means land: (1) Within 150 feet of any natural water occupied by listed salmonids during any part of the year or designated as critical habitat; (2) within 100 feet of any natural water within 1/4 mile upstream from areas occupied by listed salmonids or designated as critical habitat and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat; and (3) within 50 feet of any natural water upstream from areas occupied by listed salmonids or designated as critical habitat and that is physically connected by an above-ground channel system such that water, sediment, or woody material delivered to such waters will eventually be delivered to water occupied by listed salmon or designated as critical habitat. "Natural water" means all perennial or seasonal waters except water conveyance systems that are artificially constructed and actively maintained for irrigation.

(5) The velocity of discharge water released from an outfall or diffuser port may not exceed 4 feet per second, and the maximum size of any aperture may not exceed one inch.

g. Site restoration plan. A site restoration plan must be prepared and carried out to ensure that all streambanks, soils and vegetation disturbed by the project are cleaned up and restored as follows. The site restoration plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Goal. The goal is to reestablish habitat access, water quality, production of habitat elements (*e.g.*, large wood), channel conditions, flows, watershed conditions, and other aquatic habitat forming processes that were harmed during project completion.

ii. Responsible party. The name, address, and telephone number of the person responsible for accomplishment of the site restoration plan, including providing and managing any financial assurances and monitoring necessary to ensure restoration success.

iii. Baseline information. This information may be obtained from existing sources (*e.g.*, land use plans, watershed analyses, subbasin plans), where available.

(1) A functional assessment of adverse effects, *i.e.*, the location, extent and function of the riparian and aquatic resources that will be adversely affected by construction and operation of the project.

(2) The location and extent of resources surrounding the restoration site, including historic and existing conditions.

iv. Objectives. Restoration objectives that describe the extent and methods of site restoration necessary to offset adverse effects of the project, by aquatic resource type.

(1) Restore damaged streambanks to a natural slope, pattern and profile suitable for establishment of permanent woody vegetation, unless precluded by pre-project conditions (*e.g.*, a natural rock wall).

(2) Replant each area requiring revegetation before the first April 15 following construction. Use a diverse assemblage of species native to the project area or region, including grasses, forbs, shrubs and trees. Noxious or invasive species may not be used.

(3) Use as much as possible of the large wood, native trees, native vegetation, topsoil, and native channel material that was stockpiled during site preparation.

(4) Do not apply surface fertilizer within 50 feet of any stream channel.

(5) Install fencing as necessary to prevent access to revegetated sites by livestock or unauthorized persons.

v. Performance standards. Use the following standards to help design the plan and to assess whether the restoration goal is met. While no single criterion is sufficient to measure success, the intent is that these features should be present within reasonable limits of natural and management variation.

(1) Human and livestock disturbance, if any, is confined to small areas necessary for access or other special management situations.
(2) Areas with signs of significant past erosion are completely stabilized and healed; bare soil spaces are small and well-dispersed.
(3) Soil movement, such as active rills and soil deposition around plants or in small basins, is absent or slight and local.
(4) Native woody and herbaceous vegetation, and germination microsites, are present and well distributed across the site.
(5) Plants have normal, vigorous growth form, and a high probability of remaining vigorous, healthy and dominant over undesired competing vegetation.
(6) Vegetation structure is resulting in rooting throughout the available soil profile.
(7) 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").
(8) A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank.
(9) Streambanks are stable, well vegetated, and protected at margins by roots that extend below baseflow elevation, or by coarse-grained alluvial debris.

vi. Work plan. Develop a work plan with sufficient detail to include a description of the following elements, as applicable:

(1) Water supply source, if necessary.
(2) Boundaries for the restoration area.
(3) Restoration methods, timing, and sequence.
(4) Geomorphology and habitat features of stream or other open water.
(5) Site management and maintenance requirements, including a plan to control exotic invasive vegetation.
(6) Elevation and slope of the restoration area to ensure they conform with required elevation and hydrologic requirements of target plant species.
(7) Woody native vegetation appropriate to the restoration site.[27] This must be a diverse assemblage of species that are native to the

[27] Use references sites to select vegetation for the mitigation site whenever feasible. Historic reconstruction, vegetation models, or other ecologically-based methods may also be used as appropriate.

project area or region, including grasses, forbs, shrubs and trees. This may include allowances for natural regeneration from an existing seed bank or planting.

vii. Five-year monitoring and maintenance plan. Develop a five-year monitoring and maintenance plan with the following elements, as applicable:

(1) A schedule to visit the restoration site annually for five years or longer as necessary to confirm that the performance standards are achieved. Despite the initial five-year planning period, site visits and monitoring must continue from year-to-year until the Corps certifies that site restoration performance standards have been met.

(2) During each visit, inspect for and correct any factors that may prevent attainment of performance standards (*e.g.*, low plant survival, invasive species, wildlife damage, drought).

(3) Keep a written record to document the date of each visit, site conditions and any corrective actions taken.

h. Compensatory mitigation plan. A compensatory mitigation plan must be prepared and carried as necessary to ensure the project does not cause a long-term loss of riparian or aquatic functions. The compensatory mitigation plan must be commensurate with the scale of the project, contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations. Submit an electronic copy of this plan with the project notification form.

i. Actions of concern. The following actions require a Compensatory Mitigation Plan to offset long-term adverse effects:

(1) Riparian and aquatic habitats displaced by construction of structural stormwater facilities, a new or enlarged boat ramp, or scour protection.

(2) Riparian and benthic habitat displaced by new or enlarged over-water structures.

(3) Other activities that prevent development of properly functioning riparian and aquatic habitat processes.

ii. Goal. The goal is to ensure that completion of the project does not cause a net loss of riparian and aquatic habitat functions.

iii. Responsible party. The name, address, and telephone number of the person responsible for accomplishment of the compensatory mitigation plan, including providing and managing any financial assurances and monitoring necessary to ensure compensatory mitigation success.

iv. Objectives. Compensatory mitigation objectives related to the extent and type of compensatory mitigation necessary to offset unavoidable losses to riparian and aquatic habitat at the project site.

(1) Elements of a site restoration plan, outlined above.

(2) Watershed-level considerations related to specific aquatic resource needs of the affected area.

(3) Existing technology and logistical concerns.

(4) A description of the legal means for protecting mitigation areas, and a copy of any legal instrument relied on to secure that protection.

(5) Make mitigation compatible with adjacent land uses or, if necessary, use an upland buffer to separate mitigation areas from developed areas or agricultural lands.

(6) Base the level of required mitigation on a functional assessment of adverse effects of the proposed project, and functional replacement (*i.e.*, "no net loss of function"), whenever feasible, or a minimum one-to-one linear foot or acreage replacement.

(7) Acceptable mitigation includes reestablishment or rehabilitation of natural or historic habitat functions when self-sustaining, natural processes are used to provide the functions.

(8) Whenever feasible, complete mitigation before, or concurrent with, project construction to reduce temporal loss of aquatic functions and simplify compliance.

(9) When project construction is authorized before mitigation is completed, the applicant must show that a mitigation project site has been secured and appropriate financial assurances in place.

(a) Complete all work necessary to carry out the mitigation plan no later than the first full growing season following the start of project construction, whenever feasible.

(b) If beginning the initial mitigation actions within that time is infeasible, then include other measures that mitigate for the consequences of temporal losses in the mitigation plan.

(10) Actions to complete a mitigation plan that require a Corps permit must also me*et al*l applicable terms and conditions for this Opinion, or complete a separate consultation.

i. Surface water diversion. Surface water may be diverted, consistent with Oregon law, to meet construction needs only if water from sources that are already developed, such as municipal supplies, small ponds, reservoirs, or tank trucks, is unavailable or inadequate.

i. Alternative sources. When alternative surface sources are available, diversion shall be from the stream with the greatest flow.

ii. Fish screen. A temporary fish screen must be installed, operated and maintained according to NOAA Fisheries" fish screen criteria on any surface water diversion used to meet construction needs.

iii. Rate and volume. The rate and volume of pumping will not exceed 10% of the available flow. For streams with less than 5 cubic feet per second, drafting will not exceed 18,000 gallons per day, and no more than one pump will be operated per site.

j. Construction discharge water. All discharge water created by construction (*e.g.*, concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids) must be treated as follows.

i. Water quality treatment. Design, build, and maintain facilities to collect and treat all construction and drilling discharge water, using the best available technology applicable to site conditions, to remove debris, nutrients, sediment, petroleum products, metals, and other pollutants likely to be present.

ii. Return flow. If construction discharge water is released using an outfall or diffuser port, velocities may not exceed 4 feet per second, and the maximum size of any aperture may not exceed one inch.

iii. Pollutants. Do not allow pollutants such as green concrete, contaminated water, silt, welding slag, sandblasting abrasive, or grout cured less than 24-hours to contact any waterbody, wetland, or stream channel below ordinary high water.

iv. Drilling waste containment. All drilling equipment, drill recovery and recycling pits, and any waste or spoil produced, must be contained as necessary to prevent any drilling fluids or other wastes from entering the stream.

(1) All drilling fluids and waste must be completely recovered then recycled or disposed to prevent entry into flowing water.

(2) Drilling fluids must be recycled using a tank instead of drill recovery/recycling pits, whenever feasible.

(3) When drilling is completed, try to remove the remaining drilling fluid from the sleeve (*e.g.*, by pumping) to reduce turbidity when the sleeve is removed.

k. Heavy equipment. Use of heavy equipment is restricted as follows.

i. Choice of equipment. When heavy equipment will be used, the equipment selected must have the least adverse effects on the environment (*e.g.*, minimally sized, low ground pressure equipment).

ii. Vehicle and material staging. Store construction materials, and fuel, operate, maintain and store vehicles as follows.

(1) To reduce the staging area and likelihood of contamination, ensure that only enough supplies and equipment to complete a specific job will be stored on site.

(2) Complete vehicle staging, cleaning, maintenance, refueling, and fuel storage in a vehicle staging area placed 150 feet or more from any stream, waterbody or wetland, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

(3) Inspect all vehicles operated within 150 feet of any stream, waterbody or wetland daily for fluid leaks before leaving the vehicle staging area. Repair any leaks detected in the vehicle staging area before the vehicle resumes operation. Document inspections in a record that is available for review on request by Corps or NOAA Fisheries.

(4) Before operations begin and as often as necessary during operation, steam clean all equipment that will be used below ordinary high water until all visible external oil, grease, mud, and other visible contaminates are removed. Compete all cleaning in the staging area.

(5) Diaper all stationary power equipment (*e.g.*, generators, cranes, stationary drilling equipment) operated within 150 feet of any stream, waterbody or wetland to prevent leaks, unless suitable containment is provided to prevent likely spills from entering any stream or waterbody.

l. Pre-construction activity. The following actions must be completed before significant[28] alteration of the project area.

i. Marking. Flag the boundaries of clearing limits associated with site access and construction to prevent ground disturbance of critical riparian vegetation, wetlands, areas below ordinary high water, and other sensitive sites beyond the flagged boundary.

ii. Temporary erosion controls. All temporary erosion controls must be in-place and appropriately installed downslope of project activity until site restoration is complete.

m. Site preparation. Native materials, including large wood, native vegetation, weed-free topsoil, and native channel materials (gravel, cobble, and boulders), disturbed during site preparation must be conserved on site for site restoration.

i. If possible, leave native materials where they are found. In areas to be cleared, clip vegetation at ground level to retain root mass and encourage reestablishment of native vegetation.

ii. If native materials are moved, damaged or destroyed, replace them with a functional equivalent during site restoration.

iii. Stockpile all large wood[29] taken from below ordinary high water and from within 150 feet of a stream, waterbody or wetland, native vegetation, weed-free topsoil, and native channel material displaced by construction for use during site restoration.

iv. As part of the site restoration, all large wood taken from the riparian zone or stream during construction must returned to those areas and placed in a natural configuration that may be expected to function naturally.

n. Temporary access roads and drilling pads. All temporary access roads and drilling pads must be constructed as follows.

---

[28] "Significant" means an effect can be meaningfully measured, detected or evaluated.

[29] "Large wood" means a tree, log, or redwood big enough to dissipate stream energy associated with high flows, capture bedload, stabilize streambanks, influence channel characteristics, and otherwise support aquatic habitat function, given the slope and bankfull channel width of the stream in which the wood occurs. See, Oregon Department of Forestry and ODFW, A Guide to Placing Large Wood in Streams, May 1995 (www.odf.state.or.us/FP/RefLibrary/LargeWoodPlacemntGuide5-95.doc).

i. Existing ways. Use existing roadways, travel paths, and drilling pads whenever possible, unless construction of a new way or drilling pad would result in less habitat take. When feasible, eliminate the need for an access road by walking a tracked drill or spider hoe to a survey site, or lower drilling equipment to a survey site using a crane.

ii. Soil disturbance and compaction. Minimize soil disturbance and compaction whenever a new temporary road or drill pad is necessary within wetlands or the riparian management area by clearing vegetation to ground level and placing clean gravel over geotextile fabric, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

iii. Temporary stream crossings.

(1) Minimize the number of temporary stream crossings.

(2) Design temporary road crossings as follows:

(a) A qualified fish biologist will survey and map spawning habitat, any occupied spawning redds, and native submerged aquatic vegetation, within 300 feet upstream downstream and 100 feet upstream from a proposed crossing.

(b) Do not place a stream crossing within 300 feet downstream or 100 feet upstream from any occupied redd until fry emerge, or within 300 feet of native submerged aquatic vegetation.

(c) Design the crossing to provide for foreseeable risks (*e.g.*, flooding and associated bedload and debris, to prevent the diversion of streamflow out of the channel and down the road if the crossing fails).

(d) Vehicles and machinery must cross riparian areas and streams at right angles to the main channel wherever possible.

iv. Obliteration. When the project is complete, obliterate all temporary access roads that will not be in footprint of a new bridge or other permanent structure, stabilize the soil, and revegetate the site.

o. Earthwork. Earthwork, including drilling, excavation, dredging, filling and compacting, must be completed as quickly as possible.

i. Site stabilization. Stabilize all disturbed areas, including obliteration of temporary roads, following any break in work unless construction will resume within four days.

ii. Inspection of erosion controls. Monitor instream turbidity and inspect all erosion controls daily during the rainy season, weekly during the dry season, or more often as necessary, to ensure the erosion controls are working adequately.[30]

(1) If monitoring or inspection shows that the erosion controls are ineffective, immediately mobilize work crews to repair, replace, or reinforce controls as necessary.

(2) Remove sediment from erosion controls before it reaches 1/3 of the exposed height of the control.

iii. Drilling, boring, jacking. If drilling, boring or jacking is used, the following conditions apply.

(1) Isolate drilling operations in wetted stream channels using a steel pile, sleeve or other appropriate isolation method to prevent drilling fluids from contacting water.

(2) If it is necessary to drill through a bridge deck, use containment measures to prevent drilling debris from entering the channel.

(3) Sampling and directional drill recovery/recycling pits, and any associated waste or spoils must be completely isolated from surface waters, off-channel habitats and wetlands. All waste or spoils must be covered if precipitation is falling or imminent. All drilling fluids and waste must be recovered and recycled or disposed to prevent entry into flowing water.

(4) If a drill boring conductor breaks and drilling fluid or waste is visible in water or a wetland, all drilling activity must cease pending written approval from NOAA Fisheries to resume drilling.

p. Treated wood. Use of lumber, pilings, or other wood products that are treated or preserved with pesticidal compounds (including, but not limited to, alkaline copper quaternary, ammoniacal copper arsenate, ammoniacal copper zinc arsenate, copper boron azole, chromated copper arsenate, copper naphthenate, creosote, and pentachlorophenol) may not be used below ordinary high water, or as part of an in-water or over-water structure, except as described below.

i. On-site storage. Treated wood shipped to the project area must be stored out of contact with standing water and wet soil, and protected from precipitation.

ii. Visual inspection. Each load and piece of treated wood must be visually inspected and rejected for use in or above aquatic environments if visible residues, bleeding of preservative, preservative-saturated sawdust, contaminated soil, or other matter is present.

iii. Pilings. Pilings treated with ammoniacal copper zinc arsenate, chromated copper arsenate, or creosote may be installed below ordinary high water

[30] "Working adequately" means that upland work is not contributing visible sediment to water, and in-water work does not increase ambient stream turbidity by more than 10% above background 100 feet below the discharge, when measured relative to a control point immediately upstream from the turbidity causing activity.

according to NOAA Fisheries' guidelines,[31] provided that no more than 50 piles are used. Also note that these guidelines do not apply to pilings treated with any other preservative, and do not authorize use of treated wood for any other purpose.

iv. Pre-fabrication and field preservative treatment. Use prefabrication to the extent feasible to ensure that cutting, drilling, and field preservative treatment is minimized. When field fabrication is necessary, all cutting and drilling of treated wood, and field preservative treatment of wood exposed by cutting and drilling, will occur above ordinary high water to minimize discharge of sawdust, drill shavings, excess preservative other debris in riparian or aquatic habitats. Use tarps, plastic tubs or similar devices to contain the bulk of any fabrication debris, and wipe off any excess field preservative.

v. Abrasion prevention. All treated wood structures, including pilings, must have design features to avoid or minimize impacts and abrasion by livestock, pedestrians, vehicles, vessels, floats, *etc*., to prevent the deposition of treated wood debris and dust in riparian or aquatic habitats.

vi. Waterproof coating. Treated wood may be used to construct a bridge, over-water structure or an in-water structure, provided that all surfaces exposed to leaching by precipitation, overtopping waves, or submersion are coated with a water-proof seal or barrier that will be maintained for the life of the project. Coatings and any paint-on field treatment must be carefully applied and contained to reduce contamination. Surfaces that are not exposed to precipitation or wave attack, such as parts of a timber bridge completely covered by the roadway wearing surface of the bridge deck, are exempt from this requirement.

vii. Debris Removal. Projects that require removal of treated wood must use the following precautions.

(1) Ensure that, to the extent feasible, no treated wood debris falls into the water. If treated wood debris does fall into the water, remove it immediately.

(2) After removal, place treated wood debris in an appropriate dry storage site until it can be removed from the project area. Do not leave treated wood construction debris in the water or stacked on the streambank at or below the ordinary high water.

(3) Evaluate treated wood construction debris removed during a project, including treated wood pilings, to ensure proper disposal of debris.

---

[31] Letter from Steve Morris, National Marine Fisheries Service, to W.B. Paynter, Portland District, U.S. Army Corps of Engineers (December 9, 1998) (transmitting a document titled Position Document for the Use of Treated Wood in Areas within Oregon Occupied by Endangered Species Act Proposed and Listed Anadromous Fish Species, National Marine Fisheries Service, December 1998).

q. Piling installation. Hollow steel piling 24 inches in diameter or smaller and H-pile designated as HP24 or smaller may be installed below ordinary high water as follows.

i. Minimize the number and diameter of pilings, as feasible.

ii. Repairs, upgrades, and replacement of existing pilings consistent with these terms and conditions are allowed. In addition, up to five single pilings or one dolphin consisting of three to five pilings may be added to an existing facility per in-water construction period.

iii. Whenever feasible, use vibratory hammer for piling installation. Otherwise, use the smallest drop or hydraulic impact hammer necessary to complete the job, and set the drop height to the minimum necessary to drive the piling.

iv. When using an impact hammer to drive or proof steel piles, one of the following sound attenuation devices must be used to reduce sound pressure levels by 20 dB:

(1) Place a block of wood or other sound dampening material between the hammer and the piling being driven.

(2) If water velocity is 1.7 miles per hour or less, surround the piling being driven by an unconfined bubble curtain that will distribute small air bubbles around 100% of the piling perimeter for the full depth of the water column.[32]

(3) If water velocity is greater than 1.7 miles per hour, surround the piling being driven by a confined bubble curtain (*e.g.*, a bubble ring surrounded by a fabric or metal sleeve) that will distribute air bubbles around 100% of the piling perimeter for the full depth of the water column.

(4) Written approval of an alternative sound attenuation plan may be requested with the project notification form, provided the plan will maintain sound pressure levels below 150dB rms (re: 1 micro Pascal) for a minimum of 50% of the driver strikes, and peak sound pressure levels below 180 dB rms (re: 1 micro Pascal) for all strikes.

r. Piling removal. If a temporary or permanent piling will be removed, the following conditions apply.

i. Dislodge the piling with a vibratory hammer, whenever feasible.

ii. Once loose, place the piling onto the construction barge or other appropriate dry storage site.

---

[32] For guidance on how to deploy an effective, economical bubble curtain, see, Longmuir, C. and T. Lively, Bubble Curtain Systems for Use During Marine Pile Driving, Fraser River Pile and Dredge LTD, 1830 River Drive, New Westminster, British Columbia, V3M 2A8, Canada. Recommended components include a high volume air compressor that can supply more than 100 pounds per square inch at 150 cubic feet per minute to a distribution manifold with 1/16 inch diameter air release holes spaced every 3/4 inch along its length. An additional distribution manifold is needed for each 35 feet of water depth.

iii. If a treated wood piling breaks during removal, either remove the stump by breaking or cutting 3 feet below the sediment surface or push the stump in to that depth, then cover it with a cap of clean substrate appropriate for the site.

iv. Fill the holes left by each piling with clean, native sediments whenever feasible.

3. To implement Reasonable and Prudent Measure #3 (site preparation for construction of buildings and related features), the Corps shall ensure that:

a. Exclusions. Permits for site preparation for construction of buildings and related features inside the riparian management area are not authorized by this Opinion.

b. Applicable terms and conditions. Any site preparation for construction of buildings and related features authorized by this Opinion must be consistent with all applicable terms and conditions of this Incidental Take Statement, including, but not limited to, those that are relevant to monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, temporary access roads, work area isolation, stormwater management, site restoration, compensatory mitigation).

4. To implement Reasonable and Prudent Measure #4 (streambank stabilization), the Corps shall ensure that:

a. Exclusions. Use of dikes, groins, buried groins, drop structures, porous weirs, weirs, riprap, rock toes, and similar structures to stabilize streambanks, are not authorized by this Opinion, regardless of the addition of large wood. Use of concrete logs or cable (wire rope) or chains to anchor an engineered log jam are not authorized by this Opinion, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

b. Applicable terms and conditions. Any streambank stabilization project authorized by this Opinion must be consistent with all applicable terms and conditions of this Incidental Take Statement, including, but not limited to, those that are relevant to monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, temporary access roads, work area isolation, site restoration).

c. Streambank stabilization goal. The goal of streambank stabilization[33] authorized by this Opinion is to minimize adverse affects to natural stream and floodplain function by limiting actions to those that are not expected to have long-term adverse effects on aquatic habitats. Whether these actions will also be adequate to meet other streambank stabilization objectives depends on the mechanisms of

---

[33] Streambank stabilization includes erosion and scour repair to roadways and structures consistent with these terms and conditions.

streambank failure operating at site- and reach-scale.[34] Other than 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.

d. Large wood and rock.

i. Large wood must be used as an integral component of all streambank stabilization treatments that include large rock as a structural element.[35]

ii. Large wood must be intact, hard, and undecayed to partly decaying with untrimmed root wads to provide functional refugia habitat for fish. Use of decayed or fragmented wood found laying on the ground or partially sunken in the ground is not acceptable.

iii. Avoid or minimize the use of rock, stone and similar materials.

iv. Rock may be used instead of wood for the following purposes and structures. Whenever feasible, the rock placed below ordinary high water must be class 350 metric (700 pound), or larger, but may not impair natural stream flows into or out of secondary channels or riparian wetlands.

(1) As ballast to anchor or stabilize large wood components of an approved bank treatment.

(2) To fill scour holes, as necessary to protect the integrity of the project, if the rock is limited to the depth of the scour hole and does not extend above the channel bed.

(3) To construct a footing, facing, head wall, or other protection necessary to prevent scouring or downcutting of, or fill slope erosion or failure at, a boat ramp, bridge, culvert, flow control structure (*e.g.*, water intake or outfall), or utility line, provided the amount of rock used is limited to that necessary to support the slope. Whenever feasible, include soil and woody vegetation as a covering and throughout the structure.

(4) To construct a barb, as described below.

e. Streambank stabilization methods authorized by this Opinion. The following streambank stabilization methods may be used individually or in combination, and are the only ones authorized by this Opinion.

---

[34] For guidance on how to evaluate streambank failure mechanisms, streambank stabilization measures presented here, and use of an ecological approach to management of eroding streambanks, see, *e.g.*,WDFW, Washington Department of Transportation, and Washington Department of Ecology, Integrated Streambank Protection Guidelines, various pagination (April 2003) (http://www.wdfw.wa.gov/hab/ahg/ispgdoc.htm), and Federal Interagency Stream Restoration Working Group, Stream Corridor Restoration: Principles, Processes, and Practices, various pagination (October, 1998) (http://www.usda.gov/stream_restoration/).

[35] See, *e.g.*, WDFW, Washington Department of Transportation, and Washington Department of Ecology, Integrated Streambank Protection Guidelines, Appendix I:Anchoring and placement of LWD (April 2003) (http://www.wdfw.wa.gov/hab/ahg/ispgdoc.htm); Oregon Department of Forestry and ODFW, A Guide to Placing Large Wood in Streams, May 1995. (http://www.odf.state.or.us/FP/RefLibrary/RefsList.htm).

i. Woody plantings and variations (*e.g.*, live stakes, brush layering, facines, brush mattresses).
ii. Herbaceous cover, where analysis of available records (*e.g.*, historical accounts and photographs) shows that trees or shrubs did not exist on the site within historic times, primarily for use on small streams or adjacent wetlands.
iii. Deformable soil reinforcement, consisting of soil or gravel layers or lifts strengthened with fabric and vegetation that are mobile ("deformable") at approximately two- to five-year recurrence flows.
iv. Coir logs (long bundles of coconut fiber), straw bales and straw logs used individually or in stacks to trap sediment and provide growth medium for riparian plants.
v. Bank reshaping and slope grading, when used to reduce a bank slope angle without changing the location of its toe, increase roughness and cross-section, and provide more favorable planting surfaces.
vi. Floodplain flow spreaders, consisting of one or more rows of trees and accumulated debris used to spread flow across the floodplain.
vii. Floodplain roughness, *e.g.*, floodplain tree and LWD rows, live siltation fences, brush traverses, brush rows and live brush sills; used to reduce the likelihood of avulsion in areas where natural floodplain roughness is poorly developed or has been removed.
viii. Engineered log jams, consisting of a collection of large wood used to create structural and hydraulic complexity and redirect flow, provided that the jam is not made of concrete and is anchored primarily by the weight and shape of the structure itself. Use of biodegradable materials may be used to temporarily stabilize the log jam, but use of cable (wire rope) or chain to anchor the jam is not authorized by this Opinion, unless otherwise approved in writing by NOAA Fisheries.
ix. Barbs, sometimes also referred to as vanes or bendway weirs, to redirect flow, when designed as follows, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.
    (1) No part of the flow-redirection structure may exceed bank full elevation, including all rock buried in the bank key.
    (2) Build the flow-redirection structure primarily of wood or otherwise incorporate large wood at a suitable elevation in an exposed portion near the tip of the structure.[36] Placing the large wood near streambanks in the depositional area between flow-direction structures to satisfy this requirement is not approved, unless those

[36] See, *e.g.*, Chapter 6, Figure 6-8, and Appendix I, pp. I-6 and 7, in WDFW, Washington Department of Transportation, and Washington Department of Ecology, Integrated Streambank Protection Guidelines, various pagination (April 2003) (http://www.wdfw.wa.gov/hab/ahg/ispgdoc.htm,

areas are likely to be greater than one meter in depth, sufficient for salmon rearing habitats.

(3) Fill the trench excavated for the bank key above the ordinary high water elevation with soil and topped with native vegetation.

(4) The maximum flow-redirection structure length must not exceed 1/4 of the channel width at ordinary high water.

(5) Place rock individually without end dumping.

(6) If two or more flow-redirection structures are built in a series, place the flow-redirection structure farthest upstream within 150 feet or 2.5 channel widths at ordinary high water, from the flow-redirection structure farthest downstream.

(7) Include woody riparian planting as a project component.

5. To implement Reasonable and Prudent Measure #5 (stream and wetland restoration), the Corps shall ensure that:

a. Applicable terms and conditions. Any stream and wetland restoration project[37] authorized by this Opinion must be consistent with all applicable terms and conditions of this Incidental Take Statement, including, but not limited to, those that are relevant to monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, fish passage, temporary access roads, work area isolation, site restoration).

b. Stream and wetland restoration methods authorized by this Opinion. The following stream and wetland restoration methods are approved for use individually or in combination.

i. Road decommissioning.

ii. Set-back levees, dikes and berms.

iii. Remove levees, dikes, berms, weirs or other water control structures.

iv. Remove trash and other artificial debris dams that block fish passage.

v. Stormwater management that restores natural or normative hydrology.

vi. Streambank sloping, shaping, planting, and stabilization, as authorized by this Opinion, when completed for a restoration purpose.

vii. Culvert replacement and bridge replacement, as authorized by this Opinion, when completed for a restoration purpose.

viii. Remove sediment bars or terraces that block fish passage within 50 feet of a tributary mouth. No more than 25 cubic yards of sediment may be removed from within 25 feet of the mouth of the stream. Streambed grading could occur within 50 feet of the mouth of a stream.

ix. Place large wood within the channel or riparian area.

---

[37] "Restoration project" means a habitat restoration activity whose primary purpose is to restore natural aquatic or riparian habitat process or conditions and that would not be started but for its restoration purpose.

(1) Large wood must be intact, hard, and undecayed to partly decaying with untrimmed root wads to provide functional refugia habitat for fish.
(2) Use of decayed or fragmented wood found laying on the ground or partially sunken in the ground is not acceptable.
(3) Rock may be used as ballast to anchor or stabilize large wood. Use of cable (wire rope) or chain to anchor large wood is not authorized by this Opinion, unless otherwise approved in writing by NOAA Fisheries.

6. To implement Reasonable and Prudent Measure #6 (water control structures), the Corps shall ensure that:

a. Exclusions. Permits for new or upgraded water control structures are not authorized by this Opinion. Repairs of tide gates are not authorized by this Opinion.
b. Water control structure repairs. Except for tide gates, repair of existing water control structures that were previously permitted and that do not involve reconfiguration of an existing fish facility, are authorized by this Opinion, provided they are consistent with all applicable terms and conditions of this Incidental Take Statement, including, but not limited to, monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, treated wood, temporary access roads, work area isolation, stormwater management, site restoration, compensatory mitigation).

7. To implement Reasonable and Prudent Measure #7 (road construction, repairs, maintenance and improvements), the Corps shall ensure that:

a. Exclusions. Permits for the following types of road construction, repair, maintenance and improvements are not authorized by this Opinion.
   i. Channel[38] maintenance.
   ii. A baffled culvert or fishway.
   iii. Tide gate maintenance or replacements other than full removals.
   iv. A new or replacement bridge pier or abutment below ordinary high water.
   v. A new, permanent road inside the riparian management area that is not a bridge approach.
   vi. Trash rack cleaning more than 20 feet upstream or downstream from the trash rack.
   vii. Culvert cleaning more than 20 feet upstream or downstream from the culvert apron.

[38] A channel is different from a ditch in that a channel is a facility that collects drainage water, can be parallel or perpendicular to the roadway, and may or may not also contain a natural stream.

viii. A replacement bridge without full removal of the existing bridge, support structures and approach fill.

ix. A new bridge approach within the 100-year floodplain which will require embankment fills that impair floodplain hydraulic capacity.

x. Maintenance activities that do not return all large wood, cobbles and gravels to the stream channel which require temporary removal during roadway structure maintenance.

xi. Maintenance activities that are likely to adversely affect fish passage conditions.

b. Applicable terms and conditions. Any road construction, repair, maintenance, or improvement project authorized by this Opinion must be consistent with all applicable terms and conditions of this Incidental Take Statement, including, but not limited to, those that are relevant to monitoring and construction (project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, fish passage, temporary access roads, work area isolation, stormwater management, site restoration, compensatory mitigation), except that bridge replacements must be full span with no bents, piers or other support structures below ordinary high water.

c. Road maintenance. Road maintenance activities (beaver dam removal, bridge maintenance, guardrail maintenance, hazard tree removal, shoulder repair, sign installation, temporary bridge structures) as described in, and completed in accordance with, the most current version of the ODOT Regional Road Maintenance Endangered Species Act Program Guidelines,[39] or other ESA-approved road maintenance programs.[40]

d. Ditch cleaning, culvert and trash rack maintenance, drift removal. Complete ditch cleaning, culvert and trash rack maintenance by working from the top of the bank, unless work area isolation would result in less habitat disturbance.

i. Remove only the minimum amount of wood, sediment and other natural debris necessary to maintain ditch, culvert or trash rack function, or improve water quality or quantity characteristics in the receiving waterbody, without disturbing spawning gravel or changing the configuration of the original ditch, unless the new configuration is designed to reduce the adverse effects of ditch runoff.

ii. Place all large wood, cobbles and gravels recovered during culvert and trash rack cleaning downstream from the structure. Complete drift removal in the following priority, as feasible:

(1) Pull and release whole logs or trees downstream.

---

[39] Oregon Department of Transportation, Routine Road Maintenance: Water Quality and Habitat Guide, Best Management Practices, 21 pp. + appendices (July 1999) (providing guidance on routine road maintenance activity only) (http://www.odot.state.or.us/eshtm/images/4dman.pdf) or, see, NMFS, Regional Road Maintenance Endangered Species Act Program Guidelines (March 2002b) (http://www.metrokc.gov/roadcon/bmp/pdfguide.htm).

[40] See, 65 FR 42421 (July 10, 2000) (final rule governing take of 14 threatened salmon and steelhead ESUs).

(2) Pull whole logs and trees and place in the riparian area.
(3) Remove whole logs or trees for replacement within the same stream or 6th field HUC.[41]
(4) Pull, cut only as necessary, and release logs and trees downstream.

e. New permanent stream crossings. Build permanent stream crossings as follows.

i. Design. The goal is to allow for normative fluvial processes within the stream-floodplain corridor by promoting natural sediment transport patterns for the reach, allowing unaltered fluvial debris movement, and improving the longitudinal continuity and connectivity of the stream-floodplain system.

(1) Limit fill width to the minimum necessary to complete the crossing.
(2) Do not reduce existing functional stream-floodplain corridor width.

ii. Crossing types.[42] Design road crossings in the following priority. Explain why a particular design was chosen.

(1) Nothing – Road realignment to avoid crossing the stream.
(2) Bridge – New bridges must span the ordinary high water elevation on each bank sufficient to allow for long-term dynamic channel stability, *i.e.*, no bents, piers or other support structures below ordinary high water and of adequate dimensions to allow for normative fluvial processes.
(3) Streambed simulation – Bottomless arch, embedded culvert, or ford that spans the ordinary high water elevation on each bank sufficient to allow for long-term dynamic channel stability, *i.e.*, no apron, footing, facing, head wall, or other support structures below ordinary high water and of adequate dimensions to allow for normative fluvial processes.

8. To implement Reasonable and Prudent Measure #8 (utility lines), the Corps shall ensure that:

a. Exclusion. Permits for construction or upgrading of a gas, sewer, or water line to support a new or expanded service area for which effects, including indirect effects from interrelated or interdependent activities, have not been analyzed in this Opinion and are not authorized.

---

[41] HUC(Hydraulic Unit Code) - A distinct watershed or river basin defined by an 8-digit code. A 6th field HUC

[42] For a discussion of crossing design types and procedures, see, National Marine Fisheries Service, Southwest Region, Guidelines for Salmonid Passage at Stream Crossings (2001b) (http://swr.nmfs.noaa.gov/hcd/NMFSSCG.PDF) and WDFW, Fish Passage Design at Road Culverts: A Design Manual for Fish Passage at Road Crossings (March 3, 1999) (http://www.wa.gov/wdfw/hab/engineer/cm/toc.htm).

b. Applicable terms and conditions. Repairs, upgrades, and replacements of existing utility lines authorized by this Opinion must be consistent with all applicable terms and conditions of this Incidental Take Statement, including, but not limited to, those that are relevant to monitoring and construction (project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, temporary access roads, work area isolation, site restoration, and compensatory mitigation).

c. Utility stream crossings. Build utility stream crossings as follows:
   - i. Alignments must be perpendicular to the watercourse, or nearly so.
   - ii. Ensure that utility lines do not cause lateral migration, head cutting, general scour, or debris loading.
   - iii. Place all pits and other excavations associated with utility installation where they will not cause damage to the streambed or streambanks, and prevent wastewater or spoil material from entering the water.
   - iv. Design utility line crossings in the following priority:
     - (1) Aerial lines, including lines hung from existing bridges.
     - (2) Directional drilling, boring and jacking.
     - (3) Trenching – this method may only be used in a naturally (seasonally) dewatered stream or adjacent wetland where the work area can be completely isolated without the need for any fish salvage.
   - v. If directional drilling is used, drill, bore, or jack hole must span the channel migration zone and any associated wetland.
   - vi. If trenching or plowing are used, the following will apply.
     - (1) Any trenching or plowing must occur in the dry.
     - (2) Trenches must be backfilled below the ordinary high water line with native material, then capped with clean gravel suitable for fish use in the project area, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.
     - (3) Large wood displaced by trenching or plowing must be returned to its original position, whenever feasible, or nearby, and placed in a natural configuration that may be expected to function naturally.

9. To implement Reasonable and Prudent Measure #9 (over-water and in-water structures, including ports, industrial facilities, and marinas), the Corps shall ensure that:

a. Exclusions. Permits for the following types of new or expanded structures, locations for new or expanded structures, and maintenance activities are not authorized by this Opinion:
   - i. Excluded types of new or expanded structures.
     - (1) Boat house.
     - (2) Boat ramp made of asphalt.

(3) Buoy or float in an inactive anchorage and fleeting area.
(4) Covered moorage.
(5) Floating storage unit.
(6) Houseboat.
(7) Marina.
(8) Pier.
(9) Non-water-related facilities (*e.g.*, parking lots, picnic areas, rest rooms) inside the riparian management area.
(10) Any other over-water structure more than 6 feet wide, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

ii. Excluded locations for new or expanded structures
(1) Estuarine or saltwater.[43]
(2) Insufficient flow to dissipate fuels and other pollutants from vessels.
(3) Within 0.5 miles downstream from the confluence of a spawning tributary.
(4) An area where a floating dock is likely to ground out or where moored boats will prop wash the bottom.
(5) Requires pre-construction excavation, routine maintenance dredging (*e.g.*, alcoves, backwater sloughs, side channels, other shallow-water areas), or construction of a breakwater, jetty, or groin.

b. New structures, maintenance, and replacement authorized by this Opinion. New structures may be built and existing structures may be repaired or replaced as follows:

i. Applicable terms and conditions. Any new over-water or in-water structure, or replacement or upgrade of an existing structures, authorized by this Opinion must be consistent with all applicable terms and conditions of this Incidental Take Statement, including, but not limited to, those that are relevant to monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, piling installation and removal, treated wood, work area isolation, site restoration, compensatory mitigation).

ii. Educational Signs. Because the best way to minimize adverse effects caused by boating is to educate the public about pollution and its prevention, the following information must be posted and maintained on a permanent sign at all public facilities authorized by this Opinion.
(1) A description of the ESA-listed salmonids which are or may be present in the project area.

[43] "Estuary or other saltwater area" means an area with maximum intrusion of more than 0.5 ppt measured at depth; in the Columbia River, this includes all areas downstream from Jim Crow Sands (river mile 27).

(2) Notice that the adults and juveniles of these species, and their habitats, are be protected so that they can successfully migrate, spawn, rear, and complete other behaviors necessary for their recovery.

(3) Lack of necessary habitat conditions may result in a variety of adverse effects including direct mortality, migration delay, reduced spawning, loss of food sources, reduced growth, reduced populations. and decreased productivity.

(4) All users of the facility are required or encouraged to: (1) Follow procedures and rules governing use of sewage pump-out facilities, (2) minimize the fuel and oil released into surface waters during fueling, and from bilges and gas tanks, (3) avoid cleaning boat hulls in the water to prevent the release of cleaner, paint and solvent, (4) practice sound fish cleaning and waste management, including proper disposal of fish waste, and (5) dispose of all solid and liquid waste produced while boating in a proper facility away from surface waters.

iii. Flotation.

(1) Permanently encapsulate all synthetic flotation material to prevent breakup into small pieces and dispersal in water.

(2) Install small temporary floats less than 7 days before a scheduled event, remove them five days after a scheduled event is concluded, and do not leave them in place longer than 21 days total.

(3) Install mooring buoys and temporary floats (*e.g.*, shellfish traps) more than 300 feet from native submerged aquatic vegetation, more than 50 feet from the shoreline, and in water deeper than 20 feet deep at all times, or as necessary to ensure that gear does not ground out unnecessarily, and boats do not prop wash the bottom.

iv. Access maintenance. Sediment or other debris, including large wood, that obstructs or interferes with normal use of an over-water or in-water structure may be removed or excavated as follows, provided that the materials are all naturally-occurring; any sediment consists of more than 80% sand, gravel or other naturally-occurring bottom material; and the area to be excavated is not within an EPA-designated Superfund Site, a state-designated clean-up area, or the likely impact zone of a significant contaminant source, as identified by historical information or the Corps' best professional judgment.

(1) Only the minimum amount of sediment and debris necessary to restore normal use may be removed or excavated.

(2) All sediment and debris must be side cast or returned to the water downstream from the structure where it will continue to provide aquatic habitat function, unless otherwise approved in writing by NOAA Fisheries. Requests for approval should be submitted with the project notification form.

v. Boat ramps. Concrete boat ramps must consist of pre-cast concrete slabs below the ordinary high water, and upland portions of the ramp must be completed in the dry so that no wet concrete that has cured less than 24-hours is allowed to contact any wetland or channel below ordinary high water. Rock may be used to construct a footing or other protection necessary to prevent scouring, downcutting, or failure at the boat ramp, provided that the rock does not extend further than 4 feet from the edge of the ramp in any direction.

vi. Covered moorages and boat houses. Any replacement roof, wall, or garage door for covered moorages and boat houses must be made of translucent materials. In addition, each side (except the door) of the boat house must have windows at least 4 feet wide installed the length of the boat house, subject to breaks only for structural support. Skylights (at least two 4-foot by 4-foot) may be installed in the roof in lieu of translucent panels.

vii. Marinas. An existing marina may be modified within the existing footprint of the moorage, or in water more than 50 feet from the shoreline and more than 20 feet deep, except that structures may not be placed in areas that support aquatic vegetation or areas where boat operations may damage aquatic vegetation.

viii. Piscivorus bird deterrence. Fit all pilings, mooring buoys, and navigational aids (*e.g.*, channel markers) with devices to prevent perching by piscivorus birds.

10. To implement Reasonable and Prudent Measure #10 (other minor discharges and excavations), the Corps shall ensure that:

a. Exclusions. Permits for minor discharge and excavation of any channels or water intakes that do not have a fish screen that is installed, operated and maintained according to NOAA Fisheries fish screen criteria.

b. Applicable terms and conditions. Any minor discharge or excavation authorized by this Opinion must be to maintain or complete a minor repair of a previously authorized structure, such as an outfall, and must be consistent with all applicable terms and conditions of this Incidental Take Statement, including, but not limited to, those that are relevant to monitoring and construction (*e.g.*, project notification, project completion report, minimum area, timing of in-water work, pollution and erosion control, work area isolation, site restoration).

c. Minimum volume. The volume of material moved must be limited to the minimum amount necessary to restore normal use.

i. The volume of all material filled or discharged plus the volume excavated must not exceed 25 cubic yards.

ii. All naturally-occurring sediment and debris, including large wood, must be side cast or returned to the water downstream from the structure where it will continue to provide aquatic habitat function.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirements of section 305(b) of the MSA direct Federal agencies to consult with NOAA Fisheries on all actions, or proposed actions, that may adversely affect EFH. 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 to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 C.F.R. 600.810). Section 305(b) also requires NOAA Fisheries to recommend measures that may be taken by the action agency to conserve EFH.

The Pacific Fishery Management Council (PFMC) designated EFH for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), 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 Pacific Coast groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Pacific Coast salmon (PFMC 1999). The effects information below is adapted from work by the PFMC reported fisheries management plans for the EFH species.

EFH Identification

Pacific Coast Groundfish. The EFH for the 83 species managed as Pacific coast groundfish occurs throughout the U.S. exclusive economic zone (EEZ) that extend 200 miles offshore from the coasts of Washington, Oregon, and California, and occupy diverse habitats at all stages of their life histories. Some species are widely dispersed during certain life stages, particularly those with pelagic eggs and larvae. The EFH for these species/stages is correspondingly large. On the other hand, the EFH for some species/stages may be comparatively small, such as that of adults of many nearshore rockfishes that show strong affinities to a particular location or type of substrate. Because of the large number of species and their diverse habitat associations, the entire EEZ becomes EFH when all the individual EFHs are taken together.

The EFH for Pacific coast groundfish is defined using the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. Descriptions of groundfish fishery EFH for each of the 83 species and their life stages result in more than 400 EFH identifications. When these EFHs are taken together, the groundfish fishery EFH includes all waters from the mean higher high water line, and the upper extent of saltwater intrusion in river mouths, along the coast of Oregon, Washington, and California seaward to the boundary of the U.S. EEZ.

PFMC (1998a) groups Pacific coast groundfish EFH into seven units called “composite” EFHs. This approach focuses on ecological relationships between species and between the species and their habitat, reflecting an ecosystem approach in defining EFH. Seven major habitat types are proposed as the basis for such assemblages or "composites."

Estuarine. Those waters, substrates and associated biological communities within bays and estuaries seaward from mean higher high water (MHHW) or extent of upriver saltwater intrusion. PFMC (1998a) defines estuaries as areas with water greater than 0.5 ppt ocean-derived salts.

Rocky Shelf. Those waters, substrates and associated biological communities living on or within 5.5 fathoms overlying rocky areas, including reefs, pinnacles, boulders, and cobble along the continental shelf, excluding canyons, from the MHHW to the shelf break, approximately 109 fathoms.

Non-Rocky Shelf. Those waters, substrates and associated biological communities living on or within 5.5 fathoms overlying the substrates of the continental shelf, excluding the rocky shelf and canyon composites, from the MHHW to the shelf break.

The Pacific coast groundfish EFH that will be affected by SLOPES includes the following types of "composite" EFH occurring in Oregon and the estuary of the mainstem Columbia River.

Coastal Pelagic Species. The EFH for the eight species managed as coast pelagic species is defined using the estuarine and marine habitat necessary to provide sufficient coastal pelagic species production to support a maximum sustainable yield fishery and a healthy ecosystem. This habitat occurs throughout the U.S. EEZ offshore of Washington, Oregon, and California. The specific description and identification of EFH for coastal pelagic finfish species recognizes that the geographic range of all coastal pelagic finfish varies widely according to the temperature of the upper mixed layer of the ocean, particularly in the area north of Point Arena, California (39 ^{o} N latitude). This generalization is probably also true for market squid, but few data are available. Adult coastal pelagic finfish are generally not found at temperatures colder than 10 ^{o}C or warmer than 26 ^{o}C and preferred temperatures and minimum spawning temperatures are generally above 13 ^{o}C. Spawning is most common at 14 ^{o} to 16 ^{o}C.

The east-west geographic boundary for EFH for each individual coastal pelagic finfish and market squid is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the EEZ and above the thermocline where sea surface temperatures range between 10 to 26 ^{o}C. The southern boundary of the geographic range of all coastal pelagic finfish is consistently south of the U.S.-Mexico maritime boundary. The northern boundary of the range of coastal pelagic finfish is more dynamic and variable due to the seasonal cooling of the sea surface temperature. The northern boundary is, therefore, the position of the 10 ^{o}C isotherm which varies both seasonally and annually.

The coastal pelagic species EFH that will be affected by SLOPES includes the all marine and estuarine waters along the shoreline of Oregon and the estuary of the Columbia River.

Pacific Coast Salmon. The EFH for the Pacific coast salmon fishery means those waters and substrate necessary for salmon production needed to support a long-term sustainable salmon fishery and salmon contributions to a healthy ecosystem. To achieve that level of production, EFH must include all those streams, lakes, ponds, wetlands, and other currently viable waterbodies and most of the habitat historically accessible to salmon in Washington, Oregon, Idaho, and California. In the estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the EEZ north of Point Conception, California. Foreign waters off Canada, while still salmon habitat, are not included in salmon EFH, because they are outside United States jurisdiction. Marine areas off Alaska are also designated as salmon EFH. This identification of EFH is based on the descriptions of habitats used by coho, Chinook, and pink salmon.

The geographic extent of freshwater EFH is specifically defined as all currently viable waters and most of the habitat historically accessible to salmon within specific USGS hydrologic units, as defined in PFMC (1999). Salmon EFH excludes areas upstream from longstanding, naturally-impassible barriers (*i.e.*, natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers except the impassible barriers (dams) listed in PFMC 1999. However, activities occurring above impassable barriers that are likely to adversely affect EFH below impassable barriers are subject to the consultation provisions of the Magnuson-Stevens Act. In the future, should subsequent analyses determine the habitat above any of the dams listed in PFMC (1999) is necessary for salmon conservation, the Council will modify the identification of EFH.

The Pacific salmon EFH that will be affected by SLOPES includes the portion of Pacific coast salmon EFH occurring in Oregon and the estuary of the mainstem Columbia River downstream from McNary Dam.

Adverse Effects of the Proposed Action

Construction. Activities associated with construction (*e.g.*, building construction, utility installation, road and bridge building, storm water discharge) can significantly alter the land surface, soil, vegetation, and hydrology and can adversely impact EFH for Pacific coast groundfish, coastal pelagic species, and Pacific coast salmon through habitat loss or modification. Construction in and beside waterways can involve dredging and/or filling activities, bank stabilization, removal of shoreline vegetation, waterway crossings for pipelines and conduits, removal of riparian vegetation, channel realignment, and the construction of docks and piers. These alterations can destroy EFH directly or indirectly by interrupting sediment supply that creates spawning and rearing habitat for prey species (*e.g.*, sand lance, surf smelt, herring), by increasing turbidity levels and diminishing light penetration to eelgrass and other vegetation, by altering hydrology and flow characteristics, by raising water temperature, and by re-suspending pollutants.

Construction activities can also have detrimental effects on EFH through the runoff of sediment, nutrients, heavy metals, and pesticides. Runoff of petroleum products and oils from roads and parking lots and sediment, nutrients, and chemicals from yards and discharges from municipal sewage treatment plants and industrial facilities are also associated with urbanization. Urbanized areas also alter the rate and intensity of runoff into streams and waterways. Urban runoff can cause immunosuppression by organic contaminants.

Similarly, effects on runoff rates can be much greater than in any other type of land use, because of the amount of impervious surfaces associated with urbanization. Buildings, rooftops, sidewalks, parking lots, roads, gutters, storm drains, and drainage ditches, in combination, quickly divert rainwater and snow melt to receiving streams. This results in an increased volume of runoff from each storm, increased peak discharges, decreased discharge time for runoff to reach the stream, and increased frequency and severity of flooding. Flooding reduces refuge space for fish, especially where accompanied by loss of instream structure, off-channel areas, and habitat complexity. Flooding can also scour eggs and young from the gravel. Increases in streamflow disturbance frequencies and peak flows also compromise the ability of aquatic insects and fish life to recover.

The area of impervious surfaces also can influence stream temperatures. Summer time air and ground temperatures in impervious areas can be 10-12ºC warmer than in agricultural and forested areas. In addition, the trees that could be providing shade to offset the effects of solar radiation are often missing in urban areas. The alteration in quantity and timing of surface runoff also accelerates bank erosion and the scouring of the streambed, and the downstream transport of wood. This results in simplified stream channels and greater instability. The lack of infiltration also results in lower stream flows during the summer by reducing the interception, storage, and release of ground water into streams. This affects habitat availability and salmonid production, particularly for those species that have extended freshwater rearing requirements (*e.g.*, coho). Generally, it has been found that instream functions and value begin to deteriorate seriously when the levels of impervious surfaces exceed 10% of a subbasin.

Projects in or along waterways can be of sufficient scope to cause significant long-term or permanent adverse effects on EFH. However, waterway projects and other projects associated with SLOPES are small-scale projects that individually cause minor losses or temporary disruptions and will be subject to comprehensive compensatory mitigation requirements. The significance of small-scale projects lies in the cumulative and synergistic effects resulting from many these activities occurring in a single watershed.

Bank Stabilization. The extent and magnitude of streambank erosion are increased by human activities that remove riparian vegetation, increase sediment inputs, move and straighten channels, or otherwise cause channel down-cutting. Vessel traffic and the resulting wakes can also create bank scours.

Attempts to deal with the bank erosion resulting from these activities often involve the use of adding hardened, structural materials. In smaller streams, particularly those that seasonally become dry or nearly dry, bulldozing of streambed gravel against the banks has been a common practice to retard erosion. In larger streams and rivers the dumping or placement of rock (riprap), broken concrete, and mixtures of materials (*i.e.*, rocks, dirt, branches) along the banks is a common practice. Additionally, bulkheads and concrete walls have been used on lake and estuarine shores. Concerns for salmon associated with shoreline stabilization include loss of shallow edgewater rearing habitats, changes to benthic vegetation, impacts to eelgrass and other vegetation important for herring spawning, loss of shoreline riparian vegetation and reduction in leaf fall, loss of wetland vegetation, alteration of groundwater flows, loss of LWD, changes in food resources, and loss of migratory corridors.

The installation of riprap or other streambank stabilization devices can reduce or eliminate recruitment of crucial spawning gravel by eliminating lateral erosion, as has occurred in the Sacramento River. By confining the stream or shoreline with hard materials, the development of side channels, functioning riparian and floodplain areas, and off-channel sloughs are precluded.

Use of chemicals (*e.g.*, creosote, chromated copper arsenate, copper zinc arsenate) on bulkheads or other wood materials used for bank stabilization can introduce toxic substances into the water, injure or kill prey organisms and salmon directly, or concentrate in the food chain. Their use is generally prohibited. In freshwater, copper concentrations are acutely toxic to yearly coho salmon at 60-74 mg/l in freshwater, but affect smoltification, migration, and survival at 5-30 mg/l.

Streambank stabilization projects can cause significant long-term or permanent adverse affects on EFH. However, bank stabilization projects associated with SLOPES are small-scale projects that will individually cause minor losses or temporary disruptions, and are otherwise limited to the types of projects that are not expected to have long-term adverse effects to EFH.

Wetland and Floodplain Alteration. Many river valleys in the west were once marshy and well vegetated, filled with mazes of floodplain sloughs, beaver ponds, and wetlands. Salmon evolved within these systems. Juvenile salmon, especially coho, can spend large portions of their fresh water residence rearing and overwintering in floodplain environments and riverine wetlands. Salmon survival and growth are often better in floodplain channels, oxbow lakes, and other river-adjacent waters than in mainstream systems. Wetlands also provide other ecosystem functions important to salmonids such as regulation of stream flow, stormwater storage and filtration, and often provide key habitats for beavers that, in turn, provide instream habitat benefits to coho from their active and continual placement of wood in streams. Floodplains, even those that are not wetlands, also help store water, filter nutrients, and cycle nutrients into the aquatic ecosystem.

Wetlands and side channels throughout the region have been converted through diking, draining and filling to create agricultural fields, livestock pasture, areas for ports, cities, and industrial lands. Wetlands were further altered to improve navigation along rivers. These changes have transformed the complex river valley habitat, with many backwater areas, into a simplified drainage system most of whose flow is confined to the mainstream. Because of these alterations, these areas could not absorb flood waters as well as before those changes.

The construction of dikes, levees, and roads in the floodplain have further effects on salmon habitats. These structures prevent the connections between the rivers and floodplain, depriving the rivers of supplies of LWD and decreasing the input of fine organic matter and dissolved nutrients that support the food web for salmon. These structures also deprive the river of a place to deposit sediment, so more sediment moves downstream, causing stream channel aggradation, the scouring of spawning redds, and estuary filling.

Local physical alterations in estuarine systems that may be authorized using SLOPES include minor filling and draining of wetlands, although these will be small-scale projects that individually cause minor losses or temporary disruptions and will be subject to comprehensive compensatory mitigation requirements. Moreover, projects designed to restore wetland and floodplain function, such as removal of dikes, levees, roads, and tide gates, comprise a significant portion of the actions affecting wetlands that will be explicitly authorized by SLOPES.

Estuarine Alteration. Estuaries are transitional environments that functionally link land and sea water. The dominant features of estuarine ecosystems are their salinity variances, productivity, and diversity, which, in turn, are governed by the tides and the amount of freshwater runoff from the land. These systems present a continuum along a fresh-brackish-salt water gradient as a river system empties into the sea. Estuarine ecosystems have a high species diversity that reflect the great structural diversity and resultant differentiation of ecological niches characterized as follows:

- Unique hydrological features by which fresh water slows and flows over a wedge of heavier intruding tidal salt water resulting in suspended terrestrial and autochthonous products settling into the inflowing salt water or into bottom sediments.
- Shallow nutrient-rich environments resulting in an enormously productive vegetative habitat and detrital food chains for many organisms, such as crustaceans and juvenile fish.
- Critical nursery habitats for many aquatic organisms, particularly anadromous fish and groundfish.
- Contributing to the “trapping” and recycling of nutrients – where an accumulation of nutrients such as potassium and nitrogen are concentrated and recycled, a repeating interactive process by which the incoming tidal water re-suspends nutrients at the fresh-salt water interface while moving them back up the estuary, and the land-based sources of nutrients move towards the sea.
- Accumulating fine sediments transported in by tides and rivers, further enhancing productivity by being adsorptive surfaces for nutrients.

In Oregon and Washington there are relatively few estuarine wetlands because of the steep topography of the shore. Of those, between 50% and 90% of the tidal marsh systems in estuaries have been lost this century. The estuarine environment benefits salmon by providing a food rich environment for rapid growth, physiological transition between fresh and salt water environments, and refugia from predators. Estuarine eelgrass beds, macroalgae, emergent marsh vegetation, marsh channels, and tidal flats provide particularly important estuarine habitats for the production, retention, and transformation of organic matter within the estuarine food web and a direct source of food for salmon and their prey. Additionally, estuarine marsh vegetation, overhanging riparian vegetation, eelgrass beds, and shallow turbid waters of the estuary provide cover for predator avoidance. Estuaries provide enough habitat variety to allow the many species and stocks of salmonids to segregate themselves by niche.

Chinook salmon fry, for example, prefer protected estuarine habitats with lower salinity; moving from the edges of marshes during high tides to protected tidal channels and creeks during low tides. As the fish grow larger, they are increasingly found in higher salinity waters and increasingly use less-protected habitats, including delta fronts or the edge of the estuary before dispersing into marine waters. As opportunistic feeders, Chinook salmon consume larval and adult insects and amphipods when they first enter estuaries, with increasing dependence on larval and juvenile fish such as anchovy, smelt, herring, and stickleback as they grow larger.

For juvenile coho, LWD is an important element of estuarine habitats. During their residence time in estuaries, coho salmon consume large planktonic or small nektonic animals, such as amphipods, insects, mysids, decapod larvae, and larval juvenile fishes. In estuaries, smolts occur in intertidal and pelagic habitats with deep marine-influenced habitats often preferred.

Four general categories of impacts affect estuarine ecosystems: (1) Enrichment with excessive levels of organic materials, inorganic nutrients, or heat; (2) physical alterations that include hydrologic changes and reclamation; (3) introduction of toxic materials; and (4) introduction of exotic species leading to direct changes in species composition and food web dynamics.

Progressive enrichment of estuarine waters with inorganic nutrients, organic matter, or heat leads to changes in the structure and processes of estuarine ecosystems. Nutrient enrichment can lead to excessive algal growth, increased metabolism, and changes in community structure, a condition known as eutrophication. Addition of excessive levels of organic matter to estuarine waters result in bacterial contamination and lowered dissolved oxygen concentrations that result in concomitant changes in community structure and metabolism. Inorganic nutrients from mineralization of the organic matter can stimulate dense algal blooms and lead to another source of excessive organic matter. The source of high levels of organic matter is normally sewage waste water, but high levels can also result from seafood processing wastes and industrial effluents. Impacts from thermal loading include interference with physiological processes, behavioral changes, disease enhancement, and impacts from changing gas solubilities. These impacts may combine to affect entire aquatic systems by changing primary and secondary productivity, community respiration, species composition, biomass, and nutrient dynamics.

Toxic materials include such compounds as pesticides, heavy metals, petroleum products, and exotic by-products of industrial activity near estuaries. Such contaminants can be acutely toxic, or more commonly, they can cause chronic or sublethal effects. Toxins can also bioaccumulate in food chains. The same processes that lead to the trapping of nutrients, and by that to the productivity of the estuary, also lead to the trapping and concentrating of pollutants. Fine sediments not only retain phosphorous and other nutrients, but also petroleum and pesticide residues. Estuarine sediments can concentrate DDT more than 100,000 times higher than in the water of the estuary. Such pesticide residues enter the food chain via detritus-eating invertebrates and are further concentrated. The same features of water circulation in the estuary that concentrate nutrients also concentrate pollutants such as mercury and lead, heavy metals from sewage, industrial and pulp mill effluents. Estuarine food chains are extremely complex and sensitive to alterations in the physical and chemical range of stresses. Loss or disruption of one element can have a cascading effect on species presence and productivity.

Local physical alterations in estuarine systems that may be authorized using SLOPES include minor filling and draining of wetlands, although these will be small-scale projects that individually cause minor losses or temporary disruptions and will be subject to comprehensive compensatory mitigation requirements. Projects designed to restore estuarine function, such as removal of dikes, levees, roads, and tide gates, comprise a significant portion of the actions affecting wetlands that will be explicitly authorized by SLOPES.

Road Building and Maintenance. Roads may affect groundwater and surface water by intercepting and rerouting water that might otherwise drain to springs and streams. This increases the density of drainage channels within a watershed and results in water being routed more quickly into the streams. Altering the connection between surface and groundwater can affect water temperatures, instream flows, and nutrient availability. These factors can affect egg development, the timing of fry emergence, fry survival, aquatic diversity, and salmon growth.

In urban areas, extensive road and pavement can effectively double the frequency of hydrologic events that can mobilize stream substrates. This increased scour of gravel and cobble in areas where salmon eggs, alevins, or fry reside can kill salmon directly or indirectly increases mortality by carrying them downstream and away from stream cover. Urban roads can be a major source of sediment input during construction as can the installation of bridges, culverts, and diversions with coffer dams. However, these project impacts appear more temporary and less pervasive on sediment input than forest roads.

In small forested watersheds, streamflow appears directly related to the total area of the watershed composed of roads and other heavily compacted surfaces. In larger watersheds, where roads and impermeable areas represent a small area of the basin, few effects are seen. Altered hydrology was noted when roads covered 4% or more of a drainage area.

Road culverts can block both adult and juvenile salmon migrations. Blockages can result from the culvert becoming perched above streambed level, lack of pools that could allow salmon to reach the culvert, or from high water flow velocities in the culvert.

Road projects in or along waterways can cause significant long-term or permanent adverse affects on EFH. However, road projects associated with SLOPES are small-scale maintenance projects that individually cause minor losses or temporary disruptions and will be subject to comprehensive compensatory mitigation requirements.

Access Maintenance. Dredging results in the temporary elevation of suspended solids emanating from the project area as a turbidity plume. Excessive turbidity can affect salmon or their prey by abrading sensitive epithelial tissues, clogging gills, decreasing egg buoyancy (of prey), and affects photosynthesis of phytoplankton and submerged vegetation leading to localized oxygen depression. Suspended sediments subsequently settle, which can destroy or degrade benthic habitats.

The removal of bottom sediments during dredging operations can disrupt the entire benthic community and eliminate many feeding habitats available to fish for a significant time. The rate of recovery of the dredge area is temporally and spatially variable and site specific. Recolonization varies considerably with geographic location, sediment composition, and types of organisms inhabiting the area. Dredging may also affect the migration patterns of juvenile groundfish and salmonids because of noise, turbulence, and equipment.

The suspended sediments dredged from estuarine and coastal marine systems are generally high in organic matter and clay, both of which may be biologically and chemically active. Dredged spoils removed from areas proximate to industrial and urban centers can be contaminated with heavy metals, organochlorine compounds, polyaromatic hydrocarbons, petroleum hydrocarbons, and other substances and thus prone to resuspension. Sediments in estuaries downstream from agricultural areas may also contain herbicide and pesticide residues.

Dredging and subsequent sediment deposition poses a potential threat to the eelgrass ecosystems in estuaries, which provide important structural habitat and prey for salmon. Dredging not only removes plants and reduces water clarity, but can change the entire physical, biological, and chemical structure of the ecosystem. Dredging also can reverse the normal oxidation/reduction potential of the sediments of an eelgrass system, which can reverse the entire nutrient-flow mechanics of the ecosystem.

Concomitant with dredging is spoil disposal. Dredged material disposal has been used in recent years for the creation, protection and restoration of habitats. When not used for beneficial purposes, spoils are usually taken to marine disposal sites and this may create adverse conditions within the marine community. When contaminated dredged sediment is dumped in marine waters, toxicity and food-chain transfers can be anticipated, particularly in biologically productive areas. The effects of these changes on groundfish, pelagic species, and salmon are not known.

Dredging under SLOPES is limited to the excavation of natural substrates in areas that are not known or suspected of being within the impact zone of any significant contaminant source, as identified by historical information or the Corps' best professional judgment. It will be further limited to the removal sediments necessary to maintain existing marinas, port terminals, and industrial docks and wharfs, although some dredging may also be carried out during the construction of roads and bridges and the placement of pipe, cable, and utility lines. These projects are small-scale and will individually cause minor losses or temporary disruptions, but are otherwise limited to the types of projects that are not expected to have long-term adverse effects to EFH. Dredging to maintain channel flow capacity for flood control or water withdrawal purposes will not be authorized.

EFH Conservation Recommendations

NOAA Fisheries believes that actions described in the following terms and conditions in the ESA section of this document are necessary to avoid, mitigate, or offset the impact that the proposed action has on EFH and therefore adopts each as EFH conservation recommendations:

1(a) Statewide Programmatic General Permit
1(c) Individual project review, except for 1(c)(iii) Salvage notice
1(d) Timely reporting
1(e) Project notification form
1(f) Request for variance
1(g) Project completion report
1(h) Restoration and/or mitigation report
1(i) Annual program report
1(j) Annual coordination meeting
1(k) Reinitiation
2(a) Construction exclusions
2(b) Pollution and erosion control plan
2(c) Work area isolation plan
2(e) Fish passage
2(f) Stormwater management plan
2(g) Site restoration plan
2(h) Compensatory mitigation plan
2(i) Surface water diversion
2(j) Construction discharge water
2(k) Heavy equipment
2(l) Pre-construction activity
2(m) Site preparation
2(k) Temporary roads and drilling pads
2(l) Earthwork
2(m) Treated wood
2(c) Piling removal
3(a) Site preparation exclusions
3(b) Applicable terms and conditions
4(a) Streambank stabilization exclusions
4(b) Applicable terms and conditions
4(c) Streambank stabilization goal
4(d) Large wood and rock
4(e) Streambank stabilization methods
5(a) Applicable terms and conditions
5(b) Stream/wetland restoration

6(a) Water control structure exclusions
6(b) Water control structure repairs
7(a) Road exclusions
7(b) Applicable terms and conditions
7(c) Road maintenance
7(d) Ditches, culverts and trash racks
7(e) New permanent stream crossings
8(a) Utility line exclusions
8(b) Applicable terms and conditions
8(c) Utility stream crossings
9(a) Over-water and in-water exclusions
9(b) Authorized actions
10(a) Minor discharge and excavations
10(b) Applicable terms and conditions
10(c) Minimum volume

Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the response is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

Supplemental Consultation

The Corps must reinitiate EFH consultation with NOAA Fisheries 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 NOAA Fisheries' EFH conservation recommendations [50 C.F.R. 600.920(l)].

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.

Utility: This ESA Section 7 consultation on SLOPES III concluded that the actions that the Corps proposes to authorize using SLOPES III will not jeopardize the continued existence of the LCR Chinook salmon, UWR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, SONC coho salmon, OC coho salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, or SR Basin steelhead, or result in the destruction or adverse modification of critical habitat. Therefore, the Corps may use SLOPES III to authorize those actions. Pursuant to the MSA, NOAA Fisheries provided the Corps with conservation recommendations to conserve EFH designated for Pacific salmon, groundfish, and coastal pelagic species.

Integrity: This consultation was completed on a computer system managed by NOAA Fisheries 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.

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 NOAA Fisheries ESA Consultation Handbook, ESA Regulations, 50 C.F.R. 402.01 *et seq*., and the MSA implementing regulations regarding EFH, 50 C.F.R. 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 NOAA Fisheries staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

LITERATURE CITED

Abbott, R. and E. Bing-Sawyer. 2002. Assessment of pile driving impacts on the Sacramento blackfish (*Othodon microlepidotus*). Draft report prepared for Caltrans District 4. October 10, 2002.

Ainley, D.G. 1984. Cormorants Family Phalacrocoracidae. Pages 92- 101 in D. Haley editor Seabirds of the eastern North Pacific and Arctic waters. Pacific Search Press, Seattle. 214 p.

Armstrong, D.A., B.G. Stevens, and J.C. Hoeman. 1982. Distribution and abundance of Dungeness crab and *Crangon* shrimp, and dredged-related mortality of invertebrates and fish in Grays Harbor, Washington. Technical Report, School of Fisheries, University of Washington, Washington Department of Fisheries, and Seattle District Corps of Engineers. 349 p.

Arseneault, J.S. 1981. Memorandum to J.S. Mathers on the result of the 1980 dredge monitoring program. Fisheries and Oceans, Government of Canada.

Atkinson, C.E., J.H. Rose, and O.T. Duncan. 1967. Salmon of the North Pacific Ocean--Part IV. Spawning populations of North Pacific salmon. 4. Pacific salmon in the United States. International North Pacific Fisheries Commission Bulletin 23:43-223.

Baldwin, D.H., J.F. Sandahl, J.S. Labenia and N.L. Scholz. 2003. Sublethal effects of copper on coho salmon: Impacts on nonoverlapping receptor pathways in the peripheral olfactory nervous system. Environmental Toxicology and Chemistry 22:2266-2274.

Barnhart, R.A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)--steelhead. U.S. Fish and Wildlife Service Biological Report 82 (11.60), 21 p.

Beamer, E.M. and R.A. Henderson. 1998. Juvenile salmonid use of natural and hydromodified stream bank habitat in the maintem Skagit River, northwest Washington. Miscellaneous Report. Skagit System Cooperative, LaConner, Washington.

Beamesderfer, R.C. and B.E. Rieman. 1991. Abundance and Distribution of Northern Squawfish, Walleyes, and Smallmouth Bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:439-447.

Bedford, B.L. 1996. The need to define hydrologic equivalence at the landscape scale for freshwater mitigation. Ecological Applications 6(1):57-68.

Beechie, T.J. and T.H. Sibley. 1997. Relationships between channel characteristics, woody debris, and fish habitat in northwestern Washington streams. Transactions of the American Fisheries Society 126:217-229.

Behnke, R.J. 1992. Native trout of western North America. American Fisheries Society Monograph 6, 275 p. American Fisheries Society, Bethesda, Maryland.

Bell, M.C. 1991. Fisheries handbook of Engineering requirements and biological criteria. Fish Passage Development and Evaluation Program. U.S. Army Corps of Engineers, North Pacific Division.

Berg, L. and T.G. Northcote. 1985. "Changes In Territorial, Gill-Flaring, and Feeding Behavior in Juvenile Coho Salmon (Oncorhynchus kisutch) Following Short-Term Pulses of Suspended Sediment." Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Bevan, D., J. Harville, P. Bergman, T. Bjornn, J. Crutchfield, P. Klingeman, and J. Litchfield. 1994. Snake Salmon Recovery Team: final recommendations to the National Marine Fisheries Service. May 1994. Rob Jones, Recovery Plan Coordinator. National Marine Fisheries Service, Portland, Oregon.

Bevelhimer, M.S. 1996. Relative importance of temperature, food, and physical structure to habitat choice by smallmouth bass in laboratory experiments. Transactions of the American Fisheries Society 125:274-283.

Bilby, R.E. and J.W. Ward. 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Transactions of the American Fisheries Society 118:368-378.

Birtwell, I.K., G.F. Hartman, B. Anderson, D.J. McLeay, and J.G. Malick. 1984. "A Brief Investigation of Arctic Grayling (Thymallus arcticus) and Aquatic Invertebrates in the Minto Creek Drainage, Mayo, Yukon Territory: An Area Subjected to Placer Mining." Canadian Technical Report of Fisheries and Aquatic Sciences 1287.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 *in* W.R. Meehan, editor Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19:83-138.

Blackwell, B.F., W.B. Krohn, N.R. Dube and A.J. Godin. 1997. Spring prey use by double-crested cormorants on the Penobscot River, Maine, USA. Colonial Waterbirds 20(1):77-86.

Botkin, D., K. Cummins, T. Dunne, H. Regier, M. Sobel, L. Talbot, and L. Simpson. 1995. Status and Future of salmon of Western Oregon and Northern California: Findings and Options. Report #8. The Center for the Study of the Environment, Santa Barbara, California. 300 p.

Boyd, F.C. 1975. Fraser River dredging guide. Tech. Rpt. Series No. PAC/T-75-2. Fisheries and Marine Service, Environment Canada.

Braun, F. 1974a. Monitoring the effects of hydraulic suction dredging on migrating fish in the Fraser River Phase I. Department of Public Works, Pacific Region, Canada.

Braun, F. 1974b. Monitoring the effects of hydraulic suction dredging on migrating fish in the Fraser River Phase II. Department of Public Works, Pacific Region, Canada.

Brooks, K.M. 2000. Assessment of the environmental effects associated with wooden bridges treated with creosote, pentachlorophenol, or chromated copper arsenate wood. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. (September 2000) http://www.fpl.fs.fed.us/documnts/FPLRP/fplrp587.pdf

Brooks, K.M. 2003. Literature review, computer model and assessment of the potential environmental risks associated with copper napthenate treated wood products used in aquatic environments. A report prepared for Mr. Gerald E. Davis, Merichem Chemicals and Refinery Services, LLC, Tuscaloosa, Alabama (February 15, 2003).

Brooks, K.M. 2004. Environmental response to ACZA treated wood structures in a Pacific Northwest marine environment. A report prepared for J. H. Baxter and Company, San Mateo, California. 31 p. (January 20, 2004).

Brown, L.R., P.B. Moyle, and R.M. Yoshiyama. 1994. Historical decline and current status of coho salmon in California. North American Journal of Fisheries Management 14: 237-261.

BRT (Biological Review Team). 2003. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead West Coast Salmon Biological Review Team. Northwest Fisheries Science Center, Seattle, Washington, Southwest Fisheries Science Center, Santa Cruz, California. (July 2003)

Bryant, G.J. 1994. Status review of coho salmon in Scott Creek and Waddell Creek, Santa Cruz County, California. Natl. Mar. Fish. Serv., SW Region, Protected Species Management Division, 102 p. Available from NMFS, Southwest Region, 501 W. Ocean Boulevard, Suite 4200, Long Beach, California 90802.

Burdick, D. and F. Short. 1998. The effects of boat docks on eelgrass in coastal waters of Massachusetts. Environmental Management.

Burgner, R.L. 1991. Life history of sockeye salmon (*Oncorhynchus nerka*). Pages 1-117 *In:* Groot, C. and L. Margolis (editors). 1991. Pacific salmon life histories. Vancouver, British Columbia: University of British Columbia Press.

Burgner, R.L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1992. Distribution and origins of steelhead trout (*Oncorhynchus mykiss*) in offshore waters of the North Pacific Ocean. International North Pacific Fish Commission Bulletin 51, 92 p.

Busack, C. and D. Rawding. 2003. HPVA results for salmon an steelhead production in Washington Lower Columbia Basins. Appendix J, in, P. McElhany (chair), *et al*., Interim report on viability criteria for Willamette and Lower Columbia Basin Pacific salmonids, Willamette/Lower Columbia Technical Recovery Team, National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington (March 31, 2003).

Busby, P.J., O.W. Johnson, T.C. Wainwright, F.W. Waknitz, and R.S. Waples. 1993. Status review for Oregon s Illinois River winter steelhead. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-10, 85 p.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-27, 261p.

Caltrans. 2001. Fisheries Impact Assessment, Pile Installation Demonstration Project for the San Francisco - Oakland Bay Bridge, East Span Seismic Safety Project, August 2001. 9 pp.

Campbell, K.P. 1979. Predation principles in large rivers: A review. Pages 181-191 in R.H. Stroud and H. Clepper, editors. Predator-prey systems in fisheries management. Sport Fishing Institute, Washington D.C.

Cardwell, R.D., M.I. Carr, E.W. Sanborn. 1980a. Water quality and flushing of five Puget Sound marinas. Technical Report No. 56. Washington Department of Fisheries Research and Development. Olympia, Washington. 77 p.

Cardwell, R.D., S.J. Olsen, M.I. Carr, E.W. Sanborn. 1980b. Biotic, water quality and hydraulic characteristics of Skyline Marina in 1978. Technical Report No. 54. Washington Department of Fisheries Research and Development. Olympia, Washington. 103p.

Carie, D.G. 2000. Spring and summer Chinook salmon spawning ground surveys on the Entiat River, 2000. U.S. Fish & Wildlife Service Rept. Mid-Columbia River Fishery Resource Office. Leavenworth, Washington. 17 pp.

Carlson, J.Y., C.W. Andrus and H.A. Froehlich. 1990. Woody debris, channel features, and macroinvertebrates of streams with logged and undisturbed riparian timber in northeastern Oregon, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences, 47:1103-1110.

Carlson, T., G. Ploskey, R.L. Johnson, R.P. Mueller and M.A. Weiland. 2001. Observations of the behavior and distribution of fish in relation to the Columbia River navigation channel and channel maintenance activities. Review draft report to the Portland District Corps of Engineers prepared by Pacific Northwest National Laboratory, Richland, Washington. 35 p.

Carrasquero, J. 2001. Overwater structures: Freshwater issues. White paper submitted to Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington Department of Transportation. Olympia, Washington.

Casillas, E., L. Crockett, Y. deReynier, J. Glock, M. Helvey, B. Meyer, C. Schmitt, M. Yoklavich, A. Bailey, B. Chao, B. Johnson and T. Pepperell. 1988. Essential Fish Habitat West Coast Groundfish Appendix. National Marine Fisheries Service, Montlake, Washington.

CDFG (California Department of Fish and Game). 1995. Letter to M. Schiewe for the ESA Administrative Record for west coast steelhead, dated 30 March 1995, 10 p. plus attachments. Available from Environmental and Technical Services Division, National Marine Fisheries Service, 525 NE Oregon Street, Suite 500, Portland, Oregon 97232.

Cederholm, C.J., L.G. Dominguez and T.W. Bumstead. 1997. Rehabilitating stream channels and fish habitat using large woody debris. Chapter 8 *In:* Slaney, P.A. and Zaldokas, D. (editors) 1997. Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No. 9. British Columbia Ministry of Environment, Lands and Parks. Vancouver, British Columbia.

Chapman, D.W. 1986. Salmon and steelhead abundance in the Columbia River in the nineteenth century. Transactions of the American Fisheries Society 115:662-670.

Chapman, D.W., W.S. Platts, D. Park, and M. Hill. 1990. Status of Snake River sockeye salmon. Final report, 90 p. Available from Pacific Northwest Utilities Conference Committee, 101 SW Main Street, Suite 810, Portland, Oregon 97204.

Christopherson, A. and J. Wilson, 2002. Technical Letter Report Regarding the San Francisco-Oakland Bay Bridge East Span Project Noise Energy Attenuation Mitigation. Peratrovich, Nottingham & Drage, Inc. Anchorage, Alaska. 27 pp.

Cichosz, T., D. Saul, A. Davidson, W. Warren, D. Rollins, J. Willey, T. Tate, T. Papanicolaou and S. Juul. 2001. Clearwater Subbasin Summary. Draft submitted to the Northwest Power Planning Council (November 2001), 477 p.

Colle, D.E., R.L. Cailteux, and J.V. Shireman. 1989. Distribution of Florida largemouth bass in a lake after elimination of all submersed aquatic vegetation. North American Journal of Fisheries Management 9:213-218.

Collis, K., R.E. Beaty and B.R. Crain. 1995. Changes in Catch Rate and Diet of Northern Squawfish Associated With the Release of Hatchery-Reared Juvenile Salmonids in a Columbia River Reservoir. North American Journal of Fisheries Management 15:346-357.

Craig, J.A., and A.J. Suomela. 1941. Time of appearance of the runs of salmon and steelhead trout native to the Wenatchee, Entiat, Methow, and Okanogan Rivers. Cited In J. W. Mullan, K. R. Williams, G. Rhodus, T. W. Hillman, and J. D. McIntyre (editors). 1992. Production and habitat of salmonids in mid-Columbia River tributary streams. U.S. Fish and Wildlife Service Monograph I:J358-J380.

Cramer, S.P., and 12 co-authors. 1995. The status of steelhead populations in California in regards to the Endangered Species Act. Document prepared for Association of California Water Agencies, 167 p. Available from Environmental and Technical Services Division, National Marine Fisheries Service, 525 NE Oregon Street, Suite 500, Portland, Oregon 97232.

Crone, R.A., and C.E. Bond. 1976. Life history of coho salmon, *Oncorhynchus kisutch*, in Sashin Creek, southeastern Alaska. Fisheries Bulletin, U.S., 74(4):897-923.

Darnell, R.M. 1976. Impacts of construction activities in wetlands of the United States. U.S. Environmental Protection Agency, Ecological Research Series, Report No. EPA-600/3-76-045, Environmental Research Laboratory, Office of Research and Development, Corvallis, Oregon.

Dauble, D.D., R.L. Johnson, and A.P. Garcia. 1999. Fall Chinook salmon spawning in the tailraces of lower Snake River hydroelectric projects. Transaction of the American Fisheries Society 128 (4): 672-679.

Derby, C.E. and J.R. Lovvorn. 1997. Predation on fish by cormorants and pelicans in a cold-water river: a field and modeling study. Canadian Journal of Fisheries and Aquatic Sciences 54:1480-1493.

Collier, T.K., J.P. Meador and L.L. Johnson. 2002. Introduction: Fish tissue and sediment effects thresholds for polychlorinated biphenyls, polycyclic aromatic hydrocarbons, and tributylin. Aquatic Conservation: Marine and Freshwater Ecosystems 12:489-492.

DeVenzio, H. Undated. Timber treatments: New preservatives and standards change the way people build and specify. Bridge Builder Magazine.

Dolat, S.W. 1997. Acoustic measurements during the Baldwin Bridge demolition (final, dated March 14, 1997). Prepared for White Oak Construction by Sonalysts, Inc, Waterford, CT.. 34 p. + appendices. Enger *et al*. 1992.

Duffy, D.C. 1995. Why is the double-crested cormorant a problem? Insights from cormorant ecology and human sociology. Pages 25-32 in The Double-crested Cormorant: biology, conservation and management (D.N. Nettleship and D.C. Duffy, editors) Colonial Waterbirds 18 (Special Publication 1).

Dunne, T. and L. B. Leopold. 1978. Water in Environmental Planning. W. H. Freeman, San Francisco.

Dunsmoor, L.K., D.H. Bennett, and J.A. Chandler. 1991. Prey selectivity and growth of a planktivorous population of smallmouth bass in an Idaho reservoir. Pages 14-23 in D.C. Jackson (ed) The First International Smallmouth Bass Symposium. Southern Division American Fisheries Society. Bethesda, Maryland.

Dutta, L.K., 1976. Dredging: Environmental effects and technology. Pages 301-319 *In:* Proceedings of WODCON VII. World Dredging Conference, San Pedro, California.

Dutta, L.K. and P. Sookachoff. 1975a. Assessing the impact of a 24" suction pipeline dredge on chum salmon fry in the Fraser River. Fish. And Marine Serv., Environment Canada, Technical Report Series No. PAC/T-75-26. 24 p.

Dutta, L.K. and P. Sookachoff. 1975b. A review of suction dredge monitoring in the lower Fraser River, 1971-1975. Fish. And Marine Serv., Environment Canada, Technical Report Series No. PAC/T-75-27. 100 p.

Emmet, R.L., G.T. McCabe, Jr. and W.D. Muir. 1988. Effects of the 1980 Mount St. Helens eruption on Columbia River estuarine fishes: implications for dredging on Northwest estuaries. Pages 74-91 *In:* C. A. Simenstad (editor) Effects of dredging on anadromous Pacific coast fishes. Washington Sea Grant Program. Washington State University. Seattle, Washington.

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries, Volume II: species life history summaries. ELMR Report No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, Maryland. 329 p.

Enger, P.S., H.E. Karlsen, F.R. Knudsen, and O. Sand. 1993. Detection and reaction of fish to infrasound. Fish Behavior in Relation to Fishing Operations, 1993, ICES Marine Science Symposia. Copenhagen, Sweden. 196:108-112.

Everest, F.H. 1973. Ecology and management of summer steelhead in the Rogue River. Oregon State Game Commission, Fishery Research Report 7, Corvallis, 48 p.

Fausch, K.D. and T.G. Northcote. 1992. Large woody debris and salmonid habitat in a small coastal British Columbia stream. Canadian Journal of Fisheries and Aquatic Sciences, 49:682-693.

Fedler, A.J. and S.L. Crookshank. 1992. Measuring the value of coastal fisheries habitat. Pages 23-30 in R.H. Stroud, editor Stemming the tide of coastal fish habitat loss. Proceedings of a symposium on conservation of coastal fish habitat. National Coalition for Marine Conservation, Inc., Savannah Georgia.

Feist, B.E., J.J. Anderson, and R. Miyamoto. 1996. Potential impacts of pile driving on juvenile pink (*Oncorhynchus gorbuscha*) and chum (*O. keta*) salmon behavior and distribution. Report No. FRI-UW-9603. Fisheries Research Institute, School of Fisheries, University of Washington. Seattle, Washington.

Ferguson, R.L., G.W. Thayer and T.R. Rice. 1980. Marine Primary producers, pp. 9-69 in F.J. Vernberg and W. Vernberg editors Functional adaptation of marine organisms, Academic Press, New York.

Fisher, J.P. and W.G. Pearcy. 1996. Dietary overlap of juvenile fall- and spring-run Chinook salmon *Oncorhynchus tshawytscha* in Coos Bay, Oregon. Fishery Bulletin 95:25-38.

Fonseca, M.S., J. Kenworthy, and G. Thayer. 1998. Guidelines for the conservation and restoration of seagrasses in the United States and adjacent waters. NOAA Coastal Ocean Program Decision Analysis Series No. 12. NOAA Coastal Ocean Office, Silver Spring, Maryland. 222 p.

Ford, M., P. Budy, C. Busack, D. Chapman, T. Cooney, T. Fisher, J. Geiselman, T. Hillman, J. Lukas, C. Peven, C. Toole, E. Weber, and P. Wilson. 2001. Final report of the Upper Columbia River Steelhead and Spring Chinook Salmon Biological Requirements Committee, March 2001. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington.

Fox, W.W. Jr. 1992. Stemming the tide: Challenges for conserving the nation's coastal fish habitat. Pages 9-13 in R.H. Stroud, editor Stemming the tide of coastal fish habitat loss. Proceedings of a symposium on conservation of coastal fish habitat. National Coalition for Marine Conservation, Inc., Savannah Georgia.

FPL (Forest Products Laboratory). 2000. What's in that pressure-treated wood? U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. http://www.fpl.fs.fed.us/techlines.htm

FPL (Forest Products Laboratory). 2001a. Coatings minimize leaching from treated wood. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. (November, 2001) http://www.fpl.fs.fed.us/techlines.htm

FPL (Forest Products Laboratory). 2001b. Environmental impact of preservative-treated wood. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. (December, 2001) http://www.fpl.fs.fed.us/techlines.htm

FPL (Forest Products Laboratory). 2003. Changes in pressure-treated wood for residential construction. U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. http://www.fpl.fs.fed.us/techlines.htm

Fredenberg, W.A. 1992. Evaluation of electrofishing-induced spinal injuries resulting from field electrofishing surveys in Montana. Montana Department of Fish, Wildlife and Parks, Helena.

Frenkel, R.E. and J.C. Morlan. 1991. Can we restore our salt marshes? Lessons form the Salmon River, Oregon. Northwest Environmental Journal 7:119-135.

Frost, D.A., W.C. McAuley, D.J. Maynard, and T.A. Flagg. 2002. Redfish Lake sockeye salmon captive broodstock rearing and research, 2001, Annual Report. Report to Bonneville Power Administration, Contract No. 00004464, Project No. 199204000, 27 electronic pages (BPA Report DOE/BP-00004464-1). Available online at: http://www.efw.bpa.gov/Environment/EW/EWP/DOCS/REPORTS/HATCHERY/A00004464-1.pdf

Fulton, L.A. 1968. Spawning areas and abundance of Chinook salmon, *Oncorhynchus tshawytscha*, in the Columbia River Basin--Past and present. U.S. Fish and Wildlife Service Special Science Report – Fish. 571, 26 p.

Gerking, S.D. 1994. Feeding Ecology of Fish. Academic Press Inc., San Diego, California. 416 p.

Giger, R.D. 1972. Ecology and management of coastal cutthroat trout in Oregon. Fishery Research Report No. 6. Oregon State Game Commission. 61 p.

Gilbert, C.H. 1912. Age at maturity of Pacific coast salmon of the genus *Oncorhynchus*. Bulletin of the U.S. Fisheries Commission 32:57-70.

Godfrey, H., K.A. Henry, and S. Machidori. 1975. Distribution and abundance of coho salmon in offshore waters of the North Pacific Ocean. International North Pacific Fish Commission Bulletin 31, 80 p.

Good, J.W. 1987. Mitigating estuarine development impacts in the Pacific Northwest: from concept to practice. Northwest Environmental Journal. Volume 3, Number 1.

Gray, G.A. and D.W. Rondorf. 1986. Predation on juvenile salmonids in Columbia Basin reservoirs. Pages 178-185 in G.E. hall and M.J. Van Den Avle editors Reservoir Fisheries Management Strategies for the 80's. Southern Division American Fisheries Society, Bethesda, Maryland.

Gregory, R.S. 1988. Effects of Turbidity on benthic foraging and predation risk in juvenile Chinook salmon. Pages 64-73 *in* C. A. Simenstad, editor. Effects of Dredging on Anadromous Pacific Coast Fishes. Washington Sea Grant Program, Washington State University, Seattle.

Gregory, R.S. 1993. Effect of turbidity on the predator avoidance behavior of juvenile Chinook salmon (Oncorhynchus tshawytcha). Canadian Journal of Fisheries and Aquatic Sciences 50:241-246.

Gregory, R.S. and C.D. Levings. 1998. "Turbidity Reduces Predation on Migrating Juvenile Pacific Salmon." Transactions of the American Fisheries Society 127: 275-285.

Groot, C. and L. Margolis (editors). 1991. Pacific salmon life histories. Vancouver, British Columbia: University of British Columbia Press.

Gucinski, H., M.J. Furniss, R.R. Ziemer, and M.H. Brookes, editors. 2001. Forest roads: A synthesis of scientific information. General Technical Report PNW-GTR-509. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 103 p.

Gustafson, R.G., T.C. Wainwright, G.A. Winans, F.W. Waknitz, L.T. Parker, and R.S. Waples. 1997. Status review of sockeye salmon from Washington and Oregon. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-33, 282 p.

Hansen, J.A., J.C.A. Marr, J. Lipton, D. Cacela and H.L. Bergman. 1999a. Differences in neurobehavioral responses of Chinook salmon (*Onchorynchus tshawytscha*) and rainbow trout (*Onchorynchus mykiss*) exposed to copper and cobalt: Behavioral avoidance. Environmental Toxicology and Chemistry 18:1972-1978.

Hansen, J.A., J.D. Rose, R.A. Jenkins, K.G. Gerow and H.L. Bergman. 1999b. Chinook salmon (*Onchorynchus tshawytscha*) and rainbow trout (*Onchorynchus mykiss*) exposed to copper and cobalt: Neurophysiological and histological effects on the olfactory system. Environmental Toxicology and Chemistry 18:1979-1991.

Hara, T.J., Y.M.C. Law and S. MacDonald. 1975. Effects of mercury and copper on the olfactory response in rainbow trout. Journal of the Fisheries Research Board of Canada 33:1568-1573.

Harrison, C.S. 1984. Terns Family Laridae Pages 146-160 in D. Haley, D. editor. Seabirds of eastern North Pacific and Arctic waters. Pacific Search Press. Seattle. 214 p.

Harrison, P. 1983. Seabirds: an Identification Guide. Houghton Mifflin Company. Boston. 448 pp.

Healey, M.C. 1983. Coastwide distribution and ocean migration patterns of stream- and ocean type Chinook salmon, *Oncorhynchus tshawytscha*. Canadian Field-Naturalist 97:427-433.

Healey, M.C. 1986. Optimum size and age at maturity in Pacific salmon and effects of size selective fisheries. Canadian Special Publication on Fisheries and Aquatic Sciences 89:39-52.

Healey, M.C. 1991. Life history of Chinook salmon (*Oncorhynchus tshawytscha*). Pages 311-393 *In:* Groot, C. and L. Margolis (editors). 1991. Pacific salmon life histories. Vancouver, British Columbia: University of British Columbia Press.

Hebdon, J. L., M. Elmer, and P. Kline 1999. Snake River sockeye salmon captive broodstock program research element. Annual Progress Report January 1, 1999–December 31, 1999. Report to Bonneville Power Administration, Contract No. 00000167-00001, Project No. 199107200, 56 electronic pages (BPA Report DOE/BP-00000167-1). Available online at:http://www.efw.bpa.gov/Environment/EW/EWP/DOCS/REPORTS/HATCHERY/A00000167-1.pdf

Heiser, D.W. and E.L. Finn Jr. 1970. Observations of juvenile chum and pink salmon in marina and bulkheaded areas. Washington Department of Fisheries Management and Research Division. 28p.

Helfman, G.S. 1981. The advantage to fishes of hovering in shade. Copeia. 1981(2):392-400.

Herke, W.H. and B.D. Rogers. 1993. Maintenance of the estuarine environment. Pages 263-286 in C.C. Kohler and W.A. Hubert, editors. Inland fisheries management in North America. American Fisheries Society, Bethesda, Maryland.

Hicks, B.J., J.D. Hall, P.A. Bisson and J.R. Sedell. 1991. Responses of salmonids to habitat changes. American Fisheries Society Special Publication 19:483-518.

Hingston, J.A., C.D. Collins, R.J. Murphy, and J.N. Lester. 2001. Leaching of chromated copper aresenate wood preservatives: A review. Environmental Pollution 111:53-66.

Hobson, E.S. 1979. Interactions between piscivorous fishes and their prey. Pages 231-242 *in* R. H. Stroud and H. Clepper, editors. Predator-Prey Systems in Fisheries Management. Sport Fishing Institute, Washington, D.C.

Hogan, D.L. and B.R. Ward. 1997. Watershed geomorphology and fish habitat. Chapter 2 *In:* Slaney, P.A. and Zaldokas, D. (editors) 1997. Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No. 9. British Columbia Ministry of Environment, Lands and Parks. Vancouver, British Columbia.

Hollender, B.A. and R.F. Carline. 1994. Injury to wild brook trout by backpack electrofishing. North American Journal of Fisheries Management 14:643-649.

Hoss, D.E. and G.W. Thayer. 1993. The importance of habitat to the early life history of estuarine dependent fishes. American Fisheries Society Symposium 14:147-158.

House, R. 1996. An evaluation of stream restoration structures in a coastal Oregon stream, 1981-1993. North American Journal of Fisheries Management 16:272-281.

Howick, G.L. and W.J. O'Brien. 1983. Piscivorous feeding behavior of largemouth bass: an experimental analysis. Transactions of the American Fisheries Society 112:508-516.

Hubble, J. and S. Crampton. 2000. Methow basin spring Chinook spawner ground survey report for 1999. Fisheries Resource Management Program. Yakama Nation. Prepared for Douglas County Public Utility District 17 pp + tables.

IDFG (Idaho Department of Fish and Game). 1994. Documents submitted to the ESA Administrative Record for west coast steelhead by E. Leitzinger, 18 October 1994. Available from Environmental and Technical Services Division, National Marine Fisheries Service, 525 NE Oregon Street, Suite 500, Portland, Oregon 97232.

Irving J.S. and T. Bjornn. 1991. A forecast of abundance of Snake River fall Chinook salmon. Prepared for U.S. Fish & Wildlife Service. Unpubl. MS. 55 p. Available from Idaho Cooperative Fishery Research Unit. University of Idaho, Moscow, Idaho.

Johnson, L. 2000. An analysis in support of sediment quality thresholds for polycyclic aromatic hydrocarbons (PAHs) to protect estuarine fish. White Paper from National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. 29 p.

Johnson, L.L., T.K. Collier and J.E. Stein. 2002. An analysis in support of sediment quality thresholds for polycyclic aromatic hydrocarbons (PAHs) to protect estuarine fish. Aquatic Conservation: Marine and Freshwater Ecosystems 12:517-538.

Johnson, O. W., T. A. Flagg, D. J. Maynard, G. B. Milner, and F. W. Waknitz. 1991. Status review for lower Columbia River coho salmon. U.S. Department of Commerce, NOAA Technical Memorandum NMFS F/NWC-202, 94 p.

Johnson, L., S.Y. Sol, G.M. Ylitalo, T. Hom, B. French, O.P. Olson, and T.K. Collier. 1999. Reproductive injury in English sole (*Pleuronectes vetulus*) from the Hylebos Waterway, Commencement Bay, Washington. Journal of Aquatic Ecosystem Stress and Recovery. 6:289-310.

Johnson, O.W., W.S. Grant, R.G. Cope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-32, 280 p.

Julliard, A.K., D. Saucier and L. Astic. 1996. Time-course of apoptosis in the olfactory epithelium of rainbow trout exposed to a low copper level. Tissue Cell 28:367-377.

Kauffman, J.B., R.L. Beshta, N. Otting and D. Lytjen. 1997. An ecological perspective of riparian and stream restoration in the western United States. Fisheries, 22(5)12-23.

Keevin, T.M.. 1998. A review of natural resource agency recommendations for mitigating the impacts of underwater blasting. Rev. Fish. Sci. 6(4):281-313.

Kershner, J.L., H.L. Forsgren and W.R. Meehan. 1991. American Fisheries Society Special Publication 19:599-606.

Kesner, W.D., and R.A. Barnhart. 1972. Characteristics of the fall-run steelhead trout *(Salmo gairdneri gairdneri*) of the Klamath River system with emphasis on the half-pounder. California Fish and Game 58(3):204-220.

Kirn, R.A., R.D. Ledgerwood and A.L. Jensen. 1986. Diet of subyearling Chinook salmon (*Oncorhynchus tshawytscha*) in the Columbia River estuary and changes effected by the 1980 eruption of Mount St. Helens. Northwest Science 60:191-195.

Kline, P.A., and C. Willard. 2001. Snake River sockeye salmon captive broodstock program hatchery element. Annual Progress Report January 1, 2000 - December 31, 2000. Report to Bonneville Power Administration, Contract No. 00000167, Project No. 199107200, 42 electronic pages. (BPA Report DOE/BP-00000167-2) Available online at:http://www.efw.bpa.gov/Environment/EW/EWP/DOCS/REPORTS/HATCHERY/A00000167-2.pdf

Knudsen, F.R., C.B. Schreck, S.M. Knapp, P.S. Enger, and O. Sand. 1997. Infrasound produces flight and avoidance responses in Pacific juvenile salmonids. Journal of Fish Biology, 51:824-829.

Kohler, A., R. Griswold, and D. Take, Snake River sockeye salmon habitat and limnological research. Project No. 9107-100, 97 electronic pages, (BPA Report DOE/BP-00004343-3). Available online at: http://www.efw.bpa.gov/ Environment/EW/EWP/DOCS/REPORTS/ HABITAT/H00004343-3.pdf

Kondolf, G.M., R. Kattlemann, M. Embury, and D.C. Erman. 1996. Status of riparian habitat. Pages 1009-1029 in Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, assessments and scientific basis for management options. University of California, Davis, Centers for Water and Wildland Resources.

Kostow, K. 2003. The biological implications of non-anadromous *Oncorhynchus mykiss* in Columbia basin steelhead ESUs. Report to NOAA Fisheries & ODFW. Draft report to NMFS (January 13, 2003) 90 p.

Krohn, W.B., R.B. Allen, J.R. Moring and A.E. Hutchinson. 1995. Double-crested cormorants in New England; population and management histories. Pages 99-109 in The Double-crested Cormorant: biology, conservation and management (D.N. Nettleship and D.C. Duffy, editors) Colonial Waterbirds 18 (Special Publication 1).

Larkin, P.A. 1979. Predator-prey relations in fishes: an overview of the theory. Pages 13-22 in R.H. Stroud and H. Clepper, editors. Predator-prey systems in fisheries management. Sport Fishing Institute, Washington D.C.

Larson, K.W., and C.E. Moehl. 1990. Entrainment of Anadromous Fish by Hopper Dredge at the Mouth of the Columbia River. in Effects of Dredging on Anadromous Pacific Coast Fishes, edited by C.A. Simenstad. Washington Sea Grant program, University of Washington, Seattle. 160 p.

Laufle, J.C., G.B. Pauley, and M.F. Shepard. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest): coho salmon. U.S. Fish and Wildlife Service Biological Report 82(11.48), 18 p.

Lawson, P.W. 1993. Cycles in ocean productivity, trends in habitat quality, and the restoration of salmon runs in Oregon. Fisheries (Bethesda) 18(8):6-10.

Lebow, S. 1996. Leaching of wood preservative components and their mobility in the environment—Summary of pertinent literature. . U.S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. 36 p. http://www.fpl.fs.fed.us/documnts/fplgtr/fplgtr93.pdf

Lebow, S. 2004a. Alternatives to chromated copper arsenate (CCA) for residential construction. Pages 156-168 in Pre-Conference Proceedings, Environmental Impacts of Preservative-Treated Wood. Florida Center for Solid and Hazardous Waste Management, Gainesville, Florida. http://www.ccaresearch.org/Pre-Conference/#release

Lebow, S. 2004b. Variability in evaluating environmental impacts of treated wood. Pages 3-16 in Pre-Conference Proceedings, Environmental Impacts of Preservative-Treated Wood. Florida Center for Solid and Hazardous Waste Management, Gainesville, Florida. http://www.ccaresearch.org/Pre-Conference/#release

Lebow, S., P. Cooper and P. Lebow. 2004. Variability in evaluating environmental effects of treated wood. Pages in Pre-Conference Proceedings, Environmental Impacts of Preservative-Treated Wood. Florida Center for Solid and Hazardous Waste Management, Gainesville, Florida. http://www.ccaresearch.org/Pre-Conference/#release

Lebow, S.T., and M. Tippie. 2001. Guide for minimizing the effect of preservative-treated wood on sensitive environments. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. 18 p. http://www.fpl.fs.fed.us/documnts/fplgtr/fplgtr122.pdf

Lloyd, D.S. 1987. Turbidity as a Water Quality Standard for Salmonid Habitats in Alaska. North American Journal of Fisheries Management 7:34-45.

Lloyd, D.S., J.P. Koenings, and J.D. LaPerriere. 1987. "Effects of Turbidity in Fresh Waters of Alaska." North American Journal of Fisheries Management 7: 18-33.

Lockwood, J.C. 1990. Seagrass as a consideration in the site selection and construction of marinas. Environmental Management for Marinas Conference, September 5-7, 1990, Washington D.C. Technical Reprint Series, International Marina Institute, Wickford, Rhode Island.

Longmuir, C., and T. Lively. 2001. Bubble curtain systems for use during marine pile driving. Report by Fraser River Pile & Dredge Ltd., New Westminster, British Columbia. 9 pp.

Mallet, J. 1974. Inventory of salmon and steelhead resources, habitats, use and demands. Job Performance Report. Project F-58-R-1. Idaho Department of Fish and Game. Boise. Idaho.

Mason, J.C. and D.W. Chapman. 1965. Significance of early emergence, environmental rearing capacity, and behavioral ecology of juvenile coho salmon in stream channels. Journal of the Fisheries Research Board of Canada 22:173-190.

Matthews, G.M. and R.S. Waples. 1991. Status review for Snake River spring and summer Chinook salmon. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-F/NWC-200, 75 p.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42, Seattle, Washington, 156 p.

McEwan, D., and T.A. Jackson. 1996. Steelhead restoration and management plan for California. California Dep. Fish Game, 234 p. Available from California Department of Fish and Game, Inland Fisheries Division, 1416 Ninth Street, Sacramento, California 95814.

McGraw, K.A. and D.A. Armstrong. 1990. Fish entrainment by dredges in Grays Harbor, Washington. Pages 113-131 in Effects of dredging on anadromous Pacific coast fishes. C.A. Simenstad, editor. Washington Sea Grant. Seattle, Washington.

McLeay, D.J., G.L. Ennis, I.K. Birtwell, and G.F. Hartman. 1984. "Effects On Arctic Grayling (Thymallus arcticus) of Prolonged Exposure to Yukon Placer Mining Sediment: A Laboratory Study." Canadian Technical Report of Fisheries and Aquatic Sciences 1241.

McLeay, D. J., I. K. Birtwell, G. F. Hartman, and G. L. Ennis. 1987. "Responses of Arctic Grayling (Thymallus arcticus) To Acute and Prolonged Exposure to Yukon Placer Mining Sediment." Canadian Journal of Fisheries and Aquatic Sciences 44: 658-673.

McPhail, J.D., and C.C. Lindsey. 1970. Freshwater fishes of Northwestern Canada and Alaska. Bulletin of the Fisheries Research Board of Canada 173:381.

Mesing, C.L. and A.M. Wicker. 1986. Home range, spawning migrations, and homing of radio-tagged Florida largemouth bass in two central Florida lakes. Transactions of the American Fisheries Society 115:286-295.

Metcalfe, N.B., S.K. Valdimarsson and N.H.C. Fraser. 1997. Habitat profitability and choice in a sit-and-wait predator: juvenile salmon prefer slower currents on darker nights. Journal of Animal Ecology 66:866-875.

Miller, R.J., and E.L. Brannon. 1982. The origin and development of life-history patterns in Pacific salmon. *In* E.L. Brannon and E.O. Salo (eds), Proceedings of the Salmon and Trout Migratory Behavior Symposium., p. 296-309. University of Washington Press, Seattle, Washington.

Mitsch, W.J. 1996. Ecological engineering: A new paradigm for engineers and ecologists. Pages 111-128 *in* P.C. Schulze, editor. Engineering within ecological constraints. National Academy of Engineering, National Academy Press, Washington, D.C.

Mitsch, W.J. and R.F. Wilson. 1996. Improving the success of wetland creation and restoration with know-how, time and self-design. Ecological Applications 6(1)77-83.

Moran, D.T., J.C. Rowley, G.R. Aiken and B.W. Jafek. 1992. Ultrastructural neurobiology of the olfactory mucosa of the brown trout, *Salmo trutta*. Microscopy Research and Technique 23:28-48.

Morton, J.W. 1977. Ecological effects of dredging and dredge spoil disposal: a literature review. U.S. Fish and Wildlife Service Technical Paper No. 94. 33 p.

Mosey, T.R. and L.J. Murphy. 2002. Spring and summer spawning ground surveys on the Wenatchee River basin, 2001. Washington Dept. of Fish & Wildlife Rept. to Chelan County Public Utility District 35 pp + appendices.

Mueller, G. 1980. Effects of recreational river traffic on nest defense by longear sunfish. Transactions of the American Fisheries Society 109: 248-251.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-35, 443 p.

Myers, J.M., C. Busack, D. Rawding, and A. Marshall. 2002. Identifying historical populations of Chinook and chum salmon and steelhead within the lower Columbia River and upper Willamette River evolutionary significant units. Draft report to the co-managers from the Willamette/Lower Columbia River Technical Recovery Team. (10 May 2002).

Naiman, R.J., H. DeCamps, and M. Pollock. 1993. The role of riparian corridors in maintaining regional biodiversity. Ecological Applications, 3(2):209-212.

National Research Council. 1996. *Upstream—Salmon and Society in the Pacific Northwest*. National Academy Press, Washington, D.C.

Neave, F. 1961. Pacific salmon: Ocean stocks and fishery developments. Proceedings of the 9th Pacific Science Congress 1957(10):59-62.

Nedwell, J., and B. Edwards. 2002. Measurements of underwater noise in the Arun River during piling at County Wharf, Littlehampton. Report by Subacoustech, Ltd to David Wilson Homes, Ltd.

Nelson, W. 1997. Restoration strategies for the Umpqua basin. Pages 125-128 in J.D. Hall, P.A. Bisson, and R.E. Gresswell, editors. Sea-run cutthroat trout: biology, management, and future conservation. Oregon Chapter, American Fisheries Society, Corvallis.

Newcombe, C.P., and D.D. MacDonald. 1991. “Effects of Suspended Sediments on Aquatic Ecosystems.” North American Journal of Fisheries Management 11: 72-82.

Nickelson T. and P. Lawson. 1998. Population viability of coho salmon *Oncorhynchus kisutch* in Oregon coastal basins: Application of a habitat-based life cycle model. Canadian Journal of Fisheries and Aquatic Sciences 55: 2383-2392.

NMFS (National Marine Fisheries Service). 1987. Endangered and threatened species; winter run Chinook salmon. Federal Register [Docket No. 27 February 1986] 52(39):6041-6048.

NMFS (National Marine Fisheries Service). 1990. STATUS REVIEW: Listing Endangered and Threatened Species; Notice of Status Review for Sockeye Salmon (*Oncorhynchus nerka*). Federal Register [April 9, 1990] 55(68):13181-13182.

NMFS (National Marine Fisheries Service). 1991a. PROPOSED RULE: Endangered and Threatened Species; Proposed Endangered Status for Snake River Sockeye Salmon. Federal Register [Docket 910379-107, April 5, 1991] 56(66):14055-14067.

NMFS (National Marine Fisheries Service). 1991b. FINAL RULE: Endangered and Threatened Species; Endangered Status for Snake River Sockeye Salmon. Federal Register [Docket 910379-1256, November 20, 1991] 56(224):58619-58624.

NMFS (National Marine Fisheries Service). 1993. Endangered and threatened species; Illinois River winter steelhead in Oregon. Federal Register [Docket 930517-3117, 20 May 1993] 58(96): 29390-29392.

NMFS (National Marine Fisheries Service). 1995a. Proposed recovery plan for Snake River Salmon. 364 p. + app. Available from Environmental and Technical Services Division, Natl. Mar. Fish. Serv., 525 NE Oregon St., Suite 500, Portland, OR 97232.

NMFS (National Marine Fisheries Service). 1995b. Federal Register Vol. 60, No. 74, [I.D. 040795A] Endangered and Threatened Wildlife and Plants; Notice of Availability of a Proposed Recovery Plan for Review and Comment; Public Hearings. April 18, 1995. p. 19388.

NMFS (National Marine Fisheries Service). 1996a. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. National Marine Fisheries Service, Environmental and Technical Services Division, Habitat Conservation Branch, Portland, Oregon August 1996).

NMFS (National Marine Fisheries Service). 1996b. Supplemental report of the Biological Review Team on central California coast coho salmon. Memorandum from M. Schiewe to W. Stelle, dated 17 October, 1996, 4 p. Available from Environmental and Technical Services Division, Natl. Mar. Fish. Serv., 525 NE Oregon Street, Portland, Oregon 97232.

NMFS (National Marine Fisheries Service). 1996c. Status review update for coho salmon from Washington, Oregon, and California. Draft document prepared by the West Coast Coho salmon Biological Review Team, 20 December 1996, 47 p. plus tables, figures and appendices.

NMFS (National Marine Fisheries Service). 1997a. Status review update for coho salmon from the Oregon and Northern California coasts. West Coast coho salmon Biological Review Team, 28 Mar. 1997. 70 p. + appendices.

NMFS (National Marine Fisheries Service). 1997b. Status Review Update for West Coast Steelhead from Washington, Idaho, Oregon, and California. Memorandum from the Biological Review Team to the NMFS Northwest Regional Office. July 7, 1997, 72 p.

NMFS (National Marine Fisheries Service). 1998a. Conclusions regarding the updated status of Puget Sound, Lower Columbia River, Upper Willamette River, and Upper Columbia River spring-run ESUs of West Coast Chinook Salmon. Memorandum to U. Varanasi (Northwest Fisheries Science Center, NMFS), W. Stelle (NWFSC, NMFS), and W. Hogarth (Southwest Fisheries Science Center, NMFS) from M. Schiewe (Northwest Fisheries Science Center, NMFS), 12 February 1999. 62 p.

NMFS (National Marine Fisheries Service). 1998b. Endangered and threatened species: Proposed threatened status and designated critical habitat for Hood Canal summer-run chum salmon and Columbia River chum salmon. Federal Register [Docket 980219043-8043-01, No. 011498B. 10 March 1998] 63(46):11774-11795.NMFS 1998

NMFS (National Marine Fisheries Service). 1998c. PROPOSED RULE: Endangered and threatened species: Proposed threatened status and designated critical habitat for Ozette Lake, Washington sockeye salmon. Federal Register [Docket 980219043-8043-01, March 10, 1998] 63(46):11750-11771.

NMFS (National Marine Fisheries Service). 1998d. Status review update for deferred and candidate ESUs of west coast steelhead (Lower Columbia River, Upper Willamette River, Oregon Coast, Klamath Mountains Province, Northern California, Central Valley, and Middle Columbia River ESUs). Pre-decisional ESA document, National Marine Fisheries Service.

NMFS (National Marine Fisheries Service). 1998e. Factors contributing to the decline of Chinook salmon: an addendum to the 1996 West Coast steelhead factors for decline report. Protected Resource Division, National Marine Fisheries Service, Portland, Oregon. 70 p.

NMFS (National Marine Fisheries Service). 1999a. Status review update for deferred ESUs of West Coast Chinook salmon (*Oncorhynchus tshawytscha*) from Washington, Oregon, California, and Idaho. Memorandum to U. Varanasi (Northwest Fisheries Science Center, NMFS) and M. Tillman (Southwest Fisheries Science Center, NMFS) from M. Schiewe (Northwest Fisheries Science Center, NMFS), 16 July 1999. 116 p.

NMFS (National Marine Fisheries Service). 1999b. Endangered and threatened species: Threatened status for two ESUs of chum salmon in Washington and Oregon. [Docket 980219042-9069-02, No. 011498B. 25 March 1999] 64(57):14508-14517.NMFS 1999

NMFS (National Marine Fisheries Service). 1999c. Status review update for sockeye salmon from Ozette Lake and Baker River, Washington. Memo from Memorandum thru U. Varanasi (Northwest Fisheries Science Center, NMFS), to W. Stelle (NWFSC, NMFS), and W. Hogarth (Southwest Fisheries Science Center, NMFS) from M. H. Schiewe (Northwest Fisheries Science Center, NMFS), 17 December 1998. 40 p. + cover letter.

NMFS (National Marine Fisheries Service). 1999d. FINAL RULE: Endangered and Threatened Species; Threatened Status for Ozette Lake Sockeye Salmon in Washington. Federal Register [Docket 980219043–9068–02, March 25, 1999] 64(57):14528-14536.

NMFS (National Marine Fisheries Service). 1999e. Updated Review of the Status of the Upper Willamette River and Middle Columbia River ESUs of Steelhead. Memorandum for W. Stelle and W. Hogarth from M. Schiewe. January 12, 1999, 49 p.

NMFS (National Marine Fisheries Service). 1999f. The Habitat Approach: Implementation of section 7 of the Endangered Species Act for actions affecting the habitat of Pacific Anadromous Salmonids. Northwest Region Habitat Conservation and Protected Resources Divisions, Portland, Oregon. 12 p. (August 26, 1999)

NMFS (National Marine Fisheries Service). 2000. Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act. Protected Resources Division, NMFS, Portland, Oregon. (June 2000)

NMFS (National Marine Fisheries Service). 2001a. Status review update for Lower Columbia River Coho Salmon. West Coast coho salmon Biological Review Team, May 2001. 67 p.

NMFS (National Marine Fisheries Service). 2001b. Guidelines for salmonid passage at stream crossings. NMFS, Southwest Region, Habitat Conservation Division, Long Beach, California. 33 p. (September 2001)

NMFS (National Marine Fisheries Service). 2002a. Memorandum for Frank L. Cassidy, Jr. (Northwest Power Planning Council) from Bob Lohn (NMFS), April 2002. Available at http://www.nwr.noaa.gov/occd/InterimTargets.pdf

NMFS (National Marine Fisheries Service). 2002b. Biological Opinion on the Collection, Rearing, and Release of Salmonids Associated with Artificial Propagation Programs in the Middle Columbia River Steelhead Evolutionarily Significant Unit (ESU). NMFS, Protected Resources Division, Portland, Oregon. (February 14, 2002)

NOAA (National Oceanic and Atmospheric Administration). 1999. NOAA Screening Quick Reference Tables (SQuiRTs) for Inorganics in Solids (freshwater and marine sediment, plus soil) (revised October 1999) http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

NOAA Fisheries. 2001. Programmatic Biological Opinion – 15 Categories of Activities Requiring Department of the Army Permits. NMFS, Habitat Conservation Division, Portland, Oregon. (March 21, 2001)

NOAA (National Ocean and Atmospheric Administration) 2003. Environmental and aesthetic impacts of small docks and piers – Workshop report: Developing a science-based decision support tool for small dock management, Phase 1: Status of the science. R. Kelty and S. Bliven (editors). NOAA Coastal Ocean Program Decision Analysis Series No.22. http://www.cop.noaa.gov/pubs/das.html

Nordstrom, K.F. 1989. Erosion control strategies for bay and estuarine beaches. Coastal Management 17:25-35.

NRC (National Research Council). 1996. Upstream—Salmon and Society in the Pacific Northwest. National Academy Press, Washington, D.C. 452 p.

ODFW (Oregon Department of Fish and Wildlife). 1991. Grand Ronde River subbasin salmon and steelhead plan. Prepared for Northwest Power Planning Council. 129 pp.

ODFW (Oregon Department of Fish and Wildlife). 1995. Oregon coho salmon biological status assessment and staff conclusions for listing under the Oregon Endangered Species Act. Oregon Department of Fish and Wildlife, Portland, Oregon February 22, 1995. 59 p. Attachment to II-B-I to the Draft OCSRI Plan dated 8/20/96.

ODOT (Oregon Department of Transportation). 1999. Routine road maintenance: Water quality and habitat guide, best management practices. Oregon Department of Transportation, Salem, Oregon. 21 p.

ONRC (Oregon Natural Resources Council), Siskiyou Regional Education Project, Federation of Fly Fishers, Kalmiopsis Audubon Society, Siskiyou Audubon Society, Klamath/Siskiyou Coalition, Headwaters, The Wilderness Society, North Coast Environmental Center, Oregon Chapter of The Sierra Club, and The National Wildlife Federation. 1992. Petition for a rule to list the Illinois River winter steelhead as threatened or endangered under the Endangered Species Act and to designate critical habitat. Unpublished manuscript, 16 p. (Document submitted to USDOC NOAA NMFS Northwest Region, Seattle, Washington, May 1992).

Oregon Plan. 1997. Oregon Plan for Salmon and Watersheds (consisting of the Oregon Coastal Salmon Restoration Initiative, March 10, 1997 and as amended with the steelhead Supplement, December 1997). Governor's Natural Resources Office, State of Oregon, Salem.

Oregon Trout, Native Fish Society, Oregon Council of Trout Unlimited. 2000. Petition to list lower Columbia River coho salmon (*Oncorhynchus kisutch*) as endangered pursuant to the Endangered Species Act of 1973 as amended. Petition to Secretary of Commerce, Washington D.C., July 2000, 22 p.

Pacific Estuarine Research Laboratory. 1990. A manual for assessing restored and natural coastal wetlands with examples from southern California. California Sea Grant Report No. T-CSGCP-021. La Jolla, California.

Pacific Fisherman. 1928. Record chum caught off Quadra. Pac. Fisherman 1928(Oct.):13.

Palmisano, J.F. 1997. Oregon's Umpqua sea-run cutthroat trout: review of natural and human-caused factors of decline. Pages 103-118 *In:* J.D. Hall, P.A. Bisson, and R.E. Gresswell, editors. Sea-run cutthroat trout: biology, management, and future conservation. Oregon Chapter, American Fisheries Society, Corvallis.

Parente, W.D. and J.G. Smith. 1981. Columbia River Backwater Study Phase II. U.S. Dept of Interior. Fisheries Assistance Office. Vancouver, Washington. 87 pp.

Pearcy, W.G. 1992. Ocean ecology of north Pacific salmonids. University of Washington Press. 179 pp.

Pentec Environmental. 2003. Mukilteo Public Access Dock Pile Driving – Air Bubble Curtain and Acoustic Monitoring, Mukilteo, Washington. 18 p. + Figs. and Appendices .

Peters, D.S. and F.A. Cross. 1992. What is coastal fish habitat? Pages 17-22 in R.H. Stroud, editor Stemming the tide of coastal fish habitat loss. Proceedings of a symposium on conservation of coastal fish habitat. National Coalition for Marine Conservation, Inc., Savannah, Georgia.

Peters, R.J., B.R. Missildine, and D.L. Low. 1998. Seasonal Fish Densities near River Banks Stabilized with Various Stabilization Methods. First Year Report of the Flood Technical Assistance Project. U.S. Fish and Wildlife Service.

Petersen, J.M. and D.M. Gadomski. 1994. Light-Mediated Predation by Northern Squawfish on Juvenile Chinook Salmon. Journal of Fish Biology 45 (supplement A), 227-242.

Peterson, C.H., H.C. Summerson, and S.R. Fegley. 1987. Ecological consequences of mechanical harvesting of clams. Fishery Bulletin 85(2):281-298.

Pflug, D.E. and G.B. Pauley. 1984. Biology of Smallmouth Bass (*Micropterus dolomieui*) in Lake Sammamish, Washington. Northwest Science 58(2):119-130.

PFMC (Pacific Fishery Management Council), 1998a. Final Environmental Assessment/Regulatory Review for Amendment 11 to the Pacific Coast Groundfish Fishery Management Plan. October 1998.

PFMC (Pacific Fishery Management Council), 1998b. The Coastal Pelagic Species Fishery Management Plan: Amendment 8. Portland, Oregon.

PFMC (Pacific Fishery Management Council). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Portland, Oregon.

Phillips, R.C. 1984. The ecology of eelgrass meadows in the Pacific Northwest: a community profile. U.S. Fish and Wildlife Service. FWS/OBS-84/24. 85 pp.

Phillips, S.H. 1990. A guide to the construction of freshwater artificial reefs. Sportfishing Institute. Washington D.C. 24 pp.

Piper, K.L., J.C. Hoag, H.H. Allen, G. Durham, J.C. Fischenich, and R.O. Anderson. 2001. Bioengineering as a tool for restoring ecological integrity to the Carson River. ERDC TN-WRAP-01-05, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

Pitcher, T.J. 1986. Functions of shoaling in teleosts. *In* T.J. Fisher (editor). The Behavior of Teleost Fishes. Johns Hopkins University Press, Baltimore, Maryland, pp. 294-337.

Poe, T.P, H.C. Hansel, S. Vigg, D.E. Palmer, and L.A. Prendergast. 1991. Feeding of Predaceous Fishes on Out-Migrating Juvenile Salmonids in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:405-420.

Poston, T. 2001. Treated wood issues associated with overwater structures in marine and freshwater environments. Prepared for the Washington Departments of Fish and Wildlife, Ecology, and Transportation. Olympia, Washington.

Pritchard, A. L. 1940. Studies on the age of the coho salmon (Oncorhynchus kisutch) and the spring salmon (Oncorhynchus tschawytscha) in British Columbia. Transactions of the Royal Society of Canada, 34(V):99-120.

Raibley, P.T., K.S. Irons, T.M. O'Hara, and K.D. Blodgett. 1997. Winter habitats used by largemouth bass in the Illinois River, a large river-floodplain ecosystem. North American Journal of Fisheries Management 17:401-412.

Randall, R.G., M.C. Healey, and J.B. Dempson. 1987. Variability in length of freshwater residence of salmon, trout, and char. *In* M.J. Dodswell *et al*. (editors), Common Strategies of Anadromous and Catadromous Fishes. American Fisheries Society Symposia, Bethesda, Maryland 1:27-41.

Rawding, D. 2001. Simsam (Steelhead). Unpublished data and documentation sent from Dan Rawding (WDFW) to Paul McElhany on 5/16/2001 as Excel file and Word document, via e-mail.

Ray, D.K. and W.O. Woodroof. 1986. Approaches for restoring and recreating wetlands in California's coastal zone. Pages 392-402 in J.A. Kusler, M.L. Quammen and G. Brooks, editors Proceedings of the national wetlands symposium: mitigation of impacts and losses. Association of State Wetland Managers. Berne, New York.

Redding, J.M., C.B. Schreck, and F.H. Everest. 1987. Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids. Transactions of the American Fisheries Society 116: 737-744.

Reeves, G. H., F. H. Everest, and T. E. Nickelson. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, Oregon, 18 p.

Reeves, G.H., J.D. Hall, T.D. Roelofs, T.L. Hickman, and C.O. Baker. 1991. Rehabilitating and modifying stream habitats. American Fisheries Society Special Publication 19:519-558.

Reyff, J.A. 2003. Underwater sound levels associated with seismic retrofit construction of the Richmond-San Rafael Bridge. Document in support of Biological Assessment for the Richmond-San Rafael Bridge Seismic Safety Project. January, 31, 2003. 18 pp.

Reyff, J.A and P. Donovan. 2003. Benicia-Martinez Bridge Bubble Curtain Test - Underwater Sound Measurement Data. Memo to Caltrans dated January 31, 2003. 3 pp.

Ricker, W.E. 1938. "Residual" and kokanee salmon in Cultus Lake. Journal of the Fish and Research Board of Canada 4(3):192-218.

Rieman, B.E. and R.C. Beamesderfer. 1991. Estimated Loss of Juvenile Salmonids to Predation by Northern Squawfish, Walleyes, and Smallmouth Bass in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:448-458.

Rieman, B. E., D. L. Myers, and R. L. Nielsen. 1994. Use of otolith microchemistry to discriminate Oncorhynchus nerka of resident and anadromous origin. Canadian Journal of Fisheries and Aquatic Sciences 51:68-77.

Risser, P.G. (Chair, State of the Environment Science Panel) *Oregon State of the Environment Report 2000*, Oregon Progress Board, Salem, Oregon, 214 pp. (September 2000).

Ritter, M.A., J.A. Kainz, and G.J. Porter. 1996a. Field performance of timber bridges: 5. Little Salmon Creek stress-laminated deck bridge. U. S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. Research Paper FPL-RP-547. 15 p. http://216.48.37.142/pubs/viewpub.jsp?index=5876

Ritter, M.A., P.D.H. Lee, and G.J. Porter. 1996b. Field performance of timber bridges: 6. Hoffman Run stress-laminated deck bridge. U. S. Department of Agriculture, Forest Service, Forest Products Laboratory, Madison, Wisconsin. Research Paper FPL-RP-549. 16 p. http://216.48.37.142/pubs/viewpub.jsp?index=5877

Roelofs, T.D. 1983. Current status of California summer steelhead (*Salmo gairdneri*) stocks and habitat, and recommendations for their management. Submitted to USDA Forest Service, Region 5, 77 p. Available from Environmental and Technical Services Division, National Marine Fisheries Service, 525 NE Oregon Street, Suite 500, Portland, OR 97232.

Rogers, P.H. and M. Cox. 1988. Underwater sound as a biological stimulus. pp. 131-149 *in*: Sensory biology of aquatic animals. Atema, J, R.R. Fay, A.N. Popper and W.N. Tavolga (editors). Springer-Verlag. New York.

Roper, B.B., J.J. Dose and J.E. Williams. 1997. Stream restoration: Is fisheries biology enough? Fisheries 22(5):6-11.

Rosgen, D.L. undated. The cross-vane, w-weir, and j-hook vane structures . . . their description, design and application for stream stabilization and river restoration. Wildland Hydrology, Pagosa Springs, Colorado. (http://www.wildlandhydrology.com/assets/cross-vane.pdf)

Rumrill, S.S. and C.E. Cornu. 1995. South Slough coastal watershed restoration a case study in integrated ecosystem restoration. Restoration and Management Notes 13:1 pages 53-57.

Salo, E.O. 1991. Life history of chum salmon (*Oncorhynchus keta*). Pages 231-309 *In:* Groot, C. and L. Margolis (editors). 1991. Pacific salmon life histories. Vancouver, British Columbia: University of British Columbia Press.

Sand, O., P.S. Enger, H.E. Karlsen, F. Knudsen, T. Kvernstuen. 2000. Avoidance responses to infrasound in downstream migrating European silver eels, Anguilla anguilla. Environmental Biology of Fishes, 57:327-336.

Sandercock, F.K. 1991. Life history of coho salmon (*Oncorhynchus kisutch*). Pages 395-445 *In:* Groot, C. and L. Margolis (editors). 1991. Pacific salmon life histories. Vancouver, British Columbia: University of British Columbia Press.

Scannell, P.O. 1988. Effects of Elevated Sediment Levels from Placer Mining on Survival and Behavior of Immature Arctic Grayling. Alaska Cooperative Fishery Unit, University of Alaska. Unit Contribution 27.

Servizi, J.A. 1988. Sublethal effects of dredged sediments on juvenile salmon. Pages 57-63 *In:* C. A. Simenstad (editor) Effects of dredging on anadromous Pacific coast fishes. Washington Sea Grant Program. Washington State University. Seattle, Washington.

Servizi, J. A., and Martens, D. W. 1991. Effects of temperature, season, and fish size on acute lethality of suspended sediments to coho salmon. Canadian Journal of Fisheries and Aquatic Sciences 49:1389-1395.

Sigler, J.W. 1988. Effects of chronic turbidity on anadromous salmonids: recent studies and assessment techniques perspective. Pages 26-37 *in* C. A. Simenstad, editor. Effects of Dredging on Anadromous Pacific Coast Fishes. Washington Sea Grant Program, Washington State University, Seattle.

Sigler, J.W., T.C. Bjornn, and F.H. Everest. 1984. Effects of Chronic Turbidity on Density and Growth of Steelheads and Coho Salmon. Transactions of the American Fisheries Society 113:142-150.

Simenstad, C.A. 1994. pages 11-19 in Wyllie-Echeverria, S., A.M. Olson and M.J. Hershman (editors), Seagrass science and policy in the Pacific Northwest: proceedings of a seminar series (SMA 94-1) EPA 910/R-94-004. 63 pp.

Simenstad, C.A., K.L. Fresh, and E.O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. Pages 343-364 in Estuarine Comparisons. Academic Press, Inc.

Simenstad, C.A., C.D. Tanner, F. Weinmann, and M. Rylko. 1991. The estuarine habitat assessment protocol. Puget Sound Notes. No. 25 June 1991.

Simenstad, C.A., J.R. Cordell, W.G. Hood, B.E. Feist, and R.M. Thom. 1997. Ecological status of a created estuarine slough in the Chehalis River estuary: assessment of created and natural estuarine sloughs, January-December 1995. FRI-UW-9621, Fisheries Research Institute, University of Washington, Seattle, Washington. 47 pp.

Simenstad, C.A. and R.M. Thom. 1996. Functional equivalency trajectories of the restored Gog-Le-Hi-Te estuarine wetland. Ecological Applications, 6(1)38-56.

Slaney, P.A. and A.D. Martin. 1997. Planning fish habitat rehabilitation: linking to habitat protection. Chapter One *In:* Slaney, P.A. and Zaldokas, D. (editors) 1997. Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No. 9. British Columbia Ministry of Environment, Lands and Parks. Vancouver, British Columbia.

Snyder, J.O. 1925. The half-pounder of Eel River, a steelhead trout. California Fish and Game 11(2):49- 55.

Sogard, S.M. and K.W. Able. 1991. A comparison of eelgrass, sea lettuce macroalgae and marsh creeks as habitats for epibenthic fishes and decapods. Estuarine, Coastal and Shelf Science. 33:501-519.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. ManTech Environmental Research Services, Inc., Corvallis, Oregon, to National Marine Fisheries Service, Habitat Conservation Division, Portland, Oregon (Project TR-4501-96-6057).

Stehr, C.M., D.W. Brown, T. Hom, B.F. Anulacion, W.L. Reichert, and T.K. Collier. 2000. Exposure of juvenile Chinook and chum salmon to chemical contaminants in the Hylebos Waterway of Commencement Bay, Tacoma, Washington. Journal of Aquatic Ecosystem Stress and Recovery 7:215-227.

Steinke, T.J. 1986. Hydrologic manipulation and restoring wetland values: Pine Creek, Fairfield, Connecticut. Pages 377-383 in J.A. Kusler, M.L. Quammen and G. Brooks, editors Proceedings of the national wetlands symposium: mitigation of impacts and losses. Association of State Wetland Managers. Berne, New York.

Stickney, R.R. 1973. Effects of hydraulic dredging on estuarine animal studies. World Dredging Marine Construction, 34-37.

Stilwell, D.E. and C.L, Musante. 2004. Effect of coatings on CCA leaching from treated wood in a soil environment. Pages 113 - 123 in Pre-Conference Proceedings, Environmental Impacts of Preservative-Treated Wood. Florida Center for Solid and Hazardous Waste Management, Gainesville, Florida. http://www.ccaresearch.org/Pre-Conference/#release

Stotz, T. and J. Colby. 2001. January 2001 dive report for Mukilteo wingwall replacement project. Washington State Ferries Memorandum. 5 pp. + appendices.

Thayer, G.W., W.J. Kenworthy and M.S. Fonseca. 1984. The ecology of eelgrass meadows of the Atlantic coast: a community profile. U.S. Fish and Wildlife Service FWS/OBS-84/02. 147 pp.

Tutty, B.D. 1976. Assessment of techniques used to quantify salmon smolt entrainment by a hydraulic suction hopper dredge in the Fraser River estuary. Fisheries and Marine Service, Environment Canada. Technical Report, Series No. PAC/T-76-16.

USACE (U.S. Army Corps of Engineers), U.S. Environmental Protection Agency, Oregon Department of Environmental Quality, and Washington Department of Natural Resources. 1998. Dredged Material Evaluation Framework: Lower Columbia River Management Area.

USEPA (U.S. Environmental Protection Agency). 1993. Guidance specifying management measures for sources of nonpoint pollution in coastal waters. 840-B-92-002. EPA, Office of Water, Washington, D.C.

USEPA (U.S. Environmental Protection Agency). 1998. Rock barbs enhance fish habitat and water quality in Oregon's Tillamook Bay Watershed: Demonstrating practical tools for watershed management through the National Estuary Program. Coastlines Information About Estuaries and Near Coastal Waters, Volume 8, Number 2. U.S. Environmental Protection Agency, Office of Water. EPA842-F-98-003L. (Spring 1998)

Waknitz, F.W., G.M. Matthews, T. Wainwright, and G.A. Winans. 1995. Status review for Mid-Columbia River summer Chinook salmon. NOAA Technical Memorandum NMFS-NWFSC-22, 80 p.

Walters, D.A., W.E. Lynch, Jr., and D.L. Johnson. 1991. How depth and interstice size of artificial structures influence fish attraction. North American Journal of Fisheries Management 11:319-329.

Wanjala, B.S., J.C. Tash, W.J. Matter and C.D. Ziebell. 1986. Food and habitat use by different sizes of largemouth bass (*Micropterus salmoides*) in Alamo Lake, Arizona. Journal of Freshwater Ecology Vol. 3(3):359-368.

Waples, R.S. 1991. Pacific salmon, Oncorhynchus spp., and the definition of ‘species’ under the Endangered Species Act. Marine Fisheries Review 53(3):11-22.

Waples, R.S., R.P. Jones, Jr., B.R. Beckman, and G.A. Swan. 1991a. Status review for Snake River fall Chinook salmon. U.S. Department of Commerce, NOAA Technical Memorandum NMFS F/NWC-201. 73 p.

Waples, R.S., O.W. Johnson, and R.P. Jones, Jr. 1991b. Status review for Snake River sockeye salmon. . U.S. Department of Commerce, NOAA Technical Memorandum NMFS F/NWC-195. 23 p.

Waples, R.S., P.B. Aebersold and G.A. Winans. 1997. Population genetic structure and life history variability in *Oncorhynchus nerka* from the Snake River Basin. Final Report of Research. Bonneville Power Administration, Portland, Oregon 104 p.

Ward, D.L. (ed). 1992. Effects of waterway development on anadromous and resident fish in Portland Harbor. Final Report of Research. Oregon Department of Fish and Wildlife. 48 pp.

Ward, D.L. and A.A. Nigro. 1992. Differences in Fish Assemblages Among Habitats Found in the Lower Willamette River, Oregon: Application of and Problems With Multivariate Analysis. Fisheries Research 13:119-132.

Ward, D.L., A.A. Nigro, R.A. Farr, and C.J. Knutsen. 1994. Influence of Waterway Development on Migrational Characteristics of Juvenile Salmonids in the Lower Willamette River, Oregon. North American Journal of Fisheries Management 14:362-371.

Ward, D.L., C.J. Knutsen, and R.A. Farr. 1991. Status and biology of black crappie and white crappie in the lower Willamette River near Portland, Oregon. Oregon Department of Fish and Wildlife Fish Division Information Reports Number 91-3. Portland, Oregon. 17 pp.

Warren, C.E. 1971. Biology and water pollution control. W. B. Saunders Co., Philadelphia, Pennsylvania. 434 p.

Warrington, P.D. 1999a. Impacts of recreational boating on the aquatic environment. http://www.nalms.org/bclss/impactsrecreationboat.htm

Warrington, P.D1999b. Impacts of outboard motors on the aquatic environment. http://www.nalms.org/bclss/impactsoutboard.htm

WDFW, WDOT, WDOE, and USACE (Washington Department of Fish and Wildlife, Washington Department of Transportation, Washington Department of Ecology, and the U.S. Army Corps of Engineers). Integrated Streambank Protection Guidelines, various pagination (April 2003) (http://www.wdfw.wa.gov/hab/ahg/ispgdoc.htm)

Weis, J.S., P. Weis and T. Proctor. 1998. The extent of benthic impacts of CCA-treated wood structures in Atlantic Coast estuaries. Archives of Environmental Contamination and Toxicology 34:313-322.

Weis, J.S. and P. Weis. 2002. Contamination of saltmarsh sediments and biota by CCA treated wood walkways. Marine Pollution Bulletin 44:504-510.

Weis, J. and P. Weis. 2004. Effects of CCA wood on non-target aquatic biota. Pages 32 - 44 in Pre-Conference Proceedings, Environmental Impacts of Preservative-Treated Wood. Florida Center for Solid and Hazardous Waste Management, Gainesville, Florida. http://www.ccaresearch.org/Pre-Conference/#release

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon and California. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington.

Wentz, D.A., Bonn, B.A., Carpenter, K.D., Hinkle, S.R., Janet, M.L., Rinella, F.A., Uhrich, M.A., Waite, I.R., Laenen, A. and Bencala, K.E. 1998, Water Quality in the Willamette Basin, Oregon, 1991-95: U.S. Geological Survey Circular 1161 (updated June 25, 1998) http://water.usgs.gov/pubs/circ1161

Whitman, R.P., T.P. Quinn and E.L. Brannon. 1982. Influence of suspended volcanic ash on homing behavior of adult Chinook salmon. Transactions of the American Fisheries Society 113:142-150.

Williams, R.N, L.D. Calvin, C.C. Coutant, M.W. Erho, Jr., J.A. Lichatowich, W.J. Liss, W.E. McConnaha, P.R. Mundy, J.A. Stanford, R.R. Whitney, D.L. Bottom, and C.A Frissell. 1996. Return to the river: Restoration of salmonid fishes in the Columbia River ecosystem. Council Document 2000-12. Northwest Power Planning Council, Portland, Oregon.

Williamson, A.K., Munn, M.D., Ryker, S.J., Wagner, R.J., Ebbert, J.C., and A.M. Vanderpool. 1998. Water Quality in the Central Columbia Plateau, Washington and Idaho, 1992-95. U.S. Geological Survey Circular 1144.

Winans, G.A., P.B. Aebersold, and R.S. Waples. 1996. Allozyme variability of *Oncorhynchus nerka* in the Pacific Northwest, with special consideration to populations of Redfish Lake, Idaho. Transactions of the American Fisheries Society 125:645-663.

Winberg, S., R. Bjerselius, R. Baatrukp and K. Doving. 1992. The effect of Cu(II) on the electro-olfactogram (EOG) of the Atlantic salmon (*Salmo salar* L.) In artificial freshwater of varying inorganic carbon concentrations. Ecotoxicology and Environmental Safety 24:167-178.

Winfield, T.P. 1986. Off the rack buying or tailor-made fits: what's best for Pacific Coast coastal wetlands. Pages 410-413 in J.A. Kusler, M.L. Quammen and G. Brooks, editors Proceedings of the national wetlands symposium: mitigation of impacts and losses. Association of State Wetland Managers. Berne, New York.

Withler, R.E. 1988. Genetic consequences of fertilizing Chinook salmon (*Oncorhynchus tshawytscha*) eggs with pooled milt. Aquaculture 68: 15-25.

Wood, C.C. 1995. Life history variation and population structure in sockeye salmon. *In* J. L. Nielsen (editor), Evolution and the aquatic ecosystem: defining unique units in population conservation. American Fisheries Society Symposium 17:195-216.

Würsig, B., C.R. Greene, Jr., and T.A. Jefferson. 2000. Development of an air bubble curtain to reduce underwater noise from percussive piling. Marine Environmental Research 49: 19-93.

WWPI (Western Wood Preservers Institute). 1996. Best management practices for the use of treated wood in the aquatic environment (revised July 1996), at http://www.wwpinstitute.org/

Wyllie-Echeverria, S. and R.C. Phillips. 1994. Pages 1-4 in Wyllie-Echeverria, S., A.M. Olson and M.J. Hershman (eds), Seagrass science and policy in the Pacific Northwest: proceedings of a seminar series (SMA 94-1) EPA 910/R-94-004. 63 pp.

Zedler, J.B. 1996. Ecological issues in wetland mitigation: an introduction to the forum. Ecological Applications 6(1):33-37.

Zhou, S. and M. Chilcote. 2003. Stock assessment and population viability of Clackamas River coho salmon. Oregon Department of Fish and Wildlife Fish Division Information Report; Portland, Oregon. 35 p.

Zieman, J.C. 1976. The ecological effects of physical damage from motor boats on turtle grass beds in southern Florida. Aquatic Botany 2:127-139.

Appendix A

PROJECT NOTIFICATION FORM

INSTRUCTIONS

Before issuing a permit under the SLOPES Biological Opinion, issued on November 30, 2004, the Corps must submit a complete Project Notification Form, or its equivalent, with the following information to NOAA Fisheries at: slopes.nwr@noaa.gov

1. Date.

2. Corps Action ID.

3. Applicant.

4. Location, including any compensatory mitigation site (County and 5th field HUC).

5. Project Description.

6. Corps contact.

7. Project.

8. Type of activity.

9. Proposed start and end dates.

10. Is the project area within the present or historic range of ESA-listed salmon or steelhead or a designated critical habitat, or otherwise likely to adversely affect likely to an ESA-listed salmon or steelhead or a designated critical habitat? YES NO

11. Was the project individually reviewed to ensure that all adverse effects to ESA-listed salmon and steelhead and their designated critical habitats are within the range of effects considered in the Opinion? YES NO

12. Which terms and conditions will be attached to the permit?

Terms and Conditions	Required for Permit		Attached to notice	
Project completion report	YES	NO		
Restoration/compensatory report	YES	NO		
Monitoring	YES	NO		
Construction	YES	NO		
Planning Conditions				
Pollution and erosion control plan	YES	NO	YES	NO
Work area isolation plan	YES	NO	YES	NO
Stormwater management plan	YES	NO	YES	NO
Site restoration plan	YES	NO	YES	NO
Compensatory mitigation	YES	NO	YES	NO
Site preparation	YES	NO		
Streambank stabilization	YES	NO		
Use of large wood and rock	YES	NO		
Stream/wetland restoration	YES	NO		
Water control structures	YES	NO		
Roads	YES	NO		
Utility lines	YES	NO		
Over/in-water structures	YES	NO		

13. Requests for written approval attached to this notification? Check all that apply, attach a written explanation to support the request.

Exploration or construction near an occupied redd
Exploration or construction within 300 feet of native submerged aquatic vegetation
Timing of in-water work
Work area isolation
Transfer of ESA-listed fish
Fish passage during construction
Vehicle and material staging
Soil disturbance and compaction for temporary access road or drill pad
Piling installation – alternative sound attenuation plan
Use of cable (wire rope) or chains for an engineered log jam
Barb design
Utility trench fill
Over-water structure more than 6 feet wide
Upland disposal of sediment or debris removed for access

Appendix B

SALVAGE REPORTING FORM

INSTRUCTIONS

The applicant must submit a complete a Salvage Reporting Form, or its equivalent, with the following information to NOAA Fisheries at: slopes.nwr@noaa.gov within 10 days of completing a capture and release as part of a permit issued under the SLOPES Biological Opinion, issued on November 30, 2004.

1. Date.

2. Corps Action ID.

3. Applicant.

4. Location of fish salvage operation (County and 5th field HUC).

5. Project Name.

6. Corps contact.

7. Date of fish salvage operation.

8. Supervisory Fish Biologist:

    Name
    Address
    Telephone number

9. Describe methods used to isolate the work area, remove fish, minimize adverse effects on fish, and evaluate their effectiveness.

10. Describe the stream conditions before and following placement and removal of barriers.

11. Describe the number of fish handled, condition at release, number injured, number killed by species.