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, Washington 98115

Refer to NMFS
Tracking No.: 2007/00357

October 15, 2007

Dale Hom, Forest Supervisor
Olympic National Forest
U.S.D.A. Forest Service
1835 Black Lake Blvd. SW, Suite A
Olympia, Washington 98512-5623

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Olympic National Forest Invasive Plant Treatment Project, , Jefferson, Clallam, Grays Harbor, and Mason Counties, Washington (HUCs 1711002001, 1711002002, 1711002003, 1711002004, 1711002005, 1711001908, 1711001802, 1711001803, 1711001804, 1711001805, 1711001806, 1711001807, 1711001908, 17110021, 1711002101, 1711002102, 1710010101, 1710010102, 1710010103, 1710010104, 1710010105, 1710010108, 1710010201, 1710010204, 1710010402, 1710010403, 1710010404, 1710010501)

Dear Mr. Hom:

The enclosed document contains a biological opinion prepared by the National Marine Fisheries Service pursuant to section 7(a)(2) of the Endangered Species Act on the effects of the Olympic National Forest Invasive Plant Treatment Project for January 1, 2008, through December 31, 2013. The program covers more than 370,000 acres on the Olympic National Forest and contains more than 3,800 acres of inventoried weed infestations requiring treatment. In addition, the Olympic National Forest is anticipating continuing the invasive plant treatment program for up to fifteen years, for which National Marine Fisheries Service is consulting on five. In the biological opinion, National Marine Fisheries Service concludes that the action, as proposed, is not likely to jeopardize the continued existence of Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, or Puget Sound steelhead or result in the destruction or adverse modification of designated critical habitat for Puget Sound Chinook salmon or Hood Canal summer-run chum salmon.

As required by section 7 of the ESA, National Marine Fisheries Service provided an incidental take statement with the biological opinion. The incidental take statement describes reasonable and prudent measures National Marine Fisheries Service considers necessary or appropriate to minimize incidental take associated with this action. The incidental take statement also sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal agency and any person who performs the action must comply with to carry out the reasonable and prudent measures. Incidental take from actions by the action agency and applicant that meets these terms and conditions will be exempt from the ESA take prohibition.

This document also includes the results of National Marine Fisheries Service' analysis of the action's likely effects on essential fish habitat pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes four Conservation Recommendations to avoid, minimize, or otherwise offset potential adverse effects on essential fish habitat. These Conservation Recommendations are an identical set of the Endangered Species Act Terms and Conditions. Section 305(b)(4)(B) of the MSA requires Federal agencies provide a detailed written response to National Marine Fisheries Service within 30 days after receiving these recommendations.

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

If you have questions regarding this consultation, please contact Rachel Friedman, Washington State Habitat Office, (360) 753-4063.

Sincerely,

D. Robert Lohn
Regional Administrator

Enclosure

cc: Diana Perez, Gifford Pinchot National Forest
Robert Metzger, Olympic National Forest
Vince Harke, U.S. Fish and Wildlife Service

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

Invasive Plant Treatment Project – Olympic National Forest

Lead Action Agencies:	United States Department of Agriculture Forest Service
Consultation Conducted By:	National Marine Fisheries Service Northwest Region
Date Issued:	October 15, 2007
Issued by:	D. Robert Lohn Regional Administrator
NMFS Tracking No.:	2007/00357

TABLE OF CONTENTS

ACRONYM GLOSSARY

APHIS	Agriculture Plant Health Inspection Service
ATV	All Terrain Vehicle
BA	Biological Assessment
BRT	Biological Review Team
CFS	Cubic Feet per Second
CHARTS	Critical Habitat Analytical Review Teams
CI	Confidence Intervals
CIRS	Consultation Initiation and Reporting System
CWA	Clean Water Act
DAWACT	Dungeness Area Watershed Analysis Cooperative Team
DEIS	Draft Environmental Impact Statement
DN	Decision Notes
DPS	Distinct Population Segment
EAEST	EA Engineering, Science, and Technology
Ecology	Washington State Department of Ecology
EDRR	Early Detection/Rapid Response
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Units
FACTS	Forest Service Activity Tracking System
FEMAT	Forest Ecosystem Management Assessment Team
FEIS	Final Environmental Impact Statement
FR	Federal Register
FS	Forest Service
FSH	Forest Service Handbook
GIS	Geographical Information Survey
GW	Gray Wolf
HCC	Hood Canal Summer-run Chum
HQ	Hazard Quotient
HUC	Hydrologic Unit Code
ITS	Incidental Take Statement
IWM	Integrated Weed Management
IWMPEA	Integrated Weed Management Program Environmental Assessment
Km	Kilometer
LD	Lower Dungeness
LOAEL	Lowest Observed Adverse Effect Level
LRMP	Land and Resource Management Plan
Mg/L	Milligrams/Liter
MM	Millimeter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act

NMFS	National Marine Fisheries Service
NOAEC	No Observed Adverse Effect Concentration
NOEC	No Observed Effect Concentration
NOS	National-Origin Spawners
NPDES	National Pollutant Discharge Elimination System Permit
NPS	National Park Service
NRIS	Natural Resource Information System
NTU	National Turbidity Units
NWFP	Northwest Forest Plan
ONF	Olympic National Forest
ONF Plan	Olympic National Forest Plan
Opinion	Biological Opinion
PCB	PolyChlorinated Biphenyls
PCE	Primary Constituent Element
PCEF	Project Consistency Evaluation Form
PDF	Project Design Features
PNPTT	Point No Point Treaty Tribes
PSC	Puget Sound Chinook
PSCRBT	Puget Sound Cooperative River Basin Team
PSS	Puget Sound Steelhead
RKm	River Kilometer
RM	River Mile
RPMs	Reasonable and Prudent Measures
ROD	Record of Decision
SERA	Syracruse Environmental Research Associates
SSH	Summer-run SteelHead
TRT	Puget Sound Technical Recovery Team
UD	Upper Dungeness
USDA	United States Department of Agriculture
USDI	United Stated Department of Interior
USFWS	United States Fish and Wildlife Service
USGS	United State Geological Survey
VSP	Viable Salmonid Populations
WCR	Water Contamination Rate
WDF	Washington Department of Fisheries
WDFW	Washington Department of Fish and Wildlife
WDW	Washington Department of Wildlife
WSDA	Washington State Department of Agriculture
WSH	Winter-run SteelHead
WSHO	Washington State Habitat Office
WWTIT	Western Washington Treaty Indian Tribes
PFMC	Pacific Fishery Management Council
DQA	Data Quality Act

INTRODUCTION

This document contains a biological opinion (Opinion) and incidental take statement prepared in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, et seq.), and implementing regulations at 50 CFR 402. The National Marine Fisheries Service (NMFS) also completed an essential fish habitat (EFH) consultation, 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 CFR 600. The docket for this consultation is on file at the NMFS Northwest Region Habitat Conservation Division, Washington State Office, Lacey, Washington.

Background and Consultation History

The United States Forest Service, Olympic National Forest (ONF) proposes to carry out the control of the spread of noxious weeds and non-native invasive plants throughout the ONF. The purpose of the program is to suppress, contain, control and/or eradicate invasive plants, including those that are currently known and, within specified parameters, those discovered in the future, in a cost-effective manner that complies with environmental standards over the next 5 to 15 years (until invasive plant objectives are met or until changed conditions or new information warrants the need for a new decision).

The project will occur throughout lands administered by the U.S. Forest Service (FS) in the ONF. The 632,300 acre ONF includes the Soleduck, Quilcene, Hood Canal, and Quinault Ranger Districts, as well as the Buckhorn Wilderness, the Brothers Wilderness, Mount Skokomish Wilderness, Wonder Mountain Wilderness, and Colonel Bob Wilderness.

Weed control mechanisms in the proposed action include the integrated use of herbicides, mechanical, and manual treatments, as well as restoration actions. Herbicide treatments are limited to formulations including carriers, surfactants, and other additives applied in application methods described and analyzed in the Biological Assessment (BA) prepared to initiate this consultation, and the draft environmental impact statement (USDA 2006) (2006 ONF DEIS), which has been prepared by the FS to assess the environmental effects of the proposed action and various alternative invasive plant control programs.

The ONF is proposing the action according to its authority under the Executive Order (EO) 13112 (1999) that directs Federal agencies to reduce the spread of invasive plants. The Forest Service Pesticide Use Handbook (FSH 2109.14) provides the agency guidance on planning, implementation and reporting of projects that include herbicides. The proposed action is derived from several prior environmental analyses. In 2005, the FS prepared a regional-level environmental impact statement, the Pacific Northwest Region Final Environmental Impact Statement (R6 2005 FEIS) (USDA 2005c) which examined the environmental effects of various alternative invasive species control programs in National Forests in the states of Washington and Oregon. The FS subsequently prepared a Biological Assessment (BA) examining the effects of the proposed programs on listed species (R6 2005 BA), (USDA 2005a), and consulted with NMFS, which issued an Opinion (R6 2005 BiOp) finding that the proposed action was not likely to jeopardize the continued existence of any of the listed ESUs, or was not likely to destroy or adversely modify designated critical habitats. The FS then issued a 2005 Record of Decision (R6 2005 ROD) selecting its preferred alternative for carrying out its responsibilities under EO 13112.

The proposed action under consideration here applies the R6 2005 ROD specifically to the ONF. The project-level analysis in the 2006 ONF DEIS tiers from the broader scale analysis in the R6 2005 FEIS (USDA 2005c) and ROD (USDA 2005b), which amended the Olympic National Forest Plan (ONF Plan) by adding management direction for preventing and treating invasive plant infestations. Land uses and activities, including the proposed action, are designed to comply with the standards set forth in the R6 2005 ROD (Appendix G of the 2006 ONF DEIS).

The existing ONF program of invasive plant treatment, which the proposed action is intended to replace, follows prior National Environment Policy Agency (NEPA) decisions. Those include the Integrated Weed Management Program Environmental Assessment (IWMPEA) (USDA 1998), Decision Notes (DN), and Agriculture Plant Health Inspection Service (APHIS) approved biological controls applied on the Olympic Peninsula. The IWMPEA employs a strategy emphasizing prevention and control of invasive plants scattered across the ONF. The DN approved manual, mechanical and herbicide treatments on 75 sites totaling approximately 672 acres. Spot and hand treatments were prescribed on 86 acres, singly or in combination with manual or mechanical treatments. No broadcast treatments were approved. Herbicides allowed for use were glyphosate, dicamba, and picloram, with only glyphosate to be used in the vicinity of surface water. The remaining 586 acres were proposed for manual and mechanical treatments. The IWMPEA included all invasive plant sites that had been inventoried at that time. The IWMPEA did not include a mechanism for identifying new or previously undiscovered sites. The 2006 ONF DEIS concluded that if this program was continued, more than 80 percent currently known infestations on the ONF would go untreated.

On August 8, 2005, the FS, representing the ONF, initiated informal discussions with NMFS, Washington State Habitat Office and U.S. Fish and Wildlife Service (USFWS) regarding the effects of implementing the proposed program, which includes plans for the treatment of identified invasive plant sites as well as a program for identifying and treating presently undiscovered sites and sites where invasive species may spread in the future. The latter program is referred to as the “Early Detection/Rapid Response” program (EDRR) of invasive plant treatment. Between August 8, 2005 and January 19, 2007, numerous meetings and conference calls of both the Level 1 and Level 2 teams of staff and managers occurred, and numerous versions of the draft BA and 2006 ONF DEIS were reviewed. On January 19, 2007, the ONF sent NMFS a final BA and written request and for ESA section 7 formal consultation on site-specific treatments and the EDRR program, as well as EFH consultation pursuant to the Magnuson-Stevens Fishery Conservation and Management Act. NMFS and the ONF concluded consultation on some of the known infestation sites under separate cover wherein NMFS concurred with ONF’s determination that treating those known sites according to the proposed program was “not likely to adversely affect” listed species or their critical habitat. Those sites are thus beyond the scope of this consultation and Biological Opinion.

Description of the Proposed Action

This formal consultation covers the ONF's proposed program for responding to existing and new infestations of invasive plants with a variety of treatment methods appropriate to a range of site conditions found in the ONF. The proposed ONF program is considered in detail in the 2006 ONF DEIS, which is tiered from the R6 2005 FEIS, R6 BIOP, and ROD.

The ONF will use the treatment methods and prescriptions described below. The management techniques include integrated use of herbicides, mechanical, and manual treatments, as well as restoration actions. Infested areas would be treated with an initial prescription and retreated in subsequent years until the site was restored with desirable vegetation. Herbicide application would likely be part of the treatment prescription for all known sites; however, use of herbicides would be expected to decline in subsequent treatments, as invasive plant populations would be expected to decrease to the point where herbicide would no longer be needed. Mechanical and manual treatments would occur either in concert with herbicide applications or separately. Mechanical and manual treatments are useful in limited circumstances so their use would not likely be widespread. Ongoing inventories would confirm the location of specific invasive plants and effectiveness of past treatments. Restoration would occur once the infestation had reached the target size.

The proposed action consists of two components. First, the program calls for the treatment of certain existing, identified infestations. Existing areas of infestation are catalogued in a 2004 Data Base, included as Appendix A to the 2006 ONF DEIS (http://www.fs.fed.us/r6/olympic/projects-nu/documents/ondeis-main06A.pdf.) Vectors of invasive plant spread were surveyed in the field and the results were documented in the data base. Ninety-nine treatment areas covering about 67,000 gross acres were mapped throughout the forest. Treatment areas are defined as geographic assemblages of inventoried and anecdotal invasive plant sites based on current infestations and predicted vectors of spread. Estimated treatment acreage is based on the November 2004 Inventory and anecdotal information, modified to account for predictable rates of spread. Within the treatment areas, about 3,830 acres have been identified as needing treatment under the proposed action. Of those 3,830 acres, the majority of the infestations (3,270 acres) are along roadsides and other disturbed areas. Of the 99 treatment areas, NMFS and the ONF have concluded that 25 sites were "not likely to adversely affect" listed species or their critical habitat. These 25 sites are therefore not included in this consultation.

The second component of the proposed action is a program for identifying and treating existing but previously undocumented infestations as well as infestations that arise in the future. This is referred to as the EDRR, program. The ONF proposes to allow for treatment "within the scope of the EIS" (that is, the final version of the 2006 ONF DEIS) of new or presently unidentified infestations found over the next 5 to 15 years.

For unidentified infestations and infestations discovered in the future, the ONF will use the EDRR program, consisting of the range of methods described below. The EDRR approach enables the ONF to learn of and respond to infestations far more efficiently than has occurred in the past. The intent of the EDRR approach is to treat new infestations when they are small, so that any adverse treatment effects are minimized. The approach is based on the fact that the impacts of similar treatments are predictable and treatments can therefore be prescribed in advance with reasonable assurance as to what the environmental effects will be. To ensure the actions and their environmental results remain predictable and prescribable, the proposed action limits the spatial and temporal application of the EDRR program. For invasive plant sites above bankfull, within the aquatic influence zone, treatments would not exceed 10 acres along any 1.5 miles of stream reach within a sixth field subwatershed[1] in any given year. In addition, for invasive plant sites below bankfull, treatments would not exceed a total of six acres within a sixth field subwatershed in any given year.[2]

The Implementation Planning process (described below) ensures that treatments will be within the scope of those analyzed in this consultation. New situations that may have different treatment needs would be beyond the scope of this consultation and subject to further ESA review. Initially, a tiered, two step process, whereby NMFS would provide incidental take on individual projects, was developed by the Level 1 team to ensure section 7 compliance for projects implemented under the EDRR program. However, since this Opinion is authorizing incidental take for both known sites and the EDRR program, the tiered process is not necessary, and will not be employed.

The ONF has identified numerous invasive species that are targeted for treatment under the proposed action and has also identified a number of Project Design Features (PDFs) that will be employed on a site-specific basis to minimize the potential for adverse effects from treatments. The Common Control Measures, described in Table 1 below, are the starting point for the development of site-specific prescriptions, which will be refined for specific sites according to the PDFs.

Some control measures listed in Table 1 may not be available in some locations due to the PDFs (for instance, broadcast treatment of any herbicide within 100 feet of a live stream). The Common Control Measures would be applied to site-specific conditions as part of the Implementation Planning process.

Many of the target species may grow in riparian areas. A few, such as knotweed, reed canary grass, purple loosestrife, and the thistles tend to be associated with meadows, wetlands, and streams.

[1] Using a hierarchical structure, the U.S. Geologic Survey developed the term “sixth-field watershed” to denote subsystems of large riverine drainage areas.
[2] The biological relevance of the EDRR program delimiters stems from the use of 10 acres as the hypothetical site used to model the risks from the use of herbicides, and the fact that the largest known site with emergent vegetation on the ONF is 6 acres large.

Table 1. Common Control Measures by Target Species

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	**Acres from November 2004 Inventory**	**Common Control Measures**	**Documented Effective Herbicides**
Spotted knapweed (CEBI) *Centaurea biebersteinii* Diffuse knapweed (CEDI) *Centaurea diffusa* Meadow knapweed (CEDE) *Centaurea debeauxii* Brownray knapweed (CEJA) *Centaurea jacea* *Biennial or Perennial*	7	Manual treatments could be used for follow-up to herbicide. Hand pull or dig small populations or when regular volunteers are available. Multiple treatments per year are required. Mowing is possible, but timing is critical. Successful treatment may take up to ten years due to long-term seed viability.	Clopyralid Picloram
Japanese knotweed (POCU) *Polygonum cuspidatum* Giant knotweed (POSA) *Polygonum sachalinense* *Perennial*	11	Herbicide treatment most effective. Use stem injection or foliar spray. If chemicals are used, manual treatments could be used for follow-up. Revegetate with desirable species if surrounding cover is primarily non-native.	Glyphosate Triclopyr
Hawkweeds (HIPR, HIAU, HIVU) *Hieracium pratense, Hieracium aurantiacum, Hieracium vulgatum* *Perennial*	<1	Herbicide treatment is most effective. Some manual removal or covering with a plastic tarp possible for small infestations. If chemicals are used, manual treatments could be used for follow-up.	Clopyralid Picloram
Butter 'n' eggs (LIVU2) *Linaria vulgaris* *Perennial*	<1	Hand pull or dig small populations or when regular volunteers are available. Cutting stems in spring or early summer will eliminate plant reproduction, but not the infestation. Successful treatment may take up to ten years due to long-term seed viability.	Upland Forested: Metsulfuron methyl In native grasses: Imazapic (in fall only) Glyphosate

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	**Acres from November 2004 Inventory**	**Common Control Measures**	**Documented Effective Herbicides**
Tansy ragwort (SEJA) *Senecio jacobaea* Common tansy (TAVU) *Tanacetum vulgare* *Biennial or perennial*	536	Hand-pulling is effective if done in moist soils, as a follow-up to herbicide treatments are used to achieve initial control objectives.	Metsulfuron methyl Picloram Clopyralid Glyphosate
Scotch broom (CYSC4) *Cytisus scoparius* *Perennial*	203	Hand pulling, cutting, weed wrenching or digging up of small populations or when regular volunteers are available or as a follow up to chemical use. Hand-pulling or weed wrenching is most effective in moist soils. Cutting will require multiple visits in one year. Successful treatment may take up to ten years due to long-term seed viability.	Triclopyr Clopyralid Picloram Glyphosate
English ivy (HEHE) *Hedera helix* *Perennial*	93	Manually remove infestations by removing vines first, than digging root mats from the soil. Vines must be cut at both the shoulder and ankle height and stripped away from the tree. Work away from the tree pulling out the entire root mat for at least six feet. Apply herbicide in combination with string trimming.	Triclopyr Glyphosate
Reed canarygrass (PHAR3) *Phalaris arundinaceae* *Perennial*	156	Use a combination of herbicides and manual and mechanical treatments. Manual treatments or mowing are only practical for small stands when multiple treatments per year can be made. The entire population must be removed 2 to 3 times per year for at least five years. Covering populations with black plastic may be effective if shoots are not allowed to grow beyond tarps. This technique could take over two years to be effective.	Sulfometuron methyl Glyphosate

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	Acres from November 2004 Inventory	Common Control Measures	Documented Effective Herbicides
Cheatgrass (BRTE) *Bromus tectorum* *Annual*	3	Hand-pulling is minimally effective and may take up to five years due to long-term seed viability. Repeated mowing (every three weeks) may help contain this species, especially as a follow-up to herbicide use.	Imazapic Sethoxydim Sulfometuron methyl/ imazapyr (in fall only) Glyphosate
Canada thistle (CIAR4) *Cirsium arvense* *Perennial*	308	Herbicide treatment is most effective. The only manual technique would be hand cutting of flower heads, which suppresses seed production. Mowing may be effective in rare cases if done monthly (this intensity would damage native species). Covering with a plastic tarp may also work for small infestations.	Clopyralid Picloram Chlorsulfuron Glyphosate (best in fall)
Herb Robert (GERO) *Geranium robertianum* *Annual, Biennial or Perennial*	10	Hand-pulling is most effective if the entire plant is pulled. Herbicides may also be used on larger infestations. Steaming/foaming may be an effective treatment.	Glyphosate
English holly (ILAQ80) *Ilex aquifolium* *Perennial*	<1	Use herbicides in combination with manual and mechanical techniques that remove lower and rooted branches.	Glyphosate
Purple loosestrife (LYSA2) *Lythrum salicaria* *Perennial*	<1	Herbicide treatment is most effective. Hand removal of small populations or isolated stems is possible, but only if entire rootstock is removed. Hand cut flower heads to suppress seed production.	Glyphosate

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	Acres from November 2004 Inventory	Common Control Measures	Documented Effective Herbicides
Himalayan blackberry (RUDI2) *Rubus discolor* Cutleaf blackberry (RULA) *Rubus laciniatus* *Perennial (canes die off annually)*	86	Use a combination of herbicides and manual and/or mechanical treatments. Usually mechanical removal of large biomass in the summer (using a mower, or brush hog), followed by manual removal of re-sprouting canes and roots, then herbicide treatment of new growth in the fall/winter is most effective. The massive root crown must be fully dug out at some point if using only manual/mechanical techniques.	Triclopyr Glyphosate
Bull thistle (CIVU) *Cirsium vulgare* *Biennial*	600	Use manual, mechanical or chemical control or a combination. Any manual method that severs the root below the soil surface will kill these plants. Effective control requires cutting at the onset of blooming. Treatment before plants are fully bolted results in re-growth. Repeated visits at weekly intervals over the 4 to 7 week blooming period provide most effective control.	Clopyralid Picloram Glyphosate
St. John's wort (HYPE) *Hypericum perforatum* *Perennial*	341	Hand removal of small populations or isolated stems is possible, but repeated treatments will be necessary as lateral roots give rise to new plants. These treatments may take up to ten years due to long-term seed viability.	Metsulfuron methyl Picloram Glyphosate (not found as effective in the literature)
Oxeye Daisy (LEVU) *Leucanthemum vulgare* *Perennial*	505	Hand removal is possible, but only if entire rootstock is removed. Hand removal must be repeated for several years. Mowing is effective if repeated throughout the long growing season.	Clopyralid Picloram Glyphosate (not found as effective in the literature)

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	Acres from November 2004 Inventory	Common Control Measures	Documented Effective Herbicides
Queen Anne's Lace (DACA6) *Daucus carota* *Biennial*	2	Small populations could be handpulled, but typically it is mowed along roadsides. A combination of mowing, then applying herbicide in late fall has been effective.	Metsulfuron methyl Chlorsulfuron Glyphosate (not found as effective in the literature)
Narrow leaved plantain (PLLA) *Plantago lanceolata* *Perennial*	246	Can be handpulled or dug. Repeated treatments will be necessary. If chemicals are used, manual treatments could be used for follow-up. Out-competing through revegetation is the most effective treatment.	Clopyralid Glyphosate
Creeping buttercup (RARE3) *Ranunculus repens* *Perennial*	6	Hand digging is effective. If chemicals are used, manual treatments could be used for follow- up.	Glyphosate
Yellow nutsedge (CYES) *Cyperus esculentus* *Perennial*	15	Hand digging is effective if done before root tubers form. If chemicals are used, manual treatments could be used for follow-up. Out-competing through revegetation is the most effective means.	Glyphosate
Everlasting Peavine (LALA4) *Lathyrus latifolius* *Perennial*	<1	Herbicide treatment most effective. Hand control possible with repeated effort or combined herbicide/hand treatment. Hand removal must be repeated for several years.	Triclopyr Glyphosate Clopyralid Picloram/imazapyr (sites without grass cover)
Hairy cat's ear (HYRA3) *Hypochaeris radicata* *Perennial*	345	Herbicide treatment most effective. Hand removal is possible, and must be repeated for several years. If chemicals are used, manual treatments could be used for follow-up.	Clopyralid, Picloram Glyphosate
Big trefoil (LOPE80) *Lotus pedunculatus* *Perennial*	263	Herbicide treatment most effective. If chemicals are used, manual treatments could be used for follow-up.	Clopyralid or Picloram Triclopyr or Imazapyr (sites without grass cover) Glyphosate

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	Acres from November 2004 Inventory	Common Control Measures	Documented Effective Herbicides
English laurel (PRLA5) *Prunus laurocerasus* *Perennial*	<1	Hand pulling, cutting, girdling, weed wrenching or digging up of small plants is effective, especially when volunteers are available. Hand-pulling or weed wrenching is most effective when plants are small in moist soils. Herbicides (cut and paint, stem injection, spot spray) may be used in combination with mechanical cutting or manual girdling. Annual re-treatment may be needed for several years to eradicate sprouts.	Triclopyr Glyphosate

Treatment Methods

The Proposed Action employs a variety of invasive plant treatment methods (manual, mechanical, and herbicide treatments, and restoration methods). The following is a brief description of the different methods, based on Tu et al. 2001.

Manual and Mechanical Treatment

Manual techniques in the proposed action include hand pulling, clipping, or digging out invasive plants with non-motorized hand tools. Mechanical methods involve chain saws, mowers, or other mechanized equipment, such as brush cutters, or other machinery with various types of blades to remove plants. Manual methods include the use of hand-operated tools (e.g., axes, brush hooks, hoes, shovels, hand clippers) to dig up and remove noxious species (USDI 2003). Table 1 identified an array of treatment methods associated with target species. Appendix A in the DEIS identifies manual and mechanical methods currently proposed for each identified treatment area based on the November 2004 Invasive Plant Inventory.

These techniques tend to minimize damage to desirable plants and animals, but they are generally labor and time intensive. Treatments must typically be administered several times a year over several years to prevent the weed from re-establishing. Manual and mechanical techniques are generally favored to treat small infestations and/or in situations where a large pool of volunteer labor is available. They are often used in combination with other techniques. These techniques include weed pulling, clipping, clip and pulling, mowing, cutting and related activities, and stabbing, and girdling.

Weed pulling can be effective against some shrubs, tree saplings, and herbaceous weeds. Annuals and tap-rooted plants are particularly susceptible to control by hand-pulling. Weed wrenches and other tools can enable a person to control large saplings and shrubs that are too big to be pulled by hand. Weed pulling is not as effective against many perennial weeds with deep underground stems and roots that are often left behind to re-sprout.

Clipping removes seed heads and/or fruiting bodies to prevent germination. This method is labor intensive but effective for small and spotty infestations.

Clip and pulling is cutting a portion of the invasive plant stem and pulling it from its substrate, generally the bole of a tree. This method is labor intensive, but can be effective for larger infestations.

Mowing, cutting, brush hogging, raking, trimming, and weed eating can reduce seed production and restrict weed growth, especially in annuals cut before they flower and set seed. Some species however, vigorously sprout again when cut, replacing one or a few stems with many that can quickly flower and set seed. These treatments are used as primary treatments to remove aboveground biomass in combination with herbicide treatments to prevent re-sprouting, or as follow up treatments to treat target plants missed by initial herbicide use.

Stabbing the carbohydrate storage structure at the base of the plant can kill some plants. Depending on the species, this structure may be a root corm, storage rhizome (tuber), or taproot. These organs are generally located at the base of the stem and under the soil. Cutting off access to these storage structures can help "starve" or greatly weaken some species.

Girdling is often used to control trees or shrubs that have a single trunk. It involves cutting away a strip of bark several centimeters wide all the way around the trunk. The removed strip must be cut deep enough into the trunk to remove the vascular cambium, or inner bark, the thin layer of living tissue that moves sugars and other carbohydrates between areas of production (leaves), storage (roots), and growing points. This inner cambium layer also produces all new wood and bark.

Herbicide Treatment

The proposed action includes the use of ten herbicides applied up to the highest application rate noted in Table 2. The highest application rate would only be allowed when hand/select application methods are used. In no case would actual applications exceed rates listed on herbicide labels. Herbicide applications would primarily occur on terrestrial invasive plants growing along banks of streams, in ditches and upland. In addition, treatment of invasive plants growing above the water's surface in ditches, small lakes, ponds, streams, stream margins, and/or wet areas (emergent target vegetation) is proposed. The November 2004 inventory of known plants does not contain any sites with emergent vegetation that would adversely affect listed fish as they are in areas without listed fish. The EDRR program specifically limits treatments to no more than six acres per sixth field watershed, per year (PDF H14, Table 5), for the sixth field watershed comprising the ONF.

Table 2. Herbicide Application Rates

Herbicide	Typical Application Rate lb ai/ac*	Highest Application Rate lb ai/ac
Chlorsulfuron	**0.056**	**0.25**
Clopyralid	**0.35**	**0.5**
Glyphosate	**2**	**7**
Imazapic	**0.13**	**0.19**
Imazapyr	**0.45**	**1.25**
Metsulfuron Methyl	**0.03**	**0.15**
Picloram	**0.35**	**1.0**
Sethoxydim	**0.3**	**0.38**
Sulfometuron Methyl	**0.045**	**0.38**
Triclopyr	**1.0**	**10**
NPE	**1.67**	**6.68**
Hexachlorobenzene#	**0.000004**	**0.000012**

* pounds of active ingredient per acre
#These application rates reflect the incidental rates of application of the impurity hexachlorobenzene, found primarily in picloram, and to a lesser extent in clopyralid.

The R6 2005 FEIS/ROD allows treatment of all invasive plants, with the exception of those that are submerged and/or floating. Therefore, treatment of "emergent" invasive plants is permitted according to the standards in the R6 2005 FEIS/ROD. This consultation covers three types of herbicide application methods: broadcast spray, spot spray, and hand/selective.

Broadcast methods distribute herbicide over broad areas covering both target plants and non-target plants. Broadcast treatments would typically be used to treat denser patches of target vegetation (where target vegetation covers approximately 70 percent of the area or more). Broadcast methods include booms; boom-less nozzles, and backpack sprayers if not directed at individual plants. A boom, a long horizontal tube with multiple spray heads, may be mounted or attached to a tractor, ATV or other vehicle. The boom is then carried above the weeds while spraying herbicide, allowing large areas to be treated rapidly with each sweep of the boom.

Spot spray application directs spray onto small patches or individual target plants; non-target plants are intended to be avoided. Applicators range from motorized rigs with spray hoses to backpack sprayers, to hand-pumped spray or squirt bottles, all of which can target very small plants or parts of plants. Applications are typically hand-directed. The spray is directed immediately toward the target plant.

Hand/selective methods treat individual target plants. They intend to reduce the potential for herbicide to contact soil or non-target organisms. Hand/selective methods include wicking and wiping; basal bark treatment; frill, hack and squirt; stem injection; and/or cut-stump methods.

Wicking, wiping, and other stem and/or leaf application **-** involves using a sponge, spray bottle, paint brush, cloth and/or a wick on a long handle to wipe or apply herbicide onto individual foliage and/or stems. Use of a wick or wiping mentioned above intends to eliminate or minimize the possibility of spray drift and the potential for droplets falling on non-target plants.

Basal bark method applies a 6- to 12-inch band of herbicide around the circumference of the trunk of the target plant, approximately 1-foot above ground. The width of the sprayed band depends on the size of the plant and the species' susceptibility to the herbicide.

The frill, hack, and squirt methods are often used to treat woody species with large, thick trunks. The tree is cut using a sharp knife, saw, or ax, or drilled with a power drill or other device. Herbicide is then immediately applied to the cut with a backpack sprayer, squirt bottle, syringe, or similar equipment. Because the herbicide is placed directly onto the thin layer of growing tissue in the trunk (the cambium), an ester formulation is not required.

Herbicides can be injected into herbaceous stems using a needle and syringe, otherwise known as stem injection. Herbicide pellets can also be injected into the trunk of a tree using a specialized tool. Higher concentrations of active ingredients are often needed for effective stem injection, e.g. maximum label rate of aquatic labeled glyphosate to effectively kill knotweed by stem injection).

The cut-stump method is often used on woody species that normally re-sprout after being cut. The tree or shrub is cut down, and herbicide is immediately sprayed or squirted on the exposed cambium (living inner bark) of the stump. The herbicide must be applied to the entire inner bark (cambium) within minutes after the trunk is cut. The outer bark and heartwood do not need to be treated since these tissues are not alive, although they support and protect the tree's living tissues. The cut stump treatment allows for a great deal of control over the site of herbicide application and requires only a small amount of herbicide to be effective.

Surfactants and Additives. Herbicide manufacturers add inert ingredients (or other ingredients) to enhance the action of the active ingredient. Inert ingredients may include carriers, surfactants, spray adjuvants, preservatives, dyes, and anti-foaming agents among other chemicals. Because many manufacturers consider inerts in their herbicide formulations to be proprietary, they do not list specific chemicals. Several types of surfactants or additives are proposed for use and have been reviewed in risk assessments or reviews and thus meet the standards contained in the ONF Land and Resource Management Plan (LRMP), as amended by the R6 2005 ROD. These additives are used to help herbicides adhere to target plants and reduce drift (Bakke 2003). For the proposed action, only those additives that are approved by the Washington State Department of Agriculture (WSDA) and Department of Ecology (Ecology) and comply with the amended ONF LRMP will be permitted for use within riparian areas (Table 3).

Adjuvants are solution additives that are mixed with herbicide solutions to improve performance of the spray mixture. They can either enhance activity of the herbicide's active ingredient or offset any problems associated with spray application. Adjuvants include surfactants, anti-foaming agents, crop oil or crop oil concentrates, drift retardants, compatibility agents, and pH buffers.

Carriers are used to dilute or suspend herbicides during application and allow for proper placement of the herbicide, whether to soil or on foliage.

Table 3. Products approved by WSDA, Ecology and that meet ONF LRMP standards.

Product Name	Registrant	Principal Functioning Agent	Document supporting Std 18*
Agri-Dex	Helena Chemical Company	Petroleum Oil, polyoxyethylene sorbitant fatty acid ester, sorbitant fatty acid ester	SERA 1997, Bakke 2003
Competitor	Wilbur-Ellis Company	Modified vegetable (seed) oil, polyethylene glycol fatty acid ester, polyoxyethylene sorbitant fatty acid ester	SERA 1997, Bakke 2003
InterLock	Agriliance	Modified vegetable (seed) oil, polyoxyethylene sorbitant fatty acid ester, vegetable (seed) oil	SERA 1997, Bakke 2003
LI 700	Loveland Industries/Loveland Products	Phosphatidylcholine, propanoic (propionic) acid, alkylphenol ethoxylate	SERA 1997, Bakke 2003
Liberate	Loveland Industries/Loveland Products	Phosphatidylcholine, alcohol ethoxylate, modified vegetable (seed) oil	SERA 1997, Bakke 2003
Dyne-Amic	Helena Chemical Company	Modified vegetable (seed) oil, alkylphenol ethoxylate, Polysiloxane polyether copolymer	Bakke 2003
Cygnet Plus	Brewer International	Modified vegetable (seed) oil, alcohol ethoxylate, Limonene	USDA Forest Service 1992

* Standard 18 is one of the prevention standards proposed in the R6 2005 FEIS and states that the FS will only use adjuvants and inert ingredients reviewed in the FS hazard and risk assessment documents.

Project Design Features

The ONF proposes the following PDFs and buffers as measures to minimize or eliminate the potential undesirable environmental results of invasive plant treatment (as per R6 2005 ROD Standards 19 and 20, and other Forest Plan management direction), and provide sideboards for treatment of EDRR program sites. Implementation of the PDFs and buffers are mandatory to ensure that treatments would have effects within the scope of those addressed below. The PDFs were developed to address a range of site-specific resource conditions within treatment areas, including (but not limited to): the presence of listed species and designated critical habitat, potential for herbicide delivery to water, and the social environment.

The PDFs add layers of caution to herbicide label requirements and R6 2005 FEIS standards by limiting the rate and method of herbicide application, by buffering streams from varying herbicide application methods, and by restricting certain higher-risk herbicides near streams. The ONF asserts that this conservative approach was taken to limit the potential for herbicides coming in contact with water at concentrations of concern, while allowing for a range of effective treatments for known and predicted situations. Under the proposed action, buffers along streams, lakes, ponds, and wetlands in Tables 5, 6, and 7 would be required.

The following list includes the PDFs specific to avoiding or minimizing potential effects of the proposed action on ESA-listed species and their habitat, which are included as part of the proposed action.

Table 4. Project Design Features for the ONF invasive plant treatment program

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
A	**Pre-Project Planning**		
A1	Prior to treatment, confirm species/habitats of local interest, watershed and aquatic resources of concern (e.g. hydric soils, streams, lakes, roadside treatment areas with higher potential to deliver herbicide, municipal watersheds, domestic water sources), and places where people gather.	Ensure project is implemented appropriately.	This approach follows several previous NEPA documents. Pre-project planning also discussed in the previous section.
B	**Coordination with Other Landowners/Agencies**		
B1	Work with owners and managers of neighboring lands to respond to invasive plants that straddle multiple ownerships. Coordinate treatments within 150 feet of Forest boundaries, including lands over which the Forest has right-of-way easements, with adjacent landowners.	To ensure that neighbors are fully informed about nearby herbicide use and to increase the effectiveness of treatments on multiple ownership lands.	The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams.
B2	Coordinate herbicide use within 1000 feet (slope distance) of known water intakes with the water user or manager.	To ensure that neighbors are fully informed about nearby herbicide use.	The distance of 1,000 feet was selected to respond to public concern. Herbicide use as proposed for this project would not contaminate drinking water supplies.
B3	Coordinate herbicide use with Municipal Water boards. Herbicide use or application method may be excluded or limited in some areas.	To ensure that neighbors are fully informed about nearby herbicide use and standards for municipal watersheds are met.	1990 ONF Plan and existing municipal agreements.
C	**To Prevent the Spread of Invasive Plants During Treatment Activities**		
C1	Where practical, clean vehicles and equipment (including personal protective clothing) prior to leaving treated areas or entering new areas.	To prevent the spread of invasive plants during treatment activities	Common measure.
D	**Wilderness Areas**		
D1	No motorized equipment would be used in Wilderness areas.	To maintain Wilderness character and meet environmental standards.	Wilderness Act, 1990 ONF Plan

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
D2	Choose minimum impact treatment methods.	To maintain Wilderness values (e.g. solitude, unimpeded natural processes) and comply with environmental laws and policies.	Wilderness Act, 1990 ONF Plan
E	**There are no Design Features under "E".**		
F	**Herbicide Applications**		
F1a	Herbicides would be used in accordance with label instructions and advisories, except where more restrictive measures are required as described herein. Herbicide applications would only treat the minimum area necessary to meet site objectives. Herbicide formulations would be limited to those containing one or more of the following 10 active ingredients: chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, and triclopyr.	To limit potential adverse effects on people and the environment.	Standard 16, R6 2005 ROD; Pesticide Use Handbook 2109.14
F1b	Herbicide application methods include wicking, wiping, injection, spot, and broadcast, as permitted by the product label and these Project Design Features. The use of triclopyr is limited to spot and hand/selective methods. Herbicide carriers (solvents) are limited to water and/or specifically labeled vegetable oil.	To limit potential adverse effects on people and the environment.	Standard 16, R6 2005 ROD; Pesticide Use Handbook 2109.14
F2	Herbicide use would comply with standards in the Pacific Northwest Regional Invasive Plant Program – Preventing and Managing Invasive Plants FEIS (2005), including standards on herbicide selection, restrictions on broadcast use of some herbicides, tank mixing, licensed applicators, and use of adjuvants, surfactants and other additives. See Appendix B for tank mixture analysis.	To limit potential adverse effects on people and the environment.	R6 2005 ROD Treatment Standards
F3	The POEA surfactants, urea ammonium nitrate or ammonium sulfate would not be used in applications within 150 feet of surface water, wetlands or on roadside treatment areas having high potential to deliver herbicide.	To protect aquatic organisms.	The distance of 150 feet was selected because it is wider than the largest buffer and approximates the Aquatic Influence Zone for fish bearing streams.
F4	The lowest effective application rates would be used for each given situation. The NPE surfactant would not be broadcast at a rate exceeding 0.5 pounds (lbs.) active ingredient per acre (a.i./ac.), Other classes of surfactants besides NPE would be favored wherever they are expected to be effective. In no case would imazapyr be applied at a rate exceeding 0.70 lbs. a.i./ac.	To eliminate possible herbicide or surfactant exposures of concern to human health, and/or wildlife.	SERA Risks Assessments, Appendix Q of the R6 2005 FEIS; SERA Risk Assessment for imazapyr demonstrates that no exposures of concern are plausible
F5	Herbicide applications would occur when wind velocity is between two and eight miles per hour. During application, weather conditions would be monitored periodically by trained personnel.	To ensure proper application of herbicide and reduce drift.	These restrictions are typical so that herbicide use is avoided during inversions or windy conditions.

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
F6	To minimize herbicide application drift during broadcast operations, use low nozzle pressure; apply as a coarse spray, and use nozzles designed for herbicide application that do not produce a fine droplet spray, e.g., nozzle diameter to produce a median droplet diameter of 500-800 microns.	To ensure proper application of herbicide and reduce drift.	These are typical measures to reduce drift. The minimum droplet size of 500 microns was selected because this size is modeled to eliminate adverse effects on non-target vegetation 100 feet or further from broadcast sites (see Chapter 3.2 of the R6 2005 FEIS for details).
G	**Herbicide Transportation and Handling Safety/Spill Prevention and Containment**		
G	An Herbicide Transportation and Handling Safety/Spill Response Plan would be the responsibility of the herbicide applicator. At a minimum the plan would: • Address spill prevention and containment. • Estimate and limit the daily quantity of herbicides to be transported to treatment sites. • Require that impervious material be placed beneath mixing areas in such a manner as to contain small spills associated with mixing/refilling. • Require a spill cleanup kit be readily available for herbicide transportation, storage and application (minimum FOSS Spill Tote Universal or equivalent). • Outline reporting procedures, including reporting spills to the appropriate regulatory agency. • Ensure applicators are trained in safe handling and transportation procedures and spill cleanup. • Require that equipment used in herbicide storage, transportation and handling are maintained in a leak proof condition. • Address transportation routes so that traffic, domestic water sources, and blind curves are avoided to the extent possible. • Specify conditions under which guide vehicles would be required. • Specify mixing and loading locations away from water bodies so that accidental spills do not contaminate surface waters. • Require that spray tanks be mixed or washed further than 150 feet of surface water. • Ensure safe disposal of herbicide containers. Identify sites that may only be reached by water travel and limit the amount of herbicide that may be transported by watercraft.	To reduce likelihood of spills and contain any spills.	Pesticide Use Handbook 2109.14, Bonneville Power Administration BA, Buckhead Knotweed Project, Willamette NF BA
H	**Soils, Water and Aquatic Ecosystems**		

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
H1	Herbicide use buffers have been established for perennial and wet intermittent steams; dry streams; and lakes and wetlands. These buffers are depicted in the tables below. Buffers vary by herbicide ingredient and application method. Tank mixtures would apply the largest buffer as indicated for any of the herbicides in the mixture.	To reduce likelihood that herbicides would enter surface waters in concentrations of concern. Comply with R6 2005 ROD Standards 19 and 20.	Buffers are based on label advisories, and SERA risk assessments. Buffer distances are based on the Berg's 2004 study of broadcast drift and run off to streams, along with Washington State Dept. of Agriculture's 2003-2005 monitoring results.
H2	The following treatment methods are shown in order of preference (if effective and practical), within roadside treatment areas having high risk of herbicide delivery to streams and, in wetlands, near aquatic influence areas, especially adjacent to fish bearing streams; listed species or their critical habitat: (1) Non-herbicide methods (e.g, hand pulling). (2) Application of clopyralid, imazapic, and metsulfuron methyl, aquatic glyphosate, aquatic triclopyr, aquatic imazapyr. (3) Application of chlorsulfuron, imazapyr, sulfometuron methyl. (4) Application of glyphosate, triclopyr, picloram, and sethoxydim (see H3, picloram or non-aquatic triclopyr would not be used on roadside treatment areas that have a high risk of herbicide delivery).	To protect aquatic organisms by favoring lower risk methods where effective.	Herbicides were classed into low, moderate and higher risk to aquatic organisms based on SERA Risk Assessments. Lower risk herbicides are preferred where effective. Non-herbicide, manual methods have the least potential for impact, therefore they would be preferred.
H3	No use of picloram or Triclopyr BEE, and no broadcast of any herbicide on ***the entire*** roadside treatment areas that have a high risk of herbicide delivery to surface waters (see Appendix D of the 2006 DEIS for map and list of these roads).	To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern. Not broadcasting far reduces potential for exposure because spot and selective method substantially reduce potential for off site impacts, drift, and other herbicide delivery mechanisms to water (runoff, leaching), No use of picloram and triclopyr BEE eliminates potential for these herbicides through the road ditch network.	SERA Risk Assessments, R6 2005 FEIS and BA

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
H4	Aquatic labeled herbicides or herbicides associated with lower risk to aquatic organisms would be applied using spot or hand/selective methods within 15 feet of the edge of a wet roadside ditch. Aquatic labeled herbicides would be required for treatments of target vegetation emerging out of the wet roadside ditch.	To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern. Not broadcasting far reduces potential for exposure because spot and selective method substantially reduce potential for off site impacts, drift, and other herbicide delivery mechanisms to water (runoff, leaching), Restrictions on herbicide selection avoids potential for herbicides to reach a threshold of concern.	SERA Risk Assessments, R6 2005 FEIS and BA.
H5	Vehicles (including all terrain vehicles) used to access or implement invasive plant projects would remain on roadways, trails, parking areas or other previously disturbed areas to prevent damage to riparian vegetation and soil, and potential degradation of water quality and aquatic habitat.	To protect riparian and aquatic habitats.	SERA Risk Assessments, R6 2005 FEIS and BA.
H6	Avoid use of clopyralid on high-porosity soils (coarser than a loamy sand).	To avoid leaching/ground water contamination.	Typical label advisory.
H7	Avoid use of chlorsulfuron on soils with high clay content (finer than loam).	To avoid excessive herbicide runoff.	Typical label advisory.
H8	Avoid use of picloram on shallow or coarse soils (coarser than loam.) No more than one application of picloram would be made within a two-year period, except to treat areas missed during initial application.	To reduce the potential for picloram to enter surface and/or ground water and/or accumulate in the soil. Picloram has the highest potential to impact organisms in soil and water, and tends to be more persistent than the other herbicides.	SERA Risk Assessment. Based on quantitative estimate of risk from worst-case scenario and uncertainty.
H9	Avoid use of sulfometuron methyl on shallow or coarse soils (coarser than loam.) No more than one application of sulfometuron methyl would be made within a one-year period, except to treat areas missed during initial application.	To reduce the potential for sulfometuron methyl accumulation in the soil. Sulfometuron methyl has some potential to impact soil and water organisms and is second most persistent.	SERA Risk Assessments. Based on quantitative estimate of risk from worst-case scenario and uncertainty.
H10	Lakes and Ponds – No more than half the perimeter or 50 percent of the vegetative cover or 10 contiguous acres around a lake or pond would be treated with herbicides in any 30-day period.	To reduce exposure to herbicides by providing some untreated areas for some organisms to use.	SERA Risk Assessments. Reduces exposure to herbicides by providing untreated areas for organisms to use. Abates risks associated with worst-case scenarios and uncertainty regarding effects on reptiles and amphibians.
H11	Wetland vegetation would be treated when soils are driest. If herbicide treatment is necessary for emergent target plants when soils are wet, use aquatic labeled herbicides. Favor hand/selective treatment methods where effective and practical.	To reduce exposure to herbicides by providing some untreated areas for some organisms to use.	SERA Risk Assessments. Reduces exposure to herbicides by providing untreated areas for organisms to use. Abates risks associated with worst-case models for treatment of emergent vegetation.

PDF Reference	Design Feature	Purpose of PDF	Source of PDF
H12	All wells and springs used for domestic water supplies would be protected with a 100 foot buffer for wells and a 200 foot buffer for springs. Follow label guidance relative to water contamination.	Safe drinking water.	Label advisories and state drinking water regulations.
H13	With the exception of hand/select methods, herbicides would be applied at typical (or lower) rates within Aquatic Influence Zones.	To ensure herbicide exposures are below thresholds of concern for aquatic ecosystems.	SERA Risk Assessments, BA
H14	Treatments above bankfull, within the aquatic influence zone, would not exceed 10 acres along any 1.5 mile of stream reach within a sixth field subwatershed in any given year. In addition, treatments below bankfull would not exceed 6 acres total within a sixth field sub-watershed in any given year.	Limits the extent of treatment within the Aquatic Influence Zone so that adverse effects are within the scope of analysis.	Analysis based on SERA risk assessment worksheets and emergent vegetation analysis completed for the Cranberry Bog and Middle Hoh River. Ten acres is based on GLEAM model factors.
H16	Plan and schedule project activities to avoid disturbance of spawning fish or damage to redds.	Minimize adverse impacts within waterbodies.	Memorandum of Understanding between WDFW and USDA Forest Service, January 2005
H17	Limit the numbers of people on any one site at any one time while treating areas within 150 feet of creeks.	To minimize trampling and protect riparian and aquatic habitats.	The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams.
H18	Fueling of gas-powered equipment with gas tanks larger than 5 gallons would not occur within 150 feet of surface waters. Fueling of gas-powered equipment with gas tanks smaller than 5 gallons would not occur within 25 feet of any surface waters.	To protect riparian and aquatic habitats.	The distance of 150 feet was selected because it approximates the Aquatic Influence Zone for fish bearing streams. Filling of smaller tanks has inherently less risk.

Buffers

The proposed buffers result from the worst-case scenarios analyzed in the Syracuse Environmental Research Associates (SERA) risk assessments, risk levels associated with aquatic organisms as identified in the R6 2005 FEIS Fish BA, differences in application methods, whether water is present at the treatment site or not, buffers from previous Section 7 ESA consultations on herbicide treatments, Forest Service monitoring results from Neil Berg (2004), WSDA 2003-2005 monitoring results and inherent herbicide properties.

Buffer distances shown in Tables 5, 6, and 7 are measured in feet for perennial and wet intermittent streams, streams that are dry at the time of treatment, and wetlands, high water table areas, lakes and ponds. Buffers are measured as horizontal distance from bankfull or the ordinary high water mark.

Table 5. Perennial and wet intermittent stream buffers.

Herbicide	**Perennial and Wet Intermittent Stream Buffers**		
	Broadcast (feet)	**Spot (feet)**	**Hand/ Select (feet)**
Chlorsulfuron	100	50	Bankfull
Clopyralid	100	15	Bankfull
Glyphosate	100	50	50
Glyphosate (Aquatic Formula)	*50*	*No buffer***	*No buffer*
Imazapic	100	15	Bankfull
Imazapyr	100	50	Bankfull
Imazapyr (Aquatic Formula)	*50*	*No buffer*	*No buffer*
Metsulfuron Methyl	100	15	Bankfull
Picloram	100	50	50
Sethoxydim	100	50	50
Sulfometuron Methyl	100	50	Bankfull
Triclopyr-BEE	None Allowed	150	150
Triclopyr-TEA (Aquatic Formula)	None Allowed	15	*No buffer*

**No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, floodplains, etc., even when water is present.

Table 6. Buffers for streams that are dry at the time of treatment.

Herbicide	**Buffers For Streams That Are Dry At The Time Of Treatment**		
	Broadcast (feet)	**Spot (feet)**	**Hand/ Select (feet)**
Chlorsulfuron	*50*	15	Bankfull
Clopyralid	*50*	Bankfull	*No buffer*
Glyphosate	100	50	50
Glyphosate (Aquatic Formulation)	*50*	*No buffer*	*No buffer*
Imazapic	*50*	Bankfull	*No buffer*
Imazapyr	*50*	15	Bankfull
Imazapyr (Aquatic Formulation)	*50*	*No buffer*	*No buffer*
Metsulfuron Methyl	*50*	Bankfull	*No buffer*
Picloram	100	50	50
Sethoxydim	100	50	50
Sulfometuron Methyl	*50*	15	Bankfull
Triclopyr-BEE	None Allowed	150	150
Triclopyr-TEA (Aquatic Formula)	None Allowed	15	*No buffer*

**No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, floodplains, etc., even when water is present.

Table 7. Buffers for wetlands, high water table areas, lakes and ponds.

Herbicide	Wetlands, High Water Table Areas, Lakes and Ponds		
	Broadcast (feet)	Spot (feet)	Hand/ Select (feet)
Chlorsulfuron	100	50	Water's Edge
Clopyralid	100	15	Water's Edge
Glyphosate	100	50	50
Glyphosate (Aquatic Formula)	*50***	*No buffer*	*No buffer*
Imazapic	100	15	Water's Edge
Imazapyr (Aquatic Formula)	*50***	*No buffer*	*No buffer*
Imazapyr	100	50	Water's Edge
Metsulfuron Methyl	100	15	Water's Edge
Picloram	100	50	50
Sethoxydim	100	50	50
Sulfometuron Methyl	100	50	Water's Edge
Triclopyr-BEE	None Allowed	150	150
Triclopyr-TEA (Aquatic Formula)	None Allowed	15	*No buffer*

**If wetland, pond or lake is dry, there is no buffer. No buffer means that treatment may occur anywhere across the stream channel where target vegetation exists including backwater channels, braided streams, and floodplains.

Roadside Ditch Treatments

The majority of known treatment sites on the ONF are along roadways. As part of their road management strategy, the ONF has identified roadways that have the potential to deliver sediment to fish habitat. The identification is based on proximity (delivery) to fish habitat, stream crossing density, and stream proximity. For this consultation, the likelihood of delivering herbicide into fish bearing waters is considered analogous to the likelihood of delivering sediment via runoff. That is, roads defined as having a high potential for sediment delivery also are likely to deliver herbicide. The PDFs H2, H3 and H4 apply to roadside treatments and provide additional restrictions to roads having a high potential for herbicide delivery with the intent to reduce the effects of herbicides entering fish bearing waters via runoff. Road segments identified as a high potential for herbicide delivery may extend beyond stream buffers. In addition, there are some roads in some of the watersheds that contain listed fish that cross or discharge directly into mapped PSS streams and are not listed as having a high potential for herbicide delivery (Harke pers. com. 2007).

The PDF H3 prohibits all broadcast spraying of any herbicide on "high risk of herbicide delivery" roadsides. The ONF will not allow broadcast spraying within the entire roadside treatment, including the ditch bottom and the upslope side of the ditch. In contrast, there are no PDFs prescribing spot or selective applications within or along roadside ditches. NMFS assumes that the buffers from Tables 5 and 6 will apply. For those tables to apply to roadside ditches, NMFS also assumes that the term "bankfull" includes the road shoulder. Thus, there are numerous herbicides, illustrated in Tables 5 and 6, which can be spot sprayed and selective applied along roadsides and directly within ditches.

In addition, PDF H4 restricts the use of certain herbicides within 15 feet of a wet area within a roadside ditch. The purpose of PDF H4 is to limit herbicide use to lower risk herbicides (clopyralid, imazapic, and metsulfuron methyl) to within 15 feet of roadside ditch standing water. When herbicide is likely to get in the standing water, the ONF will follow label requirements and will therefore use the aquatic labeled herbicides (imazapyr, triclopyr and glyphosate) when applying to emergent vegetation within any wet ditch.

Restoration Methods

Restoring treated sites can include active mulching, seeding, and planting with desired target vegetation. Machine mulching will be limited to areas that are on roads. Restoration can be passively accomplished where desirable vegetation is able to naturally replace removed target invasive species. The tools and methods used for restoration activities are the same as those used for manual and mechanical treatments.

Restoration prescriptions will be developed by appropriate ONF staff during implementation planning and will be influenced by site-scale conditions and broader land management objectives (for more information on restoration prescription process, see Appendix F of the 2006 ONF DEIS, Excerpts from the 2003 Draft Guidelines for Revegetation of Invasive plant Sites and Other Disturbed Areas on National Forests and Grasslands in the Pacific Northwest).

The ONF assumes that passive restoration will be successful on about 35 percent of the treatment sites, with 65 percent needing some kind of mulching, seeding, and/or infrequent planting. This proportion is based on the range of situations surrounding the inventoried invasive plant populations known across the ONF. For instance, meadows and forested areas are most likely to respond favorably to passive restoration, while roadsides and other highly disturbed areas may require mulching and/or seeding/planting with desirable vegetation. The intent is to re-establish competitive local, native vegetation post-treatment in areas of bare ground. In some cases, preferred non-natives may be utilized as temporary ground cover for erosion control and as noxious plant competitors, until native species can become established at the site. Preferred non-native plants would not aggressively compete with natives, persist long-term, or exchange genetic material with local native plant species.

Evaluation for site restoration may occur before, during and after herbicide, manual and mechanical treatments. Passive site restoration would be favored in areas having a stable, diverse, native plant community and sufficient organics in the soil to sustain natural revegetation. If the soils lack sufficient organics, mulch and/or fungal *mycorrhizae* would be added.

Implementation Planning Process

To ensure the consistency of approach and compliance with this proposed action, treatment of all known or future invasive plant treatment sites will follow the method outlined below. The methodology follows Integrated Weed Management (IWM) principles (R6 2005 FEIS) (USDA 2005a) and satisfies U.S. Forest Service pesticide use planning requirements. It applies to currently known infestations and new sites found within or outside currently mapped treatment areas during ongoing inventory. Appropriate FS specialists will review and designate appropriate PDFs for the final site-specific prescription. For example, an ONF fish biologist will review the annual program of work to ensure that appropriate buffer widths are included where listed fish are present.

I. Characterize invasive plant infestations to be treated.

- Map and describe target species, density, extent, treatment strategy and priority.
- Add or refine target species information to database.
- Validate affected environment at the treatment site and ensure no extraordinary site conditions exist that were not considered in the 2006 ONF FEIS. New treatment areas found during future inventories will be evaluated for extraordinary site conditions, which may trigger additional NEPA or ESA requirements. For example, new information may reveal that an action may affect listed species in a way not previously considered; or methods needed to be effective would not be consistent with the PDFs and/or buffer requirements. Specific site conditions, such as soil type and depth to groundwater, will be considered in developing site-specific prescriptions.

II. Develop site-specific prescriptions.

- Use IWM principles (R6 2005 FEIS) (USDA 2005a) to identify preferred treatment methods. Considerations include the biology of the target species and surrounding environment (these items are also evaluated when invasive plant infestations are characterized). Determine whether preferred methods are within the scope of those analyzed in the 2006 ONF FEIS. Prescribe herbicides as needed based on the biology of the target species and size of the infestations. If preferred methods have ecosystem effects that are outside the scope of those analyzed in the 2006 ONF FEIS, additional NEPA and ESA analyses would be required.
- Broadcast application of herbicide would be considered for situations warranted by the density (approximately 70 to 80 percent cover) or the distribution (e.g. continuous target populations along a road), or both, of invasive plants, unless limited by PDFs (see Table 4). Broadcast applications would not occur on any road systems identified as having high potential to deliver herbicide to streams (Appendix F of the BA). Under the Proposed Action, broadcast applications along stream channels, lakes, and wetlands would be restricted by PDFs and required buffers (Tables 5, 6, and 7).
- Apply appropriate standards from the ONF LRMP as amended, and specific PDFs and buffers based on:
  - The size of the infestation, its treatment history and response to past treatment,

- Proximity to listed species and/or their habitats
- Proximity to streams, lakes, wetlands
- Whether the treatment site is along a road associated with high risk of herbicide delivery to surface water
- Soil conditions
- Municipal watersheds and/or domestic water intakes
- Places people gather (recreation areas, special forest product and special use areas).
- Effective herbicide (or mixture) and method of application needed.
- Additional considerations, such as weather conditions, can be found in the PDF section. Specialists will review and apply appropriate PDFs for the final site-specific prescription. For example, a fish biologist will review the annual program of work to ensure that appropriate buffer widths are included where federally-listed fish are present

- Review compliance criteria for Forest Plan and other environmental standards that apply to a given treatment site.
- If treatments would not be effective once PDFs are applied, further NEPA or ESA analysis may be required to authorize an alternative treatment.
- Review manual for Scotch broom treatments to ensure no effect on heritage resources.
- Complete Form FS-2100-2 (reproduced in Appendix E of the 2006 DEIS), Pesticide Use Proposal. This form lists treatment objectives, specific herbicide(s) that would be used, the rate and method of application, and PDFs that apply. Apply for an herbicide application permit from the WSDA for treatments of freshwater emergent invasive plants. No permit is required from WSDA for treatment of terrestrial invasive plants.
- Confirm that surfactants proposed meet requirement of the ONF LRMP.
- Confirm restoration plan and ensure acceptable plant or mulch materials are available.
- Determine need for pre-project surveys for listed species and/or their habitats.
- Coordinate with adjacent landowners, water users, agencies, and partners.
- Document the public notification plan.

III. Accomplishment and Compliance Monitoring.

- Develop a project work plan for herbicide use as per the Forest Service Pesticide Use Handbook (FSH 2109.14.3). This work plan presents organizational and operational details including the precise treatment objectives, the equipment, materials, and necessary supplies, the herbicide application method and rate; field crew organization and lines of responsibility and a description of interagency coordination.
- Ensure contracts and agreements include appropriate prescriptions and that herbicide ingredients and application rates meet label requirements, R6 2005 ROD (USDA 2005b),

and site-specific PDFs. Contracts and agreements will include the appropriate PDFs, buffers, and approved surfactants.

- Document and report herbicide use and certified applicator information in the National pesticide use database, via the Forest Service Activity Tracking System (FACTS). A pesticide use report extracts data from FACTS. See Appendix E of the 2006 DEIS for reporting forms.
- The WSDA is the responsible agency for pesticide management. The WSDA holds the National Pollutant Discharge Elimination System permit (NPDES) for use of herbicides to control aquatic and/or emergent noxious plants in Washington State**.**
- Implement the public notification plan and document accomplishments.
- For future or unknown infestations (EDRR program treatments), a Project Consistency Evaluation Form (PCEF) will be completed for each treatment in the action area. The ONF currently uses a PCEF to evaluate the effects of proposed actions on listed species. In addition, the ONF proposes to annually develop a Geographical Information Survey (GIS) database of all herbicide treatments. Each treatment will have information associated with it, such as what noxious plants are occurring, what treatment method, chemical, application rate and method will be employed.
- Non-herbicide treatments should be included and reported in the FACTS database.

IV. Post-treatment Monitoring, Recurring Treatments, and Adaptive Management.

- Implementation monitoring would occur during implementation to ensure PDFs are implemented as planned. Post-treatment reviews would occur on a sample basis to determine whether treatments were effective and whether or not restoration has occurred as expected. Non-target vegetation (e.g., botanical species of local interest) would be evaluated before and immediately after treatment, and two to three months later.
- Contract administration and other existing mechanisms would be used to correct deficiencies. Herbicide use would be reported as required by the FSH 2109.14 and FACTS (see Appendix E of the 2006 DEIS).
- Post-treatment monitoring would also be used to detect whether PDFs were appropriately applied, and whether non-target vegetation impacts are within tolerable levels.
    - Re-treatment and active restoration prescriptions would be developed based on post-treatment results. Changes in herbicide or non-herbicide methods, within the scope of the 2006 ONF DEIS and BA, would occur based on results. For instance, an invasive plant population treated with a broadcast herbicide may be retreated with a spot spray, or later manually pulled, once the size of the infestation is sufficiently reduced following the initial treatment.
    - Treatment buffers would be expanded if damage were found outside buffers as indicated by a decrease in the size of any non-target plant population, leaf discoloration or chlorophyll change, or mortality to individual species of local interest or non-target vegetation. The findings would be applied to buffers for waterbodies. Buffers may be adjusted for certain herbicides and application methods and not others, depending on results.

- Additional monitoring may be included as part of the ONF Annual Monitoring Plan or other ongoing programs such as state water quality monitoring. The R6 2005 ROD adopted a monitoring framework to ensure listed species are protected. Treatments within riparian areas may be selected for monitoring as part of this regional, interagency effort. If the Regional Monitoring Framework is not developed or near completion by 2007, then the ONF will develop their monitoring framework for high risk sites by December 2008.
- Reporting forms and summaries will be submitted to NMFS and USFWS annually, at the beginning of each calendar year, and a meeting to assess adherence will be conducted following receipt.

<u>Monitoring</u>

The ONF invasive plants coordinator is maintaining an up-to-date invasive plant inventory using NRIS/Terra (a Forest Service accepted protocol at the national level). The inventory will be used as the main vehicle for tracking treatment effectiveness at site-specific, Forest-wide, and Regional scales.

The ONF Plan includes a Monitoring Plan to assess treatment effectiveness. Annually, monitoring results are reported by the ONF staff. In addition, the R6 2005 ROD established a framework for project and program monitoring (see Appendix M of the R6 2005 ROD) (USDA 2005b).

Results from implementation/compliance and effectiveness monitoring (both the effectiveness of treatments in meeting project objectives, and effectiveness of protection measures) will be used to identify and respond to changing conditions and new information and assess the need to make changes to treatment and restoration prescriptions within the scope of this consultation. If there is a need to make changes to treatment and restoration strategies outside the scope of this analysis, then the ONF will need to do additional NEPA and ESA analysis, and potentially reinitiate consultation.

Implementation and Compliance Monitoring

Implementation/compliance monitoring answers the question, "Did we do what we said we would do?" This question needs to be answered on a Regional, sub-regional, and forest-level scale, because adaptive management strategies require determination that actions are taking place as described in the R6 2005 FEIS.

The ONF will contribute to compliance monitoring under the R6 2005 ROD as a part of ONF Plan Implementation monitoring. Regional Office staff will periodically aggregate this information as a part of program oversight.

An implementation/compliance monitoring database would track invasive plant treatment projects that are the subject of section 7 consultations under the ESA, generate annual reporting of compliance for use by the Services (NMFS and USFWS), and the FS, and allow for common reporting of data on individual projects. At a minimum, on each project requiring consultation, reporting will be required on compliance with Standards 16, 18, 19, and 20 in the R6 2005 ROD. Additional standards could be included, as appropriate. For example, Northwest Forest Plan (NWFP) riparian standards relevant to herbicide use.

Effectiveness Monitoring

The Effectiveness Monitoring component in the R6 2005 FEIS (USFW 2005a) is intended to answer the following questions:

- Have the number of new invasive plant infestations increased or decreased in the Region or at the project level?
- What changes in distribution, amount and proportion of invasive plant infestations have resulted due to treatment activities in the region or at the project level?
- Has the infestation size for a targeted invasive plant species been reduced regionally or at the project level?
- Which treatment methods, separate or in combination, are most successful for specific invasive species?
- Which treatment methods have not been successful for specific invasive species?

The nation-wide NRIS/Terra and the FACTS databases, provide common reporting formats to input information and provide a mechanism for addressing the above questions. In addition, current long-term ecological monitoring networks will assist the FS in determining trends of invasive plant infestations at the Regional level.

Monitoring that addresses the effectiveness of various measures designed to reduce potential adverse effects on listed species, from the project, including standards in the R6 2005 FEIS, "project design criteria", "design features", and "protection measures" would only be required for a representative sample of invasive plant treatment projects that pose a "high risk" to federally listed species. "High risk" projects are defined as projects with the potential to affect listed species, in the following situations:

- Any project involving aerial application of herbicide.
- Projects involving the use of heavy equipment or broadcast application of herbicide (e.g. boom spray or backpack spraying that is not limited to spot sprays) that occur in 1) riparian areas (as defined in NWFP, Pacfish, or Infish, as applicable), ditches or water corridors connected to habitat for listed fish; or, 2) proximity to federally listed plants or butterfly habitat.

No broadcast treatments would occur within 50 feet of any wet or dry stream, lake, or within any wetland with water present. Broadcast treatments would also not occur along roads that pose a high risk of herbicide delivery to surface waters, regardless of whether the road ditches are connected to habitat for listed fish or not. In addition, aerial application of herbicides is not part of this consultation.

However, broadcast of aquatic glyphosate and/or aquatic imazapyr may occur within a riparian area as defined in the NWFP. These treatments, along with herbicide treatment of wetland or stream emergent vegetation using spot or hand/selective methods, would be submitted as candidates for monitoring via the R6 2005 ROD Monitoring framework to ensure the design features for such treatments are effective.

Programmatic Project Consistency Reporting

The Action Agency is responsible for ensuring all individual actions taken under a programmatic consultation are carried out as described in that consultation with environmental results as predicted in that consultation. NMFS assists in this task by reviewing monitoring results to help action agencies ensure their projects do not jeopardize listed species or adversely modify or destroy their designated critical habitat. In the past, action agencies and NMFS have relied on periodic reporting, usually on batches of projects completed per year, after concluding programmatic consultation. To enable consistent reporting format, NMFS and action agencies have used forms agreed on by the agencies during consultation. For this consultation, ONF will use the Consultation Initiation and Reporting System (CIRS) for reporting on individual actions when that system becomes available.

<u>Activities Not Covered by this Consultation</u>

- Aerial Herbicide Application
- Herbicides other than the ten analyzed in this document
- Prescribed Burning
- Plowing/Tilling/Disking/Digging With Heavy Equipment
- Grazing Or Other Cultural Treatments
- Flooding/Drowning
- Foaming and Steaming

Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area is approximately 318,286 acres of ONF watersheds supporting listed fish that would be subject to site-specific treatments as well as EDRR management as described above. In addition, the action area includes stream reaches up to 300 feet in length beyond the boundary of the ONF where treatment sites adjacent to the ONF boundary may cause effects beyond the boundary. This distance is based on the typical NPDES derived distance for dilution downstream from a source of input into water.

Threatened Puget Sound (PSC) Chinook salmon, Puget Sound steelhead (PSS), and Hood Canal (HCC) summer-run chum salmon use the action area to express each of their freshwater life histories (Table 8). NMFS designated critical habitat in the action area for PSC in the mainstem Grey Wolf, Dungeness, Dosewallips, and Duckabush Rivers, and North and South Forks of the Skokomish River. NMFS designated critical habitat for HCC on the lowest extent of ONF land on the Dosewallips River (September 2, 2005; 70 FR 52630). The action area, except for areas above natural barriers to fish passage, also contains EFH for Chinook salmon (Pacific Fishery Management Council [PFMC] 1999), and is in an area where environmental effects of the proposed project may adversely affect EFH for this species.

Table 8. Federal Register Notices for Rules that list species, designate critical habitat, or apply protective regulations to ESUs/DPSs considered in this consultation.

Species ESU/DPS	**Listing Status**	**Critical Habitat**	**Protective Regulations**
Puget Sound Chinook (*Oncorhynchus tshawytscha*)	Threatened, 3/24/99; 64 FR 14308	9/02/05; 70 FR 52630, (effective 1/02/06)	6/28/2000; 70 FR 37160
Hood Canal summer-run chum (*O. keta*)	Threatened, 03/25/99; 64 FR 14507 Status confirmed, 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630, (effective 1/02/06)	6/28/2000; 70 FR 37160
Puget Sound steelhead (*O. mykiss*)	Threatened, 5/11/07; 72 FR 26722	Pending	pending

ENDANGERED SPECIES ACT

Section 7(a)(2) of the ESA requires Federal agencies to consult with NMFS to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. This Biological Opinion (Opinion) records the results of the subject consultation. Section 7(b)(4) requires the provision of an incidental take statement (ITS) that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts. The ITS follows the Opinion in this document.

Biological Opinion

This Opinion presents the results of NMFS' consultation with ONF regarding whether the proposed action will jeopardize listed species or adversely modify or destroy their designated critical habitat. For the jeopardy analysis, NMFS reviews the status of each listed species of Pacific salmon and steelhead[3] considered in this consultation, the environmental baseline in the action area, the effects of the action, and cumulative effects (50 CFR 402.14(g)). From this assessment, NMFS discerns whether effects on individual animals in the action area are meaningful enough, in view of existing risks, to appreciably reduce the likelihood of the survival and recovery of the affected listed species.

For the critical habitat adverse modification analysis, NMFS considers the status of critical habitat, the functional condition of critical habitat in the action area (environmental baseline), the effects of the action on that level of function, and the cumulative effects. From this assessment, NMFS discerns whether any change in the function of the primary constituent elements (PCEs) of critical habitat in the action area is enough, in view of existing risks, to influence the function and conservation role of designated critical habitat. This analysis does not employ the regulatory definition of "destruction or adverse modification" at 50 CFR 402.02. Instead, this analysis relies on statutory provisions of the ESA, including those in section 3 that define "critical habitat" and "conservation," in section 4 that describe the designation process, and in section 7 that sets forth the substantive protections and procedural aspects of consultation, and on agency guidance for application of the "destruction or adverse modification" standard.[4]

Status of the Species

To complete interagency consultation under ESA section 7, NMFS considers the status of each of the species likely to be adversely affected by any element of the proposed action. To make a determination on whether the proposed action will or will not jeopardize the continued existence of each affected species, NMFS considers the species' present prospects for long-term survival and the risks bearing on those prospects.

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[3] "An ESU of Pacific salmon (Waples 1991) and a DPS of steelhead (final steelhead FR notice) are considered to be 'species,' as defined in Section 3 of the ESA."

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

There are a variety of ways to describe existing risk. The analysis in this document includes a synthesis of existing status reviews, including information on the attributes of 'viable salmonid populations' (VSP) (McElhany et al. 2000). The attributes of viable salmonid populations include: abundance, productivity, spatial structure, and genetic diversity that maintain a species' capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle, characteristics that are influenced, in turn, by the functional condition of habitat such as that which might be adversely affected by the proposed action. The following definitions are generally accepted for the four VSP parameters found in McElhaney et al. (2000):

- ***Abundance*** – Abundance is simply defined as the population size. This may reflect the number of spawning adults, the number of adults surviving to recruit to fisheries, the number of smolts emigrating from the system, or in other terms. Abundance is recognized as an important parameter because small populations are at greater risk of extinction than large populations, primarily because several processes that affect population dynamics operate differently in small populations than they do in large populations. Generally, the abundance of a VSP must be sufficient to: 1) provide the population a high probability of surviving observed environmental variation; 2) provide resilience to withstand changing conditions; 3) maintain genetic diversity; 4) to provide ecological functions throughout its life-cycle, and 5) to take into account uncertainty in population assessment.

- ***Productivity*** – Productivity is generally defined to be the growth rate of the population. Productivity is usually expressed as a ratio, for example, recruits/spawner. Recruits may be adults recruiting to a fishery, spawners, smolts, or other measure. For a VSP, the productivity should be sufficient to:
  1) Maintain abundance above the viable level (in the absence of hatchery subsidy);
  2) maintain abundance above the viable level, even during poor ocean conditions;
  3) provide compensatory response at low population size.

- ***Spatial Structure*** – Population spatial structure affects evolutionary processes and may therefore alter a population's ability to respond to environmental change. A population's spatial structure depends fundamentally on habitat quality, spatial configuration, and dynamics as well as the dispersal characteristics of individuals in the population.

- ***Diversity*** – Variation has important effects on population viability. In a spatially and temporally varying environment, there are three general reasons why diversity is important for species and population viability. First, diversity allows species to use a wider array of environments than they could without it. Second, diversity protects a species against short-term spatial and temporal changes in the environment. Third, genetic diversity provides the raw material for surviving long-term environmental change.

Puget Sound Chinook

The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, 22 of which are believed to be extant currently (Puget Sound Technical Recovery Team (TRT) 2001, 2002). The populations presumed to be extinct are mostly early returning fish; most of these are in mid-to southern Puget Sound or Hood Canal and the Strait of Juan de Fuca. The ESU populations with the greatest estimated fractions of hatchery fish tend to be in mid- to southern Puget Sound, Hood Canal, and the Strait of Juan de Fuca (Good et al. 2005). Chinook salmon (and their progeny) from the following hatchery stocks are considered part of the listed ESU: Kendall Creek (spring run); North Fork Stillaguamish River (summer run); White River (spring run); Dungeness River (spring run); and Elwha River (fall run).

Although the TRT identified two independent populations in the Hood Canal region, the team concluded that extensive diversity of the historical Skokomish River population or populations has been lost. These losses include early returning life histories that are no longer expressed, and genetic diversity that was lost due to extensive introductions of nonnative hatchery fish. Early reports on salmonid use of Hood Canal streams documented early returning life histories in the Skokomish, Dosewallips, Duckabush, and Hamma Hamma rivers and late-returning life histories in the Skokomish River. More recently, Williams et al. (1975) noted the historical occurrence of early returning life histories and reported late-returning life histories in the Dosewallips, Duckabush, and Hamma Hamma rivers; however, whether these fish represented historical population components or introductions of nonnative hatchery fish remains unclear. Nehlsen et al. (1991) considered the early returning populations extinct, and the co-managers concluded that if these fish still existed in the Skokomish River, they were at very low abundances (WDF et al. 1993). The strong genetic similarities of extant populations to Green River Chinook salmon (Marshall 2000) suggest that the historical genetic characteristics of the early and late-returning populations were replaced or substantially altered by Green River-origin fish, which have been released extensively in the region (Myers et al. 1998).

The Dungeness River Chinook population is one of two identified by the TRT in the Strait of Juan de Fuca region. In the Dungeness River extensive human disruptions, including introductions of nonnative hatchery fall Chinook salmon may have more severely impacted late-returning life histories (Williams et al. 1975, Jamestown S'Klallam Tribe 2003). Questions remain about the population structure of the PSC salmon spawning in the basin. Nehlsen et al. (1991) identified the late-run fish as being at high risk of extinction. More recent assessments indicate that only one PSC salmon stock with no discontinuity in spawning distribution through time or space exists in the basin (Ruckelshaus et al. 2006). Based on available evidence, the TRT concluded that the late-returning life history in the Dungeness River was a significant part of the historical diversity of the PSC salmon population, which remains at high risk of extinction.

The range-wide habitat needs of PSC vary depending on the life history stage present and the natural range of variation present within the system (NRC 1996; Spence et al. 1996). For this action area, PSC need the habitat characteristics that support successful spawning, rearing, and migration. These include sufficient water and passage conditions that allow access to and from spawning areas (migration), appropriate spawning substrate, cold clean water for egg and alevin survival, shallow water margins for juvenile avoidance of predators, sufficient prey base for juvenile growth, presence of riparian vegetation, floodplain connectivity for refugia from high flows, and appropriate volumes and flows of water for rearing.

The VSP parameters are at least partly influenced by how well these habitat elements and characteristics function to support the life stages of salmon expresses in that habitat. The following section provides more detail about the current status of the Dungeness River, Duckabush River, Dosewallips River, Hamma Hamma River, Skokomish River, and Dungeness Chinook populations, as defined by the action area, in relation to the four VSP parameters as described by McElhany et al. (2000).

Because of the geographic isolation of the Hood Canal streams, the TRT concluded that PSC salmon spawning historically in Hood Canal streams were independent populations from other Chinook salmon spawning aggregations in Puget Sound. Within Hood Canal, PSC salmon spawn in the Skokomish, Hamma Hamma, Duckabush, and Dosewallips Rivers, which drain the Olympic Mountains to the west and which are larger, steeper, and deeper than streams to the east (WDF et al.1993). Identifying historical independent populations within Hood Canal from these extant spawning aggregations is problematic because of early alterations to habitat, fish passage, and fisheries; limited historical and life history data; and introductions of non-native hatchery fish, which likely confounded genetic patterns.

Genetically most of this area's present spawning aggregations are similar and appear to reflect the extensive influence of hatchery releases in the region, mostly from the Green River broodstock (WDF et al. 1993, Myers et al. 1998, Marshall 2000).

For the Hood Canal major population group, spawning areas are mostly in the stream's lower reaches because the upper reaches extend to high-gradient of the eastern Olympic Range. Mean spawn timing of the extant spawning aggregations in Hood Canal Rivers (ranging from mid-September to early October) is somewhat earlier than in south Puget Sound. Within Hood Canal, spawning occurs earlier in the Dosewallips and North Fork Skokomish rivers than in the Hamma Hamma, Duckabush, South Fork Skokomish and Skokomish rivers.

In Hood Canal, spawning populations in six streams were considered a single stock by the co-managers because of extensive transfers of hatchery fish (WDF et al.1993). Fisheries in the area were managed primarily for hatchery production and secondarily for natural escapement; high harvest rates directed at hatchery stocks resulted in failure to meet natural escapement goals in most years (USFWS 1997).

The biological review team (BRT) found moderately high risks for all VSP categories. Informed by this risk assessment, the strong majority opinion of the BRT was that the naturally spawned component of the PSC ESU is "likely to become endangered within the foreseeable future." The minority opinion was in the "not in danger of extinction or likely to become endangered within the foreseeable future" category (Good et al. 2005).

In terms of productivity, these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS 2004). However, long-term trends in abundance for naturally spawning populations of PSC salmon indicate that approximately half the populations are declining, and half are increasing in abundance over the length of available time series. The median over all populations of long-term trend in abundance is 1.0 (range 0.92 to 1.2), indicating that most populations are just replacing themselves. Over the long-term, the most extreme declines in natural spawning abundance have occurred in the combined Dosewallips and Elwha populations. Those populations with the greatest long-term population growth rates are the North Fork Nooksack and White Rivers. All populations reported above are likely to have a moderate to high fraction of naturally spawning hatchery fish, so it is not possible to say what the trends in naturally spawning, natural-origin PSC salmon might be in those populations.

Fewer populations exhibit declining trends in abundance over the short-term than over the long-term. Four of 22 populations in the ESU declined from 1990 to 2002 (median = 1.06, range = 0.96 to 1.4) (Good et al., 2005). In contrast, estimates of short-term population growth rates suggest a very different picture when the reproductive success of hatchery fish is assumed to be one. The following is a detailed summary of the Hood Canal PSC VSP elements.

Skokomish Populations of Puget Sound Chinook. The Skokomish River is the largest Hood Canal stream, and historically it produced Chinook salmon with extensive life history diversity.

Abundance. Between 1987 and 2002 the abundance ranged between 2,200 and 2,500 natural-origin spawners (NOS) with a high around 2600 NOS in 1998 and a low below 500 NOS is 1996 (Good et al. 2005). This can be categorized as an abundance status ranging between a critical and current capacity threshold. This does not take into account the potential contribution of hatchery-origin Chinook to the total population abundance.

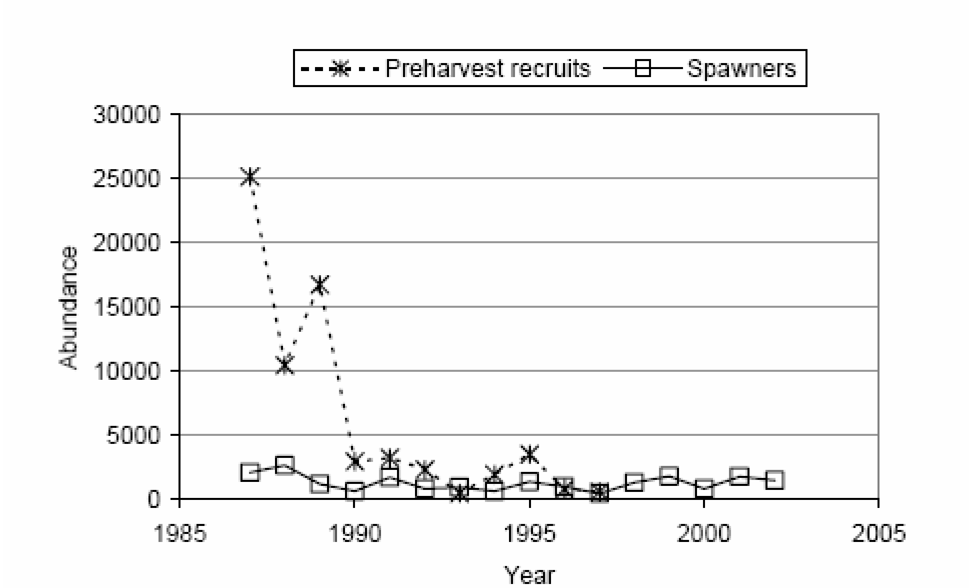

Figure 1. Preharvest recruits and spawners versus broodyear for the Skokomish River Chinook salmon population, 1987–2002 (Good et al. 2005)

Productivity. The population in this watershed is exhibiting a short-term positive trend (1.04 short-term lambda) (Table 12). However, it should be noted that these fish are primarily non-indigenous in origin (Good et al. 2005). One might assume that the reproductive success of naturally spawning hatchery-origin fish is the driver for this positive short-term growth trend.

Spatial Structure. This population has a relatively high spatial structure. The population is considered a boundary stock that defines the geographical extent of the ESU. In addition, the population serves as a source stock for re-colonizing the vacant habitat (Good et al. 2005).

Diversity. Puget Sound Chinook in this watershed is not genetically unique. Extensive diversity of the historical Skokomish River population or populations has been lost (Ruckelshaus et al. 2006). This is indicated by the fact that this population is 1 of 2 in the sub-region. The geographic separation between the upper and lower south fork and mainstem Skokomish River is less than 3 km, however, which is at the extreme lower end of reported geographic separations of other PSC salmon populations. The potential risk of hatchery Chinook salmon production in this watershed on natural population diversity is moderate. In addition, there appears to be a low genetic introgression risk of non-native hatchery-origin strays in natural spawning areas of this watershed (Ruckelshaus et al. 2006). Lastly, the percent of sub-yearling emigrant life history strategy of this population is very high (100 percent), indicating that the rare and diminishing yearling emigrant life history strategy does not exist in this population (Ruckelshaus et al. 2006).

Skokomish River Populations Summary. The strong genetic similarities of extant Skokomish populations to Green River Chinook salmon (Marshall 2000) suggest that the historical genetic characteristics of the early and late-returning populations were replaced or substantially altered by Green River-origin fish, which have been released extensively in the region (Myers et al. 1998). This is reflected by the current abundance status ranging between critical and current capacity thresholds. Also, the diversity of the extant population is poor in comparison to other major populations in the ESU and to the Skokomish historic populations, even though the short-term growth rate is weakly positive. This positive trend is due in large part to the reproductive success of naturally spawning hatchery-origin Chinook. The poor population status and integrity bodes poorly for the ESU as this population is an important contributor to the whole as a result of its high spatial structure.

Dosewallips, Duckabush, Hamma Hamma Rivers. The balance of information the TRT has at this time supports treating these three spawning aggregations as a single independent population, although other categorizations are possible. Most PSC salmon spawning in the mid-Hood Canal streams likely occurred in the Dosewallips River, because it is larger and has more area accessible to anadromous fish (Ruckelshaus et al. 2006).

Abundance. Between 1968 and 2002 the abundance ranged between a bit over 800 and approximately 100 natural-origin spawners (NOS) with a high around 1,500 NOS in 1985 and a low below 100 NOS is 1977 (Good et al. 2005). This can be categorized as a natural-origin population abundance status at a critical threshold. This does not take into account the potential contribution of hatchery-origin Chinook to the total population abundance. Over the long-term, the most extreme declines in natural spawning abundance have occurred in the combined Dosewallips populations (Figure 2).

Productivity. The combined populations in the three watersheds have one of the most positive short-term trends and population growth rates in the ESU (1.17 short-term lambda). These populations are thought to have a moderate fraction of naturally spawning hatchery fish, but because such estimates are not available, estimating the trends in natural-origin spawners is not possible.

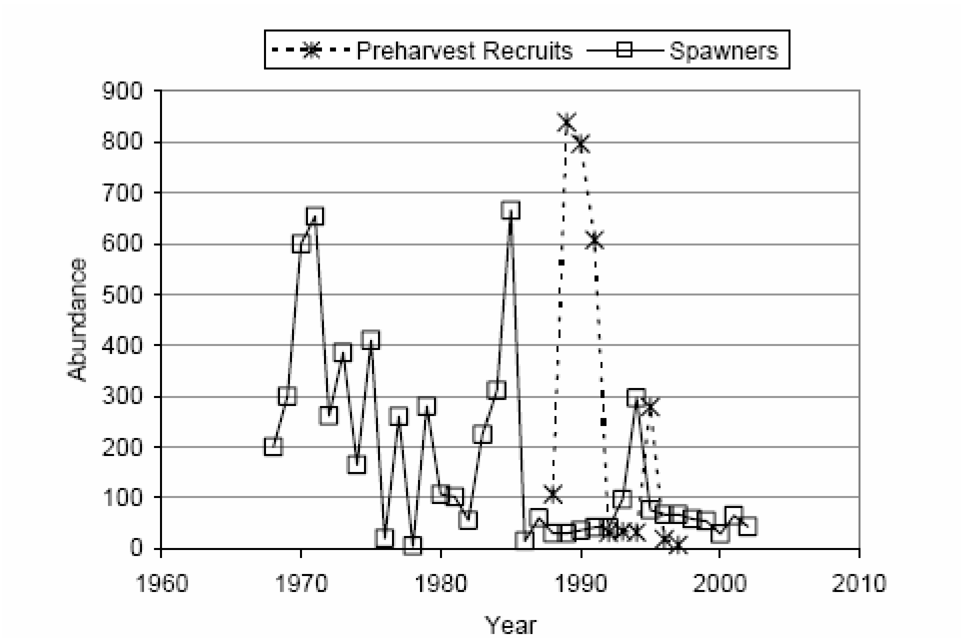

Figure 2. Preharvest recruits and spawners versus broodyear for the Dosewallips River Chinook salmon population, 1967–2002

Spatial Structure. The combined populations in the three watersheds have a spatial structure role from the point of connectivity to the entire ESU. These populations have an important connectivity value as a bridging point between sub-regions or genetic diversity units (Good et al. 2005).

Diversity. The Hamma Hamma River has the greatest amount of data to estimate genetic diversity. This population is not genetically unique when compared to other Puget Sound major populations. This is indicated by the fact that this population is one of two in the sub-region, relating to the frequency of occurrence within the region. The potential risk of hatchery Chinook salmon production in this watershed on natural population diversity is moderate. In addition, there appears to be a low genetic introgression risk of non-native hatchery-origin strays in natural spawning areas of this watershed (Ruckelshaus et al. 2006). Lastly, the percent of sub-yearling emigrant life history strategy of this population is very high (100 percent), indicating that the rare and diminishing yearling emigrant life history strategy does not exist in this population (Ruckelshaus et al. 2006).

Dosewallips, Duckabush, Hamma Hamma Rivers Populations Summary. Limited data for the three populations in this combined group is a source of uncertainty and prevents solving the questions about the disparity of the VSP parameters. One potential, yet unaddressed, scenario is that the Chinook salmon spawning in the Dosewallips, Duckabush, Hamma Hamma Rivers were subpopulations of a single, large Hood Canal Chinook salmon population with a primary spawning aggregation in the Skokomish River. In any event, spawning abundance has been deemed at a critical threshold due to numbers of natural-original spawners as low as 100 fish. This is contrasted by the highest short-term growth rate in the entire ESA, most likely due to a fraction of hatchery-origin spawning. From the limited existing data, diversity has been determined to be low with little genetic uniqueness and a low genetic introgression risk of non-native hatchery-origin strays in natural spawning areas of this watershed. The spatial structure of these populations is important from the standpoint of acting as a bridge between sub-regions or genetic diversity units.

San Juan de Fuca major population group - The Dungeness River has a fairly large spawning area accessible to Chinook salmon that reaches into the snowmelt-transition hydroregion. Spawning in the Dungeness River extends up to river mile (RM) 18.7 and up to RM 8 in the GW River (Lichatowich 1993 referenced in Haring 1999). Spawning in the Dungeness River begins significantly earlier in the upper main stem than in the main stem.

Dungeness River Population. The Dungeness River has natural Chinook salmon runs as well as hatchery runs. The Dungeness River had a run of spring- and summer-run Chinook salmon, with a 5-year geometric mean natural escapement of 105 fish at the time of the last status review update (Myer et al. 1998). The Dungeness river population exhibited downward trends in abundance in the 1990s.

Abundance. Between 1986 and 2002 the abundance ranged between 250 and greater than 650 NOS with a high greater than 650 NOS in 2002 and a low below 50 NOS in 1993. The most recent 5-year (1998–2002) geometric mean of natural spawners in the Dungeness River population of PSC salmon is 222 fish (Good et al. 2005). This can be categorized as a natural-origin population abundance status at a critical threshold. This does not take into account the potential contribution of hatchery-origin Chinook to the total population abundance.

Productivity. The population in this watershed is exhibiting a short-term positive trend (1.09 short-term lambda) (Table 10). However, it should be noted that these fish are primarily non-indigenous in origin (Good et al. 2005). One might assume that the reproductive success of naturally spawning hatchery-origin fish is the driver for this positive short-term growth trend.

Spatial Structure. This population has a relatively high spatial structure. The population is considered a boundary stock that defines the geographical extent of the ESU (Beechie et al. 2006).

Diversity. The population uniqueness and genetic diversity of this population are low. This is indicated in part by the fact that this population is 1 of 2 in the sub-region, relating to the frequency of occurrence within the region. Based on the potential adverse effects of hatchery Chinook salmon production in the watershed on the natural population diversity, this population is at a high risk. In addition, there appears to be a low genetic introgression risk of non-native hatchery-origin strays in natural spawning areas of this watershed (Ruckelshaus et al. 2006). Lastly, the percent of sub-yearling emigrant life history strategy of this population is quite high (84 percent), indicating that the rare and diminishing yearling emigrant life history strategy does not exist in this population (Ruckelshaus et al. 2006).

Dungeness River Population Summary. In the Dungeness River extensive human disruptions including introductions of nonnative hatchery fall Chinook salmon may have more severely impacted late-returning life histories (Williams et al. 1975, Jamestown S'Klallam Tribe 2003). In general, this population is exhibiting a critical abundance status, and a low diversity status, even though the short-term growth rate is weakly positive. This positive trend is due in large part to the reproductive success of naturally spawning hatchery-origin Chinook. The poor population status and integrity bodes poorly for the ESU as this population is an important contributor to the whole as a result of its high spatial structure.

Table 9. Estimates of long- and short-term trends and the short-term median population growth rate (λ), and their 95 percent confidence intervals for spawners in Puget Sound Chinook salmon populations (data are from the Puget Sound TRT, unpublished data). Long and short-term trends are calculated on all spawners; short-term λ is calculated assuming the reproductive success of naturally spawning hatchery fish is equivalent to that of natural-origin fish (for those populations where information on the fraction of hatchery fish in natural spawning abundance is available).

Population*	**Data years**	**LT Trend (CI)**	**ST Trend (CI) (1990-2002)**	**ST λ (+ lnSE) (1990-2002)**
Skokomish	1987-2002	0.99 (0.93-1.05)	1.04 (0.97-1.12)	1.04 (0.04)
Combined Dosewallips	1968-2002	0.96 (0.93-0.98)	1.11 (0.99-1.20)	1.17 (0.10)
Dungeness1	1986-2002	1.02 (0.94-1.10)	1.07 (0.94-1.20)	1.09 (0.11)

* Estimate of the fraction of hatchery fish in time series is not available for use in λ calculation, so trend represents that in hatchery-origin + natural-origin spawners.

Information on the in-river timing of anadromous salmonids at various life stages in presented in Table 10.

Table 10. Timing of life stages of anadromous salmonids on the Dungeness River (modified from Hiss 1993)

Species	Life Stage		Month									
		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
P.S. Chinook	Migration					X	X	X	X	X			
	Spawning								X	X	X		
	Rearing	X	X	X	X	X	X	X	X	X	X	X	X
P.S. steelhead	Migration	X	X	X	X	X	X	X	X	X	X	X	X
	Spawning		X	X	X	X	X						
	Rearing	X	X	X	X	X	X	X	X	X	X	X	X

Hood Canal Summer-Run Chum

Eight extant summer-run chum salmon stocks in Hood Canal are spawning in 13 streams, primarily on the western side of Hood Canal. An estimated 7 of 16 historical populations in this ESU have been extirpated, with most of the population losses occurring on the eastern side of Hood Canal. The Jimmycomelately Creek summer chum population shows a loss of abundance and productivity compared to historic levels. The Salmon-Snow summer chum population shows a high loss in performance compared to historic levels both in abundance and productivity, particularly under unfavorable ocean survival conditions. Summer chum salmon in the Dungeness River are infrequently observed and their status is currently unknown. Given the size and historic diversity of the watershed, it is likely that summer chum salmon production occurred in the Dungeness River.

Although many of the remaining populations are at very depressed levels, adult returns in a number of streams increased between 2000 and 2002. In particular, the BRT remains concerned that widespread loss of estuary and lower floodplain habitat is an ongoing risk factor for this ESU. A number of supplementation programs have been initiated in recent years to help boost abundance of local populations. Although these programs may help speed recovery of existing populations or reseed vacant habitat, the BRT found it difficult to assess the current effects of these programs because of the inability to distinguish most hatchery and wild fish (Good et al. 2005).

Collectively, artificial propagation programs in the ESU presently provide a slight beneficial effect to ESU abundance, spatial structure, and diversity, but uncertain effects on ESU productivity. The long-term contribution of these programs after they are terminated is uncertain. Despite the current benefits provided by the comprehensive hatchery conservation efforts for Hood Canal summer-run chum, the ESU remains at low overall abundance with nearly half of historical populations extirpated. Informed by the BRT findings (Good et al. 2005) and the assessment of the effects of artificial propagation programs on the viability of the ESU, the Artificial Propagation Evaluation Workshop concluded that the Hood Canal summer-run chum ESU in-total is "likely to become endangered in the foreseeable future" (NMFS 2004).

Abundance. Recent four year (1999–2002) geometric mean abundance of summer-run chum salmon in Hood Canal streams containing extant populations ranges from 10 to just over 4,500 spawners (median = 576, mean = 1,064) (Good et al. 2005). Most of the naturally spawning populations of Hood Canal summer-run chum salmon exhibit increasing abundance over the short-term—seven of eight extant populations in the ESU increased in abundance from 1990 to 2002 (short-term lambda range 0.85 to 1.39 (Table 14). These recent increases likely reflect the supplementation programs in some streams and possibly recent improvements in ocean conditions (Good et al. 2005). In contrast to short-term trends, long-term trends in abundance for extant naturally spawning populations of summer-run chum salmon in Hood Canal indicate that only two populations (combined Quilcene and Union rivers) are increasing in abundance over the length of available time series (Table 11). The median long-term trend over all populations is 0.94, indicating that most populations are declining at a rate of 6 percent per year. The range in long-term trend across the extant populations in Hood Canal is from 0.88 in the Jimmycomelately and Lilliwaup populations to 1.08 in the Union population. The Quilcene population's positive growth rate is most likely due to the supplementation program on that stream (Good et al. 2006).

Table 11. Estimates of long- and short-term trends, short-term median population growth rate (λ), and their 95 percent confidence intervals (CI) for natural spawners in extant Hood Canal summer-run chum salmon populations. Source: WDFW and PNPTT (2000, 2001); Puget Sound TRT database, unpublished data, available from N. Sands, Northwest Fisheries Science Center, Seattle, WA 98119.

Population	Data years	Long-term trend (95% CI)	Short-term trend[a] (95% CI)	Short-term λ[b] ($\pm$ lnSE)
Big/Little Quilcene[c]	1974–2002	1.05 (0.96–1.16)	1.62 (1.31–2.01)	1.39 (0.22)
Dosewallips	1972–2002	0.96 (0.90–1.04)	1.25 (0.94–1.63)	1.17 (0.24)
Duckabush	1968–2002	0.91 (0.87–0.96)	1.14 (0.96–1.36)	1.1 (0.17)
Hamma Hamma	1968–2002	0.90 (0.86–0.94)	1.20 (1.04–1.40)	1.3 (0.19)
Jimmycomelately	1974–2002	0.88 (0.84–0.93)	0.815 (0.64–1.03)	0.85 (0.16)
Lilliwaup	1971–2002	0.88 (0.83–0.92)	1.00 (0.74–1.37)	1.19 (0.44)
Salmon/Snow[c]	1974–2002	0.99 (0.94–1.03)	1.24 (1.12–1.37)	1.23 (0.10)[c]
Union	1974–2002	1.08 (1.05–1.12)	1.10 (1.00–1.22)	1.15 (0.10)

[a] Short term is 1990 to 2002.
[b] Short-term λ is calculated assuming the reproductive success of hatchery-origin spawners is equivalent to that of wild-origin spawners (in cases where information on hatchery fish is available).
[c] Estimates of the fraction of hatchery fish are available only for the combined Quilcene and Salmon/Snow populations for the years 1995–2000.

Productivity. The contribution of the summer chum salmon hatchery programs to natural summer chum productivity is unknown, although each program, on average, appears to be returning hatchery-origin adult spawners above replacement levels, as evidenced by available smolt to adult survival rate data (Adicks et al. 2005; NMFS 2005).

Spatial Structure. Population spatial structure has also benefited from reintroduction of spawners in historically used watersheds. Spatial structure has also been enhanced through increased spawning abundances and attendant density dependent expansion of spawning area use.

Diversity. Extant diversity of the ESU has been preserved through likely prevention of further extirpations, and creation of genetic reserves for several populations via reintroductions of naturally spawning adult returns to streams where native populations had been extirpated.

Puget Sound Steelhead

The geographic boundaries of the PSS DPS include winter- and summer-run steelhead runs in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). The PSS ESU is primarily composed of winter steelhead stocks, but also includes several small stocks of summer steelhead occupying limited habitat (Busby et al. 1996).

Populations in Hood Canal and along the Strait of Juan de Fuca are generally small, averaging fewer than 100 spawners annually. The geometric means of most populations have declined in the last 5 years, and are below the long-term means. The BRT identified that the Hamma Hamma winter-run hatchery steelhead stock is part of the PSS DPS. The BRT did note that the Hamma Hamma program does appear to have successfully increased the number of natural spawners in the population (although the relative increase in natural spawners is large, the absolute increase in natural spawners is modest). The BRT concluded that the risk to the viability of PSS due to declining abundance is high (Good et al. 2005, NMFS 2005).

The BRT estimated median population growth rates (λ) for several populations in the ESU, using the 4-year running sums method (Holmes 2001, Holmes and Fagan 2002; see also McClure et al. 2003). For the steelhead populations in Hood Canal and the Strait of Juan de Fuca an average age structure was applied based on a mean of age structures within the region or across the ESU. The estimates of λ (Table 12) are consistent with the trends in natural run size; λ is less than 1, indicating declining population growth, for nearly all populations in the ESU. Exceptions in the action area include Hamma Hamma winter-run populations in Hood Canal. Of the populations showing evidence of declining recent population growth, some show only slight declines, e.g. Quilcene (NMFS 2005).

Table 12. Median short-term population growth rate estimates (λ) and their 95 percent confidence intervals for PSS within the action area. For each population, estimates are computed for the most recent 10 years of data (1995-2004). Estimates in bold are based on natural spawners solely. (WSH – winter-run steelhead, SSH summer-run steelhead, N/A data not available, CI – confidence interval).

Run Type	**Population**	**λ**	**95 percent CI (λ)**
WSH	Dosewallips	N/A	N/A
WSH	Duckabush	N/A	N/A
WSH	Hamma Hamma	1.013	N/A
WSH	Quilcene	**0.988**	N/A
WSH	Skokomish	**0.865**	N/A
WSH	Dungeness	0.924	0.924-0.924
WSH	Elwha	0.966	0.965-0.966

Estimates of population growth rate are alarmingly low for several populations throughout the ESU. These populations include the Skokomish winter-run in Hood Canal. Thus, there is evidence for declining population growth in large winter-run populations in the major production areas of northern and southern Puget Sound. Relevant data are not available for nearly all of the smaller populations, several of which show some evidence for declines as well. Similarly, relevant data are not available for virtually all summer-run populations in the ESU. Trends in marine survival were not available for any of the populations in the ESU (NMFS 2005).

Nearly all PSS populations in the DPS exhibited diminished productivity as indicated by below-replacement population growth rates, and declining short- and long-term trends in natural escapement and total run size. Declining productivity was particularly evident in southern PSS populations, but was also exhibited by some populations in Hood Canal, and the Strait of Juan de Fuca. For example, the average escapement of Skokomish River winter-run PSS between 1994 and 2004 was 34 percent (WDFW 2006). Positive population trends were observed in the Hamma Hamma river winter-run populations (as noted above, the increasing trend for the Hamma Hamma River population likely reflects a recently established supplementation hatchery program, rather than an increase in naturally produced steelhead). The BRT concluded that the risk to the viability of PSS due to declining productivity is high (Good et al. 2005).

The BRT noted that the distribution of steelhead has been affected by a number of dams in several Puget Sound river basins that block accessibility to habitat and connectivity among populations. Additionally, the BRT noted that urban development has degraded or eliminated wetland and riparian habitats, resulting in changes to river hydrology and the loss of side-channel areas, thereby reducing the spawning and rearing distribution of PSS populations. The BRT concluded that the viability of PSS is at moderate risk due to the reduced spatial complexity of, and connectivity among, populations (Good et al. 2005, NMFS 2005).

The BRT noted concern regarding the apparent reduction of the summer-run steelhead populations in Puget Sound. Some members of the BRT felt that adverse impacts from these out-of DPS hatchery programs may be contributing to the declines in natural steelhead productivity, but acknowledged that the magnitude of any such impact could not be ascertained. The BRT concluded that the viability of PSS is at moderate risk due to the reduced life-history diversity of populations and the potential threats posed by artificial propagation and harvest in the Puget Sound (Good et al. 2005, NMFS 2005).

Status of Critical Habitat

The status of designated critical habitat considers the range-wide condition and trends of those physical and biological features that are essential to the conservation of a given species, referred to as the "Primary Constituent Elements" (PCEs) (Table 13) and that may require special management considerations or protection (50 CFR 424.12(b)).

The designated critical habitat for PSC and HCC salmon includes rivers and streams flowing into Puget Sound including the Strait of Juan De Fuca from the Elwha River, westward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington and Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington, respectively (50 CFR 52630; September 2, 2005).[5]

[5] More detailed information on the 2005 critical habitat designations, including exclusions, is available at: http://www.nwr.noaa.gov/Publications/FR-Notices/2005/upload/70FR52630Pre.pdf

Table 13. Essential physical and biological features named as PCEs in all salmon critical habitat designations.

Site	Essential Physical and Biological Features	Species Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover [a]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[b]	Juvenile and adult mobility and survival
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater
	Natural cover,[a] forage,[b] and water quantity	Growth and maturation
Nearshore marine areas	Free of obstruction, water quality and quantity, natural cover,[a] and forage [b]	Growth and maturation, survival
Offshore marine areas	Water quality and forage [b]	Growth and maturation

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

The relevant PCEs for this consultation area limited to those supporting the freshwater life histories of PSC and HCC. The rangewide functional condition of those PCEs is generally diminished and rangewide limiting factors include disconnected floodplains (rearing and migration PCEs), altered and simplified channel structure (rearing, migration, and spawning PCEs), diminished riparian habitat and watershed processes (spawning, rearing, and migration PCEs), altered instream flow (spawning, rearing and migration PCEs). Short explanations of the effect of each limiting factor are summarized below.

- Floodplain disconnectivity and channel simplification is widespread in the ESUs, causing diminished space for spawning and rearing capacity, increased egg and alevin death during incubation, and loss of juvenile rearing refugia from predation and high instream flow.
- Historic forest practices allowing timber harvest and related management activity within the riparian zone has affected the riparian processes that make and maintain shade, bank stability, intercept overland sediment flow, and contribute food and recruitable large wood in streams. Loss of these functions diminishes the capacity and condition of salmon spawning, incubation, and rearing areas. This factor is prevalent throughout the range of both ESUs and causes destabilization of streambeds and channels, leading to loss of rearing refugia and killing eggs during incubation.

- Human land use activities enable erosion and transport of sediment to streams. In turn, water quality diminished from turbidity, and deposition leads to streambed aggradation. These changes affect the availability of food items, the condition of spawning areas, and the survival of incubating eggs and alevins.
- Instream flows and changed hydrology affect HCC that migrate in summer and spawn in lower stream channels. Excessively low flows resulting from water withdrawals or wetlands loss limit access to spawning streams and/or to suitable spawning sites, and restricts spawning to unprotected main-channel areas that are highly vulnerable to scour during freshets. In addition, altered summer low flows lead to excessively high water temperatures that adversely affect adult fish migration, rearing and incubation success. Finally, increases in the magnitude, frequency and duration of peak flow events resulting from man-caused hydrologic alterations adversely affect salmonid survival during incubation.

To assist NMFS during the designation of critical habitat, NMFS convened several Critical Habitat Analytical Review Teams (CHARTs). The CHARTs, organized by major geographic domains that roughly correspond to recovery planning domains, consisted of federal salmonid biologists and habitat specialists tasked with assessing biological information pertaining to areas under consideration for designation. The CHARTs explored a variety of data sources and used their best professional judgment to: 1) determine if occupied areas contained PCEs essential for conservation; 2) determine whether there were any unoccupied areas within the historical range of the listed salmon and steelhead that may be essential for conservation; 3) score each habitat area based on several factors related to the quantity and quality of the physical and biological features; 4) rate each habitat area as having a ‘‘high,’’ ‘‘medium,’’ or ‘‘low’’ conservation value; 5) identified management actions that could affect salmonid habitat in given areas.[6] The CHART ratings for each of the watersheds in the action area are listed in the section below.

Puget Sound Chinook Critical Habitat

Myers et al. (1998) noted that anthropogenic activities have limited the access to historical spawning grounds and altered downstream flow and thermal conditions. In general, forest practices impacted upper tributaries, and agriculture or urbanization impacted lower tributaries and mainstem rivers. The WDF et al. (1993) cited diking for flood control, draining and filling of freshwater and estuarine wetlands, and sedimentation due to forest practices and urban development as problems throughout the ESU. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in several basins. Bishop and Morgan (1996) identified a variety of critical habitat issues for streams in the range of this ESU, including changes in flow regime (all basins), sedimentation (all basins), high temperatures (Dungeness River), streambed instability (most basins), and estuarine loss (most basins). These impacts on the spawning, rearing and migrating environments may also have altered the expression of many life-history traits, and masked or exaggerated the phenotypic distinctiveness of many stocks.

[6] CHART reports are available at: http://www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/2005-Biological-Teams-Report.cfm

Adult spring-run PSC salmon typically return to freshwater in April and May and spawn in August and September (Orrell 1976; WDF et al. 1993). Adults migrate to the upper portions of their respective river systems and hold in pools until they mature. In contrast, summer-run fish begin their freshwater migration in June and July and spawn in September, while summer/fall-run chinook salmon begin to return in August and spawn from late September through January (WDF et al. 1993). The majority of PSC migrate to the ocean as subyearlings.

Water diversion and hydroelectric dams have prevented access to portions of several rivers. Watershed development and activities throughout the Puget Sound, Hood Canal, and Strait of Juan de Fuca regions have resulted in increased sedimentation, higher water temperatures, decreased large woody debris recruitment, decreased gravel recruitment, a reduction in river pools and spawning areas, and a loss of estuarine rearing areas (Bishop and Morgan 1996).

The action area contains critical habitat the Skokomish, Hood Canal, and Dungeness and Elwha Subbasins. The Skokomish Subbasin (HUC5 1711001701) contains a single watershed encompassing approximately 248 square miles (642.3 sq km). The Skokomish River population is the only historically independent population documented in this Subbasin by Ruckelshaus et al. (2001, 2004). Fish distribution and habitat use data from WDFW identify approximately 72 miles (115.9 km) of occupied riverine and estuarine habitat in the watershed (WDFW and PNPTT 2003). The CHART concluded that all occupied areas contain spawning, rearing, or migration PCEs for this ESU and identified several management activities that may affect the PCEs, including channel modification or confinement by manmade dikes, dams, forest management, and land use change leading to urbanization which alters watershed processes related to hydrology, among other things. The CHART also concluded that habitat areas in this watershed warrant a high rating for conservation value to the ESU (NMFS 2004a). The CHART did not identify any unoccupied areas in this subbasin that may be essential for the conservation of the ESU (NMFS 2004). Critical habitat within the action area is identified along the South Fork of the Skokomish River, Brown Creek and the North Fork of the Skokomish River.

The Hood Canal Subbasin (HUC5 1711001803, 1711001804, 1711001805) contain six occupied watersheds encompassing approximately 605 sq miles (1,567sq km). Fish distribution and habitat use data from WDFW identify approximately 59 mi (95.0 km) of occupied riverine/estuarine habitat in the watersheds (WDFW and PNPTT 2003). The Mid-Hood Canal population is the only historically independent population documented in this subbasin by Ruckelshaus et al. (2004). Occupied reaches in two HUC5s (Dosewallips River and Duckabush River) overlap with FEMAT key watersheds for at-risk anadromous salmonids (FEMAT 1994). The CHART concluded that all occupied areas contain spawning, rearing, or migration PCEs for this ESU and identified several management activities that may affect the PCEs, including agriculture, channel modifications/diking, forestry, roadbuilding, and urbanization (Table 15). Of the six watersheds reviewed by the CHART, habitat areas in two were rated as having high conservation value (Duckabush and Dosewallips Rivers). Habitat in one watershed was rated as having medium conservation value (Hamma Hamma River), and habitat in three watersheds were rated as having low conservation value to the ESU (Lower West Hood Canal Frontal, Big Quilcene River, West Kitsap) (NMFS, 2004a). The CHART did not identify any unoccupied areas in this subbasin that may be essential for the conservation of the

ESU. Critical habitat within the action area is identified along the Duckabush and Dosewallips Rivers.

The Dungeness and Elwha Subbasin (HUC5 1711002003) contains five watersheds, three of which are occupied, and encompass approximately 695 square miles (1,800 sq km). Ruckelshaus et al. (2001, 2004) identified two historically independent populations in this subbasin, the Dungeness River and Elwha River. Chinook salmon in the Port Angeles Harbor watershed are not currently assigned to a historically independent population for this ESU. Fish distribution and habitat use data from WDFW identify approximately 47 miles (75.6 km) of occupied riverine/estuarine habitat in the watersheds (WDFW and PNPTT 2003). CHART concluded that all occupied areas contain spawning, rearing, or migration PCEs for this ESU and identified several management activities that may affect the PCEs, including channel modifications, forestry, irrigation impoundments and withdrawals, roadbuilding, and urbanization. Of the three watersheds reviewed by the CHART, habitat areas in two were rated as having high conservation value (Dungeness and Elwha Rivers) and habitat in one watershed was rated as having medium (Port Angeles Harbor) conservation value to the ESU (NMFS 2004). Occupied reaches on the Dungeness River overlap with a FEMAT key watershed for at-risk anadromous salmonids (FEMAT 1994). CHART did not identify any unoccupied areas in this subbasin that may be essential for the conservation of the ESU. Critical habitat within the action area is identified along the Dungeness and Grey Wolf Rivers.

Table 14. Summary of Occupied Areas, PCEs, and Management Activities Affecting PCEs for the Puget Sound Chinook salmon ESU within the Action Area.

Subbasin	**Watershed**	**HUC5 Code**	**Spawning/ Rearing PCEs (mi)**	**Rearing/Migration PCEs (mi)**	**Presence/Migration Only PCEs (mi)***	**Management Activities ** **
Skokomish	Skokomish River	1711001701	37.7	3.7	30.5	C, D, F, U
Hood Canal	Lower West Hood Canal Frontal	1711001802	0.7	<0.1	0.5	C, F, R, U
Hood Canal	Hamma Hamma River	1711001803	3.8	0.0	<0.1	C, F
Hood Canal	Duckabush River	1711001804	6.4	<0.1	1.6	C, F
Hood Canal	Dosewallips River	1711001805	13.0	0.5	<0.1	C, F, R
Hood Canal	Big Quilcene River	1711001806	2.2	0.5	0.2	C, F
Dungeness/ Elwha	Dungeness River	1711002003	31.8	<0.1	1.2	C, F, I, R, S, U
Dungeness/ Elwha	Port Angeles Harbor	1711002004	4.7	0.0	4.8	F, U
Dungeness/ Elwha	Elwha River	1711002007	5.2	1.2	<0.1	D, F

* Some streams classified as "Presence/Migration Only PCEs" may also include rearing or spawning PCEs, but the GIS data are still undergoing review to confirm species use type.
** This list is not exhaustive. It is intended to highlight key management activities affecting PCEs in each watershed. Activities identified are based on the general categories described by Spence et al. (1996) and summarized previously in the "Special Management Considerations or Protection" section of this report. Coding is as follows: F= forestry, G = grazing, A = agriculture, C = channel modifications/diking, R = road building/maintenance, U = urbanization, S = sand and gravel mining, M = mineral mining, D = hydroelectric dams, I = irrigation impoundments and withdrawals, T = river, estuary, and ocean traffic, W = wetland loss/removal, B = beaver removal, X = exotic/invasive species introductions, H = forage fish/species harvest. Primary sources for this information were CHART.

Hood Canal Summer-Run Chum Critical Habitat

The HCC streams are characterized by low summer and early fall flows and likely experience elevated stream temperatures during the summer chum spawning periods. Given the return timing of summer-run chum and the associated low flow conditions of spawning streams, chum are confined to the lower reaches of the streams (Crawford 1997; Turner 1995). Degradation of spawning habitat, reduced river flows, and increased pinniped populations in Hood Canal have been cited as habitat limiting factors for the Hood Canal summer-run chum ESU (Johnson et al. 1997).

Migration to spawning grounds occurs from late August through late October. Adults generally spawn in low gradient, lower mainstem reaches of natal streams, typically in center channel areas where low flows are likely concentrated during late summer and early fall. Eggs incubate in redds for 5 to 6 months, and fry emerge between January and May. After hatching, fry move rapidly downstream to sub-estuarine habitats (WDFW and PNPTT, 2000).

The action area contains no critical habitat designated for HCC. As such, there will be no effect from the proposed action on designated critical habitat. Therefore, the consultation did not consider whether the proposed action will adversely modify or destroy HCC critical habitat and this Opinion presents no further analysis.

Environmental Baseline

The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The NMFS describes the environmental baseline in terms very similar terms to those informing the status of the species and critical habitat, with focus specifically limited to the action area defined for the consultation. As such, the environmental baseline focuses the discussion of extant risk factors for the entire species or critical habitat unit, to those present in the action area and which might be influenced by the effects of the proposed action.

For actions affecting habitat, NMFS typically describes the environmental baseline in terms of the functional condition of the processes that create and maintain habitat in the action area. Each listed species considered in this Opinion is known to spawn, rear, and migrate through freshwater in or through the action area. Thus, for this action area, the relevant habitat conditions are those that support successful completion of those life histories, including:

1. Freshwater spawning sites with water quantity and quality conditions and substrate that supports spawning, incubation and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without them juvenile salmonid cannot access and use the areas needed to forage, grow, and develop behaviors (*e.g.*, predator avoidance, competition) that help ensure their survival.

3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use

the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.

The elements of PCEs that are most relevant to the proposed action are: water quality, substrate, forage, natural cover, and aquatic vegetation as they will be affected by the proposed action. The section that follows describes the existing life history strategies of the fish populations in the action area, and the factors that bear on their present PCEs within each watershed.

Puget Sound Chinook in the Action Area

The Dungeness and Elwha Subbasin (HUC5 1711002003) contains the Dungeness River watershed, which itself contains three separate fifth field watersheds the Lower Dungeness (LD), the Upper Dungeness (UD) and Gray Wolf (GW) (De Cillis 1999). Spring- and summer-run Chinook salmon spawn from river mile (RM) 3 to 18.8 in the mainstem of the Dungeness River and in the lower 5.1 miles of Grey Wolf. These are considered a single Chinook stock although spawning times are slightly different (WDF et al. 1993). Peak spawning in the upper section of spawning area in the river is August 20 through September 8, while peak spawning in the lower reaches is from August 27 through October 8 (Lichatowich 1993). Chinook salmon remain in the river approximately 12 months following emergence from the gravel. The stock is native, with a wild origin. Captive broodstock recovery programs for spring-run Chinook salmon are in place on the Dungeness River (NMFS 1998).

The Hood Canal Subbasin (HUC5 1711001803, 1711001804, 1711001805) includes the mid-Hood Canal PSC population (comprised of the Dosewallips, Duckabush and Hamma Hamma sub-populations), is one of the two genetically distinct Chinook populations that historically and currently exist within the Hood Canal area of the P.S. Chinook salmon ESU, the other being the Skokomish Chinook population. PSC spawn in the lower reaches of all three of the Mid Hood Canal rivers. In the Hamma Hamma River mainstem, spawning occurs up to RM 2.5, where a barrier falls prevents higher access. A series of falls and cascades typically block access to the upper Duckabush River at RM 7, and to the upper Dosewallips River at RM 14, though spawning may also occur in Rocky Brook Creek, a tributary to the Dosewallips River. Because most tributaries to the three rivers are inaccessible the mainstems are vital in terms of production potential.

Life history strategies for all three subpopulations are similar. Chinook spawn from late September through October. Eggs that are laid in the fall hatch in the early spring. As juveniles grow, they gradually move out into swifter water, smolting to enter the marine environment after approximately a year and a half. These subpopulations originated through hybridization of native and non-native fish or were previously native fish that had undergone substantial genetic alteration. Composite production indicates that a subpopulation is sustained by both wild and artificial (i.e., hatchery) production. Escapement for Hood Canal chinook salmon has ranged from a high of 4,537 in 1971 to a low of 292 in 1981; 1991 escapement was 1,823 (WDF et al. 1993). The Dosewallips River is believed to have historically supported a spring Chinook run.

By 1991, however, the stock was described as a remnant and at high risk of extinction, and by 1993 was not listed as one of the disputed spring Chinook stocks (WDF et al. 1993). Similarly, the Duckabush River subpopulation has extremely weak escapements, and is regarded as at high risk of extinction. Fall-run Chinook return to Duckabush River at a rate of 100 to 200 individuals per year (WDF et al. 1993; EAEST 1999b; EAEST 1999c).

The Skokomish Subbasin (HUC5 1711001701) populations consist of summer- and fall-run PS Chinook that enter the Skokomish River in September and October. These populations have a mixed origin, in that they originate through hybridization of native and non-native, hatchery fish. Peak spawning occurs in the river mainstem up to RM 5.8 and in the lower Vance Creek in late October. The river mainstem and Vance Creek are also primary habitat locations utilized by all life history stages (EAEST 1999d).

Hood Canal Summer-Run Chum in the Action Area

The HCC return to spawn in natal streams in late summer and their fry migrate back to the estuary in late winter and early spring. While spawning varies somewhat between some populations, it typically occurs from late August through late October. Fry emerge from the gravel between early February and May, with peak emergence being March 22 and April 4 for Hood Canal and Strait populations respectively (Tynan 1997). Summer chum spawn soon after freshwater entry in the lower reaches of the mainstem streams. The use of lower reaches may be an adaptation to the low flow conditions present at arrival time; September is frequently the month of lowest flow in Hood Canal streams (Brewer et al. 2005).

Simenstad and Salo (1982) estimated that chum emerge during the darkness of night, and then fry immediately move downstream, likely entering the stream mouth estuary the same night of emergence within Hood Canal streams. Transition from freshwater to brackish and saline waters within the estuary can therefore be very brief (less than 12 hours). Emergence and fry emigration to the estuary from a single watershed likely occurs over several weeks, similar to emergence patterns seen for other salmonids. Instream feeding during migration by chum in general is probably insignificant except in very large rivers where spawning migrations are extensive (Simenstad and Salo 1982).

WDFW and PNPTT (2000) state that chum survival during the freshwater life history stage is linked to a number of habitat parameters. Those include water quantity (low and peak flows), water quality (temperature, sediment, and chemical composition), riparian forest conditions (width of riparian forest, age of trees, species composition), sediment conditions (aggradation, degradation, and presence of fine sediment), channel complexity (large woody debris quantities, channel condition, and amount of side channel habitat), access to habitat, and presence of predators (Brewer et al. 2005). Most factors are interrelated, as a change in one parameter typically manifests itself in changes to other parameters. For example, reduced channel complexity is closely correlated with high rates of sediment transport and deposition, as well as reduced channel interaction with the associated floodplain. The factors relevant to this consultation are water quality, riparian and sediment conditions.

Dungeness River (HUC5 1711002003) summer chum salmon distribution is not well known. Summer chum have been observed (WDFW and PNPTT 2003) and adults have been recovered at the Dungeness Hatchery located at RM 10.8 (WDFW and PNPTT 2000).

The Eastern Strait of Juan de Fuca (HUC5 1711002001, 1711002002, 1711001908) includes the Jimmycomelately Creek stock where fish spawn up to RM 1.5. Historic spawning may have occurred up to RM 1.9 (Brewer et al. 2005). Jimmycomelately Creek summer chum salmon stocks are considered the "core" source for the Strait population aggregation.

The H.C. summer-run sub-population produced in Salmon and Snow Creek watersheds spawn up to RM 2.0 in Salmon Creek and RM 3.0 in Snow Creek. The highest density of spawners in Salmon Creek has been observed at approximately river mile RM 0.7, hence, from the mouth to RM 0.8 is the primary spawning habitat for summer chum salmon. In Snow Creek the majority of spawning occurs below RM 1.5. The primary summer chum spawning habitat is found from RM 0.0 to 1.0 in Snow Creek (Brewer et al. 2005). Salmon/Snow Creek summer chum salmon stocks are considered the "core" source for the Strait population aggregation.

The indigenous Chimacum Creek summer-run sub-population was extirpated, but a naturally spawning aggregation, using transplanted Salmon/Snow Creeks stock as a donor, has been reintroduced. Chimacum Creek is considered, at least initially, as an extension of the Salmon/Snow Creeks summer-run chum stock. Spawning in Chimacum Creek likely occurs in the lower river below RM 3.0. Surveys have observed spawning between the mouth and RM 1.0 (WDFW and PNPTT 2003). During 2004, adults were observed up to the Nesses Corners Road at approximately RM 2.0. Chimacum Creek functions as the "satellite" area for the Strait population aggregation.

Spawning does not occur within the action area. The HCC are unlikely to rear on National Forest lands, which are located upstream from spawning locations. This assumption is based on the knowledge that chum fry, following emergence, immediately move downstream, likely entering the stream mouth estuary the same night of emergence within Hood Canal streams (Simenstad and Salo 1982). For this reason, these populations will not be analyzed further in this Opinion.

The Quilcene (HUC5 1711001806, 1711001807) system populations includes the Big and Little Quilcene River sub-populations. Presence of HCC has been documented in a section of the Big Quilcene River which extends onto the ONF (Brewer et al. 2005). NMFS assumes that spawning does occur within the action area. Summer-run chum salmon spawn in the Big Quilcene River from mid-September through late October. Summer-run chum spawn up to RM 2.8, the location of the Quilcene National Fish Hatchery and in the lower mile of the Little Quilcene River. Primary spawning grounds are in the first mile of the Big Quilcene River. The early (summer) run is native stock with wild production. The subpopulations suffer from chronically low escapement. Although there are no escapement figures specific to the Big Quilcene River, Hood Canal escapement has fallen from a high of nearly 44,000 fish in 1968 to approximately 700 in 1991. Escapement figures for Little Quilcene River range from a high of approximately 2,200 in 1978 to a low of nearly zero in 1985; in 1996 escapement was approximately 50. Fish harvests between 1991 and 1996 removed an average of 2.5 percent of the summer-run chum salmon returning to Hood Canal, compared with an average of 71 percent between 1980 and 1989 (EAEST 1999a; WDF, WDW, WWTIT 1992).

The Hood Canal Subbasin (HUC5 1711001803, 1711001804, 1711001805) supports the HCC sub-population naturally produced in the Hamma Hamma River watershed (Hamma Hamma River, John Creek), the Duckabush River watershed, and the Dosewallips River watershed. The HCC sub-populations from these systems do not spawn inside ONF lands nor within 300 feet beyond the ONF boundary. Therefore, HCC spawning from these sub-populations does not occur within the action area. Since rearing typically occurs downstream from spawning (Simenstad and Salo 1982), HCC from these sub-populations are also unlikely to rear in the action area. For the foregoing reasons, these populations will not be analyzed further in this biological opinion.

The Skokomish Subbasin (HUC5 1711001701) indigenous HCC sub-population in the Skokomish River was extirpated. Summer chum spawning, presumably by strays, is still observed.

Puget Sound Steelhead in the Action Area

Steelhead spawn in large rivers and their tributaries, and most anadromous streams. Summer PSS generally arrive in May through October and spawn from February through April. Winter PSS enter fresh water as early as December, continuing through April. Both steelhead stocks occur within the Dungeness River upstream to RM 18.7 and within the GW River upstream to RM 9.6. Bountry et al. (2002) evaluated potential spawning gravel sites within the Dungeness and GW Rivers. Emergence occurs in spring or early summer and juveniles may spend 1 to 4 years (most typically 2 to 3 years) in freshwater before emigrating to sea. The PSS make significant use of the lower river and side-channel habitat. An additional 2 to 3 years are spent at sea, and steelhead may return to spawn two or three times.

Estimates of natural recruitment (naturally produced recruits per spawner, R/S) are highly variable among PSS populations. Low estimates are represented in winter-run populations across the range of the ESU: particularly in the Skokomish winter-run (Hood Canal), and Dungeness Rivers (NMFS 2005).

Habitat utilization by steelhead, while affected by modifications in flood flow and changes in riverine morphology from urbanization, loss of wetlands/riparian habitat, and agricultural development, has been most dramatically affected by a number of large dams in basins to Puget Sound (Moscrip and Montgomery 1997, Booth et al. 2002, May et al. 2003, Beechie et al. 2001, Collins and Montgomery 2002, Pess et al. 2002). In addition to eliminating accessibility to habitat, dams affect habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and the movement of large woody debris.

The two Cushman dams, Dam No. 1 (River kilometer (RKm) 31.5, constructed in 1926) and Dam No. 2 (RKm 27.8, constructed in 1930) eliminated anadromous access to much of the North Fork Skokomish River. Anecdotal evidence suggests that steelhead utilized much of the North Fork Skokomish River, although it is not clear whether these were winter- or summer-run steelhead. Additionally, the diversion of flow from the North Fork to the powerhouse has reduced the overall flow of the Skokomish River by 40 percent (USDA Forest Service 1995). The FERC and NMFS completed consultation on the operation of Cushman Dam on the North Fork Skokomish River on February 24, 2004. That consultation concluded with a “no jeopardy” determination and conditions in the FERC license relating to changed operations. Changes in dam operations in the North Fork of the Skokomish River provide improved flow regimes for migrating, spawning, and rearing anadromous fish in river reaches below the dams. General habitat recovery objectives to reduce the adverse effects of dam operation include (1) providing free and unimpeded access to migrating adult and emigrating juvenile chum through elimination of existing human caused barriers and maintenance of adequate flow, and (2) improving the stability, quantity, and quality of spawning habitat by providing adequate stream flow.

In the Elwha River Basin, two dams, the Elwha Dam (RKm 7.9, constructed in 1911) and the Glines Canyon Dam (RKm 21.6, constructed in 1927) block access to over 100 Km of historical mainstem and tributary habitat. Both dams are scheduled to be removed beginning sometime around 2012. NMFS completed formal consultation with the National Park Service (NPS) in 2006. The proposed dam removal has not yet been started.

Environmental and Habitat Conditions in the Action Area

Dungeness and Elwha Subbasin (HUC5 number 1711002003). The following section focuses solely on the Dungeness River watershed (HUC 171100203) as the Elwha River distribution of PSC does not extend into the ONF, and is not part of the action area.

The Dungeness River is relatively short (31.9 miles) and steep. The Dungeness drains a watershed of 172,517 acres (270 square miles), emptying into the Strait of Juan de Fuca (Bountry et al. 2002). Its largest tributary, the GW River, is 17.4 miles long, with a total sub-watershed of 76 square miles. A total of 546 miles of streams and tributaries make up the watershed.

The Dungeness River descends steep mountain canyons from the core rocks of the Olympic Mountains. The Dungeness River is an active, high energy river, characterized in its upper basin by steep unstable canyon slopes and high flow velocities. The upper watershed contributes gravel and large boulders as well as large woody debris downriver.

The Dungeness is a bimodal flow river, showing two peaks over the course of the year: a smaller December peak associated with winter storm flows, and a larger June peak associated with snowmelt and spring runoff. The variability of flows is a major problem in the Dungeness River. There is relatively little storage in the upper watershed, so that current-year precipitation directly controls runoff. The location of the watershed in the so-called “rain shadow” of the Olympic Peninsula exacerbates the late-summer low flow. The average runoff of the Dungeness River, 2.46 cubic feet per second (cfs) per square mile, is lower than any other major north or east Olympic Peninsula basin.

Thomas et al. (1999) finds that snowmelt in the upper watershed causes consistently high flows in the late spring and early summer, and rainfall in the upper watershed causes high and more variable flows in the winter. The lowest flows occur in September and October; from September to mid-November 25 percent of the daily mean flows over the 67-year record were less than 150 cfs.

Human activity within the Lower Dungeness (LD) River (RM 0.0 to 10.5) has altered natural river processes, and as a result, river morphology. Bountry et al. (2002) identifies six primary human activities that have altered the LD, including construction of levees, clearing of riparian vegetation, construction of highway and railroad bridges, construction of riverbank protection structures, gravel extraction, and water diversion. Similarly, and in addition, environmental conditions in the Upper Dungeness (UD) have been influenced by forest management and timber harvest activities. These typically lead to the loss of riparian vegetation which in turn reduces slope stability leading to land movement and transportation of sediment and other debris to streams and the river.

Riparian condition varies throughout the Dungeness. The historic progression of forest practices approaches and regulation has resulted in different conditions and responsive succession depending when, how, and where harvests and roading have been conducted. Since, 1994, the ONF itself has been managed under the NWFP with its integrated Aquatic Conservation strategy. In addition, forest practices on nearby State and private forest land have been conducted under progressively more protective forest practices regulations and programs including the State of Washington Department of Natural Resources Habitat Conservation Plan and the Washington Forest Practices Habitat Conservation Plan.

The PSCRBT (1991) identified the UD (upstream of RM 10.8) as having excellent streambank cover, and the lower portion (downstream of RM 10.8) as having poor riparian condition (sporadic streambank cover, primarily deciduous vegetation, lack of conifer, pasture land, armored riprap banks). Loss of riparian vegetation reduces shading, and decreased bank porosity (Haring 1999). A decrease in bank porosity (i.e. filtering qualities) will transfer nutrients and toxins into the river where they may accumulate during low-flow periods. These effects decrease the overall water quality of the river and the water in it. Reduced shading increases water temperatures and can also lead to increased predation on rearing salmonid smolts.

Temperature. The reach of the Dungeness River from the mouth to Canyon Creek (RM 10.8) is designated as Class A waters. Upstream of RM 10.8, and all tributaries, are designated as Class AA waters. Within the various fifth field watersheds, valley form influences stream temperatures. The UD River and the middle to upper portions of the LD River, to RM 10, are confined channels, with narrow valley hill slopes and close in riparian vegetation, providing shade that keep water temperatures cool. The UD River met target shade levels except for Gold Creek, possibly reflecting the extensive timber harvest in that tributary (DAWACT 1995). The GW River mainstem appears to have a wider valley bottom providing naturally lower levels of shading, though the tributaries are steep and well shaded (De Cillis 1999).

Water temperatures contributed from the UD and GW Rivers are considered close to or near natural conditions. Average temperatures monitored in August, at RM 18 downstream to RM 10.8, showed minor increases in water temperature, from 11 degrees Celsius to more than 12 degrees Celsius. Several miles below the ONF boundary, from RM 10.8 to RM 1.0, temperatures increased more rapidly per length of channel compared to up-river locations. Water temperature increases downstream reflect the dramatic change in valley form, as the river flows through unconfined alluvial fan deposits with little or no protective shade. Substantial irrigation diversions and loss of riparian vegetation in the lower river may increase water temperatures (Barecca 1998).

The Dungeness River is on the CWA 303(d) List of impaired water bodies for instream flow. Extensive irrigation systems in the Dungeness Valley decrease instream flow, particularly from April through October, which adversely affects salmon stocks. A total of 581 cfs have been appropriated under water rights of the Dungeness River, while the average August-September flow measures only between 187 to 227 cfs (Barecca 1998).

Sediment and Turbidity. Both alpine and continental glaciation have shaped the landform features of the Dungeness basin. The UD and GW River headwaters contain steep slopes and shallow soils, resulting in chronic sediment production. These are natural processes, in areas unaffected by management activities.

Another result of alpine and continental glaciation is the "glacial lake" deposits. These deposits now comprise hillslopes, contain fine sediment (clays and silts), and are prone to slope failure leading to transport into waters within the watershed. The Dungeness River is naturally turbid from glacial runoff through much of the year (Haring 1999). The Dungeness River produces naturally high levels of turbidity during winter storms and spring and summer glacial melt. The GW River remains minimally impacted by management activities, though it has active geologic features. Underlying glacial lake deposits naturally produce turbid water conditions, when streams flow through disturbed or erodible soils.

The UD River reaches have been altered by bridge crossings and sediment input associated with timber harvesting, chronic landslides and road failures. However, the overall effects have been less persistent than in the lower river. The upper reaches are typically confined, steep, resistant to bed form changes, and have suffered only temporarily from the cumulative effects of upstream slope failures. The bed transport capacity of the upper river tends to pass sediment and flow downstream (to depositional areas) where the effects are cumulative, widespread, both persistent and transient, and ecologically significant. One exception occurs near the Dungeness Forks, where the channel widens (Osborn and Ralph 1994). The Dungeness Forks is in the upper Basin (upstream of where the GW River joins the Dungeness) and there are no channel constrictions. Channel slope decreases as the river comes out of the mountainous region and sediment delivery expands to the floodplain. On the other hand, the UD River watershed, above RM 24, is considered pristine habitat (De Cillis 1999). Over 27,000 acres within the Buckhorn Wilderness in the ONF and the Olympic National Park remain roadless.

Less than 1.5 percent of the GW River watershed has been logged, with activity mostly confined to the lower portion of the watershed (De Cillis 1999). Road densities are less than 0.3 mile per square mile of watershed area. Development is limited to the Dungeness Forks Campground, located at the confluence of the Dungeness and GW Rivers. Over 46,000 contiguous acres of the watershed are in the Buckhorn Wilderness on the ONF and Olympic National Park, remaining in a natural state, providing cold, clean water for prime refuge habitat for salmonids.

Side channels in the UD, at least as far as the suspected passage barriers above Gold Creek, have been recognized for their importance to the life histories of salmon and steelhead. They provide several benefits, including refuge areas from steeper gradients and higher flows, providing notably diverse habitat (especially for rearing Chinook), and as a potentially limiting factor for salmonids in the upper watershed. Above the Gold Creek confluence, three cataracts (boulder cascades) probably form barriers to salmon migration to the upper reaches of the Dungeness (Osborn and Ralph 1994). Also, above the Gold Creek confluence is an impassible falls at RM 18.7 that acts as a passage barrier to spawning habitat in the upper watershed (Bountry et al. 2002).

The Hood Canal Subbasin (HUC5 1711001803, 1711001804, 1711001805) lies predominantly in the rain shadow of the Olympic Mountains, which intercepts much of the precipitation from the Pacific Ocean. The southern part of the watershed experiences increased precipitation to as much as 70 to 80 inches per year along the foothills of the eastern Olympic Mountains. Eighty-five percent of the rainfall occurs in the winter. Many streams are naturally flow-limited and some dry during the summer months. This condition renders streams particularly vulnerable to habitat impacts such as elevated water temperatures or channel de-watering stemming from human removal of riparian vegetation and water extraction, and elevated herbicide concentrations. The Hood Canal subbasin is comprised of the Dosewallips, Duckabush, and Hamma Hamma rivers. Habitat factors for decline have been identified as altered sediment dynamics, and riparian degradation.

In the Dosewallips River Watershed, the largest landowners are the Olympic National Park and the ONF. Together, they comprise 93 percent of the watershed, and a significant portion of the National Forest land is protected as wilderness area. As a result, the environmental conditions there vary from wilderness supporting the processes that make and maintain excellent salmon and steelhead habitat, to active forest lands that have been managed for timber production; most recently under the Northwest Forest Plan. The NWFP incorporated an aquatic conservation strategy that, among other things typically results in riparian forest protection that is allowing the natural restoration of well-functioning watershed conditions and habitat maintaining processes.

Temperature. A synthesis of Washington State Department of Ecology records reveals a mean temperature was 8.6 degrees Celsius with a maximum of 15.5 degrees Celsius in the Dosewallips (Washington State Department of Ecology 1996), which is known for its cold water (EAEST 1999e). Nearly, three-quarters of the Duckabush River Watershed is managed as National Park or Wilderness Area. As a result, the Duckabush River provides high quality (clean and cool) water (EAEST 1999b). The watershed contains no waters listed on the Washington State 1996 303(d) listing or the Proposed 1998 303(d) listing (Washington Department of Ecology 1996).

Sediment, Turbidity, Chemical Contaminants and Nutrients. Snowpack and highly unstable landforms in the upper watershed, within the Olympic National Park, provide a naturally higher level of turbidity as the result of natural sediment delivery to the mainstem Duckabush River. Approximately 78 percent of all known erosional features in the watershed may deliver some quantity of sediment to stream channels. Analysis of aerial photos taken between 1939 and 1993 indicated that changes in channel dimensions in the middle watershed may be related to natural high sediment supply from streambanks and hillsides, since no management has occurred in this portion of the watershed (EAEST 1999b). □he Duckabush River is classified as “AA Extraordinary” water quality by the State of Washington (Washington Department of Ecology 1996).

In the Hamma Hamma River Watershed, temperature is not considered to be affecting the conservation role of the watershed and is not a limiting factor. The watershed has seen historic forest practices leading to presently lacking overstory canopy through portions of the basin, which can lead to an increase in water temperature, but data is lacking. The watershed contains no waters listed on the Washington State 1996 303(d) listing or the Proposed 1998 303(d) listing (Washington Department of Ecology 1996). This watershed is also more likely to bear increases of fine sediment in the streambed affecting suitability for salmonids spawning where sediment embeds the larger gravels preferred for redds. Timber harvest on steep slopes and along riparian corridors has led to an increase in slope erosion and sedimentation (EAEST 1999c). Forest practices along riparian corridors have increased fine sediment production. This increase has been found in stream channels in managed forest stands (EAEST 1999c).

The Skokomish Subbasin (HUC5 1711001701), containing the South Fork and North Fork Skokomish Rivers, is located in the southeastern corner of the Olympic Peninsula. The South Fork Skokomish River is the largest tributary in the Hood Canal basin of Puget Sound. The South Fork Skokomish River flows in a southeasterly direction and drains approximately 67,000 acres. Approximately 80 percent of the basin is managed by the ONF (EAEST1999d). The upper North Fork of the Skokomish River fifth field HUC includes the headwaters down to the Cushman Dam. Lake Cushman, created by the Cushman Dam (owned and operated by Tacoma City Light), experiences large fluctuations in water levels and have inundated the lower half mile of the North Fork of the Skokomish River above the reservoir. Habitat factors for decline have been identified as riparian degradation.

Temperature. Random temperature sampling in the mainstem of the Skokomish river produced temperatures above 60 degrees Fahrenheit (Simpson Timber 1996). However, segments of the South Fork Skokomish River and lower Vance Creek have naturally low levels of canopy cover due to channel widening resulting from unconfined valley morphology. Combined with the low elevation and channel gradient, these segments are naturally susceptible to seasonal temperature increases.

Sediment and Turbidity. Turbidity is high during peak flow events when greater than 100 National Turbidity Units (NTU) have been measured. The South Fork Skokomish River may have a naturally high level of background turbidity due to the influence of snowpack in the headwaters, and erosion of glacial deposits in the valley bottom. Levels of fines in the substrate are considered low within certain reaches of the mainstem and in Vance Creek (Simpson Timber 1996), although other tributary streams throughout the watershed exhibit fining of the bed surface. In-stream sediment sampling conducted in the lower watershed and several major tributaries, quantified that the percent fine sediment in the gravel (less than 0.85 millimeter (mm)) is at levels considered to be detrimental to egg survival (USDA Forest Service 1995).

The Eastern Strait of Juan de Fuca (HUC5 1711002001, 1711002002, 1711001908) contains Jimmycomelately Creek. Here, HCC and their incubating redds experience increased water temperature as a result of historic riparian degradation from timber harvest and land-use change in riparian forests. In addition, these past practices reduce stability of floodplain landforms, as well as sediment and channel aggradation, leading to soil transport to streams where sediment deposition causes egg and fry entombment in incubating redds, and redd dislocation causing decreased availability of areas to spawn (Brewer et al. 2005).

Temperature. Jimmycomelately Creek is a relatively confined, moderate to steep gradient stream with well vegetated riparian areas providing adequate stream shading. In the lower reach, at about RM 1.5, the valley is wider and the stream channel less confined. Agricultural and rural development has had more of an impact on riparian vegetation in this reach. Maximum stream temperatures recorded in the mainstem of the creek, during habitat surveys conducted between September and October of 1998, ranged from 9.4 to 11.7 degrees Celsius. Temperatures taken in tributaries feeding the mainstem were within a similar range. Stream temperatures during the 1990 surveys recorded maximum temperatures of 12.8 degrees Celsius in the lower mainstem (EAEST 1999f).

Sediment and Turbidity. Extensive stream habitat surveys conducted in 1990 and 1998 provided enough photographic and quantitative information to indicate that hillslope failures associated with road number FS 2850 (Woods Road) in the lower 1.7 miles of the mainstem have contributed to increasing fines in spawning gravels in this lower mainstem reach. Wolman pebble counts taken in several cross sections of the lower mainstem showed fine bed material constituted a large percentage of the substrate composition (EAEST 1999f).

The Quilcene Watershed (HUC5 1711001806, 1711001807), containing the Big and Little Quilcene River systems, is also subject to the effects of decreased riparian forest function including decreased shade (greater exposure to solar radiation can raise streams water temperature), decreased sediment trapping and filtration, decreased bank stability, and lost opportunity for recruitment of large wood. The effects of sediment aggradation were mentioned above.

Temperature. Annual high water temperatures recorded at the fish hatchery range from 62 to 64 degrees Fahrenheit. Temperatures recorded from 1983 to present indicate that temperatures are suitable year-round for fish habitat and reproduction (EAEST 1999a). Riparian zones, channel geometry, and streamflows have been altered in the lower watershed, which is the main spawning ground for HCC salmon. Riparian zones have been cleared for agriculture and development, which reduces streamside shade. The stream has also widened due to aggradation, exposing a greater surface area to solar radiation. Streamflows during the warmest months have been reduced due to water withdrawals (EAEST 1999a).

The effectiveness of dominant factors influencing water temperature (i.e., shade, stream width, flow) have been altered in the lower two miles of the Big Quilcene River, representing the probability that water temperatures have increased over the natural or reference condition. However there is no indication that temperatures are a limiting factor on salmon productivity in the lower several miles of the mainstem (Point No Point Treaty Council 1999).

Eighty percent of the riparian zones in the upper watershed are at or above target shade levels (EAEST 1999a). Temperatures in the upper watershed are assumed to be near-reference conditions, based on high gradients, confined channels that provide a topographic control on solar radiation input, and good riparian canopy. In addition the upper watershed lies within designated Wilderness.

Although the Little Quilcene River was listed on the 1996 Washington State 303(d) listing as at hazard for water temperatures, it does not appear on the Proposed 1998 Washington State 303(d) listing (Washington Department of Ecology 1996). Temperatures in the three reaches surveyed varied from mid-40 to mid-50 degrees Fahrenheit.

Sediment and Turbidity. No quantitative information on fine sediment is available on a watershed or stream reach scale. Some inferences of increased levels of fine sediments in the spawning gravels may can be made based on documentation of aggradation in the lower several miles of the mainstem Big Quilcene, relating to land management activities and rural development. Habitat surveys conducted from RM 4 to RM 9 indicate that cobble and small boulder were dominant substrate. Fine sediment was limited to sheltered locations behind large roughness elements (EAEST 1999a). The Little Quilcene watershed contains no waters listed on the Washington State 1996 303(d) listing or the Proposed 1998 303(d) listing for sediment/turbidity.

Chemical Contaminants and Nutrients. The City of Port Townsend samples the Big Quilcene River yearly for inorganic contaminants, volatile organics, pesticides, polychlorinated biphenyls (PCB), and herbicides; and quarterly for nitrates and trihalomenthanes. All tests indicate the river water is of very high quality (EAEST 1999a). The Little Quilcene watershed contains no waters listed on the Washington State 1996 303(d) listing or the Proposed 1998 303(d) listing for chemicals or nutrients (Washington State Department of Ecology 1996).

In 2007, NMFS completed consultation with the ONF on the City of Port Townsend's application to renew its existing special use permit. That permit enables Port Townsend to divert and transport its municipal water supply within and across the ONF. The effects on salmon of diversion of instream flows in the lower watershed include reducing space in the lower river at a time of year when HCC stage to spawn. Mindful of that ecological concern, the ONF and the City of Port Townsend agreed during consultation to a diversion regime that would protect certain minimum instream flows during the time of year when they are most likely to be lowest.

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, which will be added to the environmental baseline (50 CFR 402.02). Neither ONF nor NMFS identified any interrelated or interdependent actions during consultation.

During consultation, the agencies focused on two categories of effects to which fish would be exposed. The first category stems from activities that modify habitat in a way that fish would experience and respond to by changing their normal behavior. The second category consists of physical interaction between ONF workers carrying-out invasive plant treatments and salmon, steelhead, or incubating redds. The latter category includes the possible trampling of fish or redds that could injure or kill fish, or disrupt (or end) incubation. After consultation, NMFS believes the number of incidents would be so low given the program's scope and timing restrictions, and PDFs, that it could not adequately predict such occurrences. The ONF disagreed asserting that the possibility of trampling exists. Therefore, NMFS analyzes the effects of trampling below. Nevertheless, NMFS cannot relate these effects to predictable amount of injured or dead fish and as such, trampling is not considered in the Incidental Take Statement that accompanies this Opinion.

The habitat modification analysis in this Opinion focuses on those activities of invasive plant treatment that will change the environment in a way that some life history will encounter, resulting in a change of normal behavior. These activities include physical (manual or mechanical) and chemical treatment of both known site-specific infestations, and future EDRR infestations that are presently unknown or non-existent but would discovered in the next five to 15 years. For the chemical treatments, the description breaks out the results of treatments in and around running streams, riparian areas, and those in and around dry intermittent channels and ditches. The basis for the breakout is explained in brief, below.

For the known site-specific infestations and the EDRR invasive plant treatments, chemical treatments are central to the analysis. The use of chemical treatment is likely to directly affect fish, and indirectly affect their food. The effects range from killing fish outright as a result of subtle, sublethal changes in behavior or physiology, to reductions in the availability of prey (Scholz et al. 2005). The analysis is based primarily on toxic effects of herbicides (including surfactants, adjuvants, dyes, and other additives to chemical formulations) on listed fish and their prey, and secondarily on the physical effects of invasive plant treatment, including the non-chemical treatment effects. Non-chemical treatment effects include the physical effects of weed removal, such as sediment-filtering during construction, and the minimal extent of riparian function weeds might provide such as shade, cover, and loss of debris recruitment.

Most of the adverse effects from the proposed action are short-term in nature and are caused by invasive plant treatments in or adjacent to the stream. NMFS has evaluated these effects in many individual consultations over the past ten years. The knowledge gained from these individual consultations has been applied by NMFS and the Forest Service to compose the project PDFs for this consultation. Invasive plant treatment activities that introduced the greatest risk to listed fish (*i.e.,* aerial application, prescribed burning) were not included.

Implementation of a successful IWM plan for invasive plants on the ONF should have overall beneficial effects on listed fishes and their designated critical habitat by removing invasive plants detrimental to channel forming processes and subsequently to spawning and rearing habitat, and by restoring native riparian vegetation, and thereby, restoring ecosystem and riparian functions. Potential adverse effects should be short-term, and if, as expected, invasive plant treatments are successful, should be offset by long-term benefits to riparian function, surface erosion, prey species production and possibly other habitat features (NMFS 2005b). For example, if monocultures of invasive plant species are eliminated that exclude native trees and other woody plants from the riparian zone, shade and large woody debris recruitment should increase over time, while bank erosion should decline. The time lag in such situations may be several decades, however, before native riparian tree species function properly in the aquatic ecosystem.

Most short-term adverse effects of the proposed activities will result from near- and instream invasive plant treatments. The first step of the analysis estimates the likelihood invasive plant treatments will expose listed fish to adverse effects. The second step assesses the responses of exposed individual fish, and in turn, the populations and ESU or DPS they are part of. Risks are considered in terms of the characteristics of viable salmonids populations (McElhaney et al. 2000). Finally, risk from invasive plant treatments, expressed as exposure and effect predictions, are also evaluated for critical habitat.

Effects on Endangered Species Act-Listed Species

The analysis of the effects of herbicides on salmonids is evaluated in this Opinion by assessing the likelihood that listed fish and other aquatic organisms or plants that contribute to their nutrition will be exposed to the herbicides. The toxicological effects and ecological risks of the chemicals on listed fish and other aquatic organisms are quantitatively and qualitatively assessed based on the exposure risk and toxicity. The analysis considers: (1) The life history stages (and any associated vulnerabilities) of the listed species present in the action area; (2) the routes of exposure and the associated modeled and calculated exposure levels; (3) the known or suspected mechanisms of toxicity for the active ingredients or known adjuvants; (4) PDFs, chemical application rates, location, application methods, and other factors that determine the likelihood of chemicals reaching the water; and (5) the possibility of additive or synergistic interactions with other chemicals that may enter surface waters as a result of mixtures, be they tank mixtures or in-situ mixing between upstream and downstream emergent treatment or run-off.

In contrast to the effects of exposure to chemicals, adverse changes in terrestrial vegetation from the both physical and chemical treatment will be small because of the spatial and temporal limitations on treatment under management of invasive plant at known and future EDRR sites. In turn, the longer term result of controlling invasive plants in the treated areas will enable beneficial succession by native vegetation that better matches the natural ecology in treated areas.

Exposure: Presence of the Listed Species in the Action Area. The ONF-administered lands in watersheds with listed salmon contain over 2,400 miles of streams. Of that distance, only 110.6 miles or 4.6 percent falls within the identified treatment areas. The area analyzed extends from the Skokomish River drainage along the southern end of Hood Canal north to the Elwha River drainage along the Strait of Juan de Fuca. The three listed species, PSC, PSS, and HCC range variably throughout the ONF. As seen on Table 17, HCC are least abundant on the ONF, being mapped on only 2.67 stream-miles of the Forest. They are most prevalent in the Skokomish River. The length of HCC occupied streams represents 0.11 percent of the total stream miles and 2.41 percent of the stream miles within the identified treatment areas.

Similar to HCC, PSC and PSS range most broadly within the North and South Forks of the Skokomish River, however, both PSC and PSS habitat use exceeds the HCC utilized length of stream miles by a factor of 25 to 30 (Table 15). As the PSS ranges the most broadly of the three listed species, and because its life history strategy finds it in the rivers year-round, it was used as the indicator for potential exposure.

Table 15. Summary of Stream Miles Located within Plant Treatment Areas on the ONF by Fifth-Field Watersheds with Puget Sound steelhead and Chinook, and Hood Canal summer-run chum. Summary includes currently inventoried sites only.

5th Field Watershed	ONF stream miles (all stream types)	Stream miles located within ONF treatment areas	Total mapped PSS Stream Length (miles) on ONF	Total mapped PSS Streams (miles) Located within ONF Treatment Areas	Total mapped PSC Stream Length (miles) on ONF	Total mapped HCC Stream Length (miles) on ONF
NF SKOKOMISH RIVER	171.05	3.7	6.51	0.26	4.84	0
SF SKOKOMISH RIVER	524.66	17.1	31.81	0.24	26.29	1.74
SKOKOMISH RIVER	**695.71**	**20.8**	**38.32**	**0.50**	**31.12**	**1.74**
LOWER WEST HOOD CANAL FRONTAL	84.93	4.6	0.00	0.00	0	0
HAMMA HAMMA RIVER	303.75	6.1	0.00	0.00	0	0
DUCKABUSH RIVER	121.82	9.0	6.08	1.11	5.91	0.15
DOSEWALLIPS RIVER	151.10	11.1	7.76	0.47	7.23	0
BIG QUILCENE RIVER	307.58	15.5	2.70	0.07	0.57	0.58
UPPER WEST HOOD CANAL FRONTAL	99.65	12.8	0.46	0.00	0.54	0
DISCOVERY BAY	72.45	5.9	1.24	0.00	0	0
SEQUIM BAY	62.37	2.6	1.37	0.06	0	0.2
DUNGENESS RIVER	428.55	19.3	0.00	0.06	14.35	0
PORT ANGELES HARBOR	31.01	2.3	15.85	0.00	0	0
ELWHA RIVER	62.16	0.7	7.80	0.02	7.79	0
TOTAL	**2,421.08**	**110.6**	**81.58**	**2.29**	**67.51**	**2.67**

Note:
Total acres and stream miles on ONF are gross estimates that include inholdings within the ONI administrative boundary.
All PSS habitat on the ONF lands in the Elwha River is considered potential habitat.
Lake areas (i.e., Cushman or Aldwell Reservoirs) are included in stream length estimates.
Datasource: Olympic National Forest GIS data.
Created by Vince Harke, May 7, 2007.

Table 16. Summary of road miles and number of stream crossings within invasive plant treatment areas on the ONF by fifth-field watershed within Puget Sound steelhead habitat.

5th Field Watershed	Total ONF road miles located within treatment areas in watershed	Road miles located within 50 meter riparian buffers of mapped PSS streams	Total Stream Crossings in Treatment Areas	Number of Treatment Area Stream Crossings that Flow directly to PSS streams	Stream crossings in treatment areas that are located within the entire 660' of PSS streams	Treatment Area Stream Crossings over mapped PSS Streams
NF SKOKOMISH RIVER	33.84	0.57	86	19	7	2
SF SKOKOMISH RIVER	191.03	1.45	493	127	42	4
SKOKOMISH RIVER	**224.86**	**2.02**	**579**	**146**	**49**	**6**
OWER WEST HOOD CANAL FRONTA	39.74	0.00	117	0	0	0
HAMMA HAMMA RIVER	62.28	0.00	172	0	0	0
DUCKABUSH RIVER	19.24	0.76	32	12	6	1
DOSEWALLIPS RIVER	38.02	2.26	107	25	27	3
BIG QUILCENE RIVER	86.10	0.00	233	10	3	0
PPER WEST HOOD CANAL FRONTA	33.77	0.29	58	0	0	0
DISCOVERY BAY	29.71	0.00	42	4	0	0
SEQUIM BAY	39.00	0.87	67	9	5	1
DUNGENESS RIVER	100.30	0.27	222	17	2	2
PORT ANGELES HARBOR	10.14	0.00	25	1	0	0
ELWHA RIVER	20.81	0.98	26	9	5	1
TOTAL	**794.08**	**7.45**	**1,680**	**233**	**97**	**14**

Notes:
All values listed for the Olympic National Forest are gross estimates that include inholdings within the ONF administrative boundary.
This table was created using Olympic National Forest GIS data. Due to inherent inconsistencies in GIS analyses, the figures reported here may differ slightly from figures reported elsewhere.
North Fork and South Fork Skokomish subwatersheds were calculated separately for analysis purposes.
Vince Harke, USFWS - May 10, 2007

Table 16 above, illustrates that certain watersheds contain greater or lesser road miles and stream crossings than others. Stream crossings and storm runoff from roadside treatments are vehicles for herbicide exposure. If herbicides are applied within an entire 660 feet of ditch that discharges to a stream, the concentration of herbicides can increase prior to discharge (Huang et al. 2004). Of the total ONF road miles within the treatment areas with listed fish, the Skokomish River watershed has the greatest number (224.86 road miles), followed by the Dungeness River (100.30 road miles). However, the length of road located within a 50 meter riparian buffer of mapped PSS streams shows that the Duckabush River has 4 percent (0.76 road miles) and Skokomish River watershed has less than 1 percent (2.02 road miles). The Dosewallips River watershed has approximately 6 percent (2.26 road miles) of road miles located within a 50 meter buffer of mapped PSS streams. The number of stream crossings that flow directly into PSS mapped streams follows a similar pattern with the Skokomish River watershed having the greatest number of total stream crossings (579), and the greatest number of treatment area stream crossings that flow into PSS mapped streams (146). However, the Big Quilcene and Dungeness River watersheds have the next greatest numbers of total stream crossings in treatment areas (233 and 222, respectively). While the Dosewallips River watershed does not have a high total number of stream crossings within treatment areas, it does have the second highest number of treatment area stream crossings that flow directly into PSS mapped streams. Column 6 provides the number of roadside crossings that are within 660 feet of PSS streams for which the ditch analysis below is relevant. Column 7 provides the number of crossings that are directly over PSS streams. Column 7 is incorporated into column 6.

During consultation, NMFS conducted an analysis to distinguish between treatment regimes that were and were not likely to adversely affect listed species and designated critical habitat. That analysis determined that treatment of invasive plants within ditches and dry channels closer than 660 feet to a confluence of a stream and which were to be treated along the entire length of the ditch or dry channel minus the appropriate buffer to a confluence with a fish bearing water were likely to adversely affect listed fish and designated critical habitat. Table 16 above identifies the number of stream crossings by watershed that are closer than 660 feet to PSS mapped streams. The trends are similar to the above findings, with the Skokomish River watershed having 49 stream crossings within 660 feet of a confluence with a PSS bearing water, and the Duckabush River having 6 crossings closer than 660 feet.

Exposure Mechanisms: Accidental Wounding or Killing by Trampling. The ONF identified the possibility of people working in water stepping on redds and disturbing spawning fish. The extent of exposure depends on the species present, life stage, number of people in the water, and the amount of time spent in the water. Exposure of redds or spawning fish to trampling is possible unless work in water is limited in timing and duration. The proposed action minimizes exposure by planning and scheduling activities to avoid disturbance of spawning fish or damage to redds. Exposure of fry and smaller rearing juveniles has the potential to occur as they only move short distances to the closest cover. Exposure of larger juveniles and adults is unlikely to occur as they generally avoid predators and are likely to swim away when people are in the water. These facts apply for activities conducted under both known treatment sites and to EDRR activities. Therefore, trampling is unlikely, and adverse effects from trampling are therefore discountable.

Exposure Mechanisms: Habitat Modification. As described above, the activities most likely to expose fish to habitat modification are the physical (manual and mechanical) treatment of invasive plants, and the chemical treatment of invasive plants and the areas containing them. Each mechanism of exposure is described below.

Manual, Mechanical, and Restoration Treatment Activities. Mechanical treatments include use of brush cutters (or other machinery) with various types of blades to remove plants, see Appendix A of the 2006 ONF DEIS. Manual methods include the use of hand-operated tools (e.g., axes, brush hooks, hoes, shovels, hand clippers) to dig up and remove invasive species (USDI 2003). All physical treatments can cause or lead to decreased riparian vegetation (albeit, undesirable vegetation), and in turn to erosion, turbid water, stream sedimentation, and disturbance of aquatic organisms if carried out over a large enough area. Riparian vegetation affects habitat in several important ways. Roots of riparian vegetation reduce soil erosion, stabilize banks, and help to create overhanging banks, with the cumulative effect of minimizing turbidity and instream fine sediment deposition. Riparian and emergent aquatic vegetation can provide hiding cover or refuge for fish and other aquatic organisms where native plants have been replaced. Finally, riparian vegetation can provide some shade function, helping to maintain water temperature by limiting exposure to the sun.

Persistence of increased turbidity depends on the size of the suspended particle and velocity of the water. Exposure to fine sediment depends on the amount of fine sediment introduced and the holding capacity of the surface water. Increased turbidity can reduce feeding ability or gill function in some fish species and fine sediments can cover eggs or spawning gravels. Exposure of listed aquatic species will vary with the proximity of the species and their habitat to the treatment area and the size of the area treated. Riparian surface soils in the ONF are predominantly fine sandy loams and loams. Soils directly adjacent to stream are primarily alluvial, and are gravelly to very gravelly (35 to 60 percent rock fragments), and are loams to loamy sand textures.

Sediment in suspension can harm fish gills, and interrupt feeding and migration. Sedimentation can cover eggs or spawning gravels, reduce prey availability, fill pools, and change width/depth ratios. Soil can also become compacted and prevent the establishment of native vegetative cover. All invasive plant treatments can reduce insect biomass, which would result in a decrease in the supply of food for fish and other aquatic organisms.

Aquatic species have specific needs in terms of water temperature. Increasing water temperature may decrease the dissolved oxygen in water which may affect metabolism and food requirements. Many factors influence water temperature including shade, stormwater discharge, channel morphology, air temperature, topography, stream aspect, and interactions with ground water. Shade is the factor that has the potential to be impacted by any treatment that removes vegetation, but only where that is the only factor affecting water temperature. In addition, a significant amount of vegetation would need to be removed to change water temperature in the stream.

As seen above in Table 16, when total mapped PSS stream miles located within ONF treatment areas are used as a metric to predict temperature effects from manual or mechanical vegetation removal, the effects are predicted to be minimal. The Duckabush, Skokomish, and the Dosewallips River watershed have the greatest total PSS stream miles (1.11, 0.50, and 0.47, respectively) located within treatment areas (Table 6). When looking at the percentage of the PSS stream miles in those watersheds compared to the total stream miles located within ONF stream miles, the fractions are very small (Duckabush River 0.91 percent, Skokomish River 0.07 percent, and Dosewallips River 0.31 percent). Therefore, vegetation removal is not likely to expose listed fish to measurably increased water temperature.

Exposure Mechanisms: Herbicide Applications and Estimated Exposure Levels. During consultation, NMFS identified three scenarios creating the chance of herbicide exposure for listed fish. These include 1) runoff from riparian application, 2) application within perennial streams, and 3) runoff from treated ditches and dry intermittent streams. Each exposure scenario was analyzed to determine the level of acute exposure risk. The risk of chronic exposure from riparian application of the ten herbicides included in the activity description was analyzed in the FS R6 2005 BA, and that analysis is incorporated by reference and summarized below.

The chronic effects analysis concluded that an insufficient amount of the proposed herbicides would be applied in the 10 acre/small stream scenario to result in exposure of fish and aquatic invertebrates to chronic effects threshold concentrations for the standard durations (90 days for fish, 21 days for aquatic invertebrates). The analysis also concluded that chronic effects on algae

(21 days) from herbicides other than sulfometuron are not possible from activity. Chronic effects on aquatic macrophytes (21 days) from clopyralid, glyphosate, and sethoxydim were determined not to be possible, not likely to occur for imazapyr, metsulfuron, and sulfometuron, and likely to occur for chlorsulfuron under some conditions. The chronic exposure analysis determined that adverse effects on aquatic macrophytes are likely for chlorsulfuron when 10 or more streamside acres are treated at application rates greater than about 0.08 pounds a.i./acre (0.056 pounds a.i./acre is the typical rate, and 0.25 pounds a.i./acre is the maximum rate).

The risk of adverse effects on listed salmonids and their habitat was evaluated in terms of hazard quotient (HQ) values. Hazard quotient values are calculated by dividing the expected environmental concentration (expected exposure) by the effects threshold concentration (identified threshold). For fish, the effects threshold was the no-observed-effect concentration (NOEC) used by the R6 2005 Biological Opinion. The NOEC is defined as representing the threshold of acute sub-lethal effects. Thus, when the HQ value is greater than one, then adverse effects on fish, in the form of acute sub-lethal effects, are likely to occur.

Hazard quotient values were also calculated for aquatic invertebrates, algae, and aquatic macrophytes. Threshold concentrations at which herbicides are likely to adversely affect aquatic invertebrates, algae, and aquatic macrophytes were equal to LC_{50} and EC_{50} concentrations. The LC_{50} values were used for aquatic invertebrates and some algal species, and EC_{50} values were used for the remaining algal species and aquatic macrophytes.

The LC_{50} and EC_{50} values for each species group were obtained from the risk assessments conducted by SERA for the FS. The values recommended in the risk assessments for “sensitive” species within each species group were used. The LC_{50} and EC_{50} values were frequently those for which toxicity data was required for EPA registration of the herbicide. If an HQ value exceeded one for algae or aquatic macrophytes an adverse effect to habitat was considered to occur.

Exposure from Riparian Application This section addresses direct exposure risks to listed fish in both small streams and the margins of larger streams from runoff and percolation resulting from herbicide application in riparian areas. The analysis is based on the small stream scenario used in the risk assessments performed by SERA for the FS. The exposure scenario is for a 10 acre herbicide application adjacent to a small stream (base flow of 1.8 cfs).

Since several relevant parameters of the margins of larger streams are analogous to the modeled small stream scenario, the small stream analysis results are extended to stream margin habitat. Stream margins often provide shallow, low flow habitat, may have a slow mixing rate with mainstem waters, and may also be the site at which subsurface runoff is introduced.

Early stage juvenile salmonids, particularly recently emerged fry, often utilize low flow areas along stream margins (Johnson et al. 1992; Quinn 2005). As juveniles grow, they migrate away from margins, occupying habitats of progressively higher velocity (Lister and Genoe 1970; Everest and Chapman 1972). Weber and Fausch (2004) found that wild Chinook salmon reared near the river margin until reaching about 60 mm in length. Stream margins are utilized by salmonids for a variety of reasons, including nocturnal resting (Roussel and Bardonnet 1999;

Polacek and James 2003), summer and winter thermal refuge, predator avoidance (Roussel and Bardonnet 1999), and flow refuge (Roussel and Bardonnet 1999).

Exposure resulting from riparian applications occurs when rainfall mobilizes herbicides and associated compounds through dissolution and into surface runoff, or into subsurface runoff through percolation through soils, and ultimately into stream channels. Soil erosion can also deliver herbicides from riparian applications.

Table 17 below summarizes the results of the small stream exposure analysis (see Appendix C for the full display of the small stream analysis). Water contamination rate (WCR) values used in this analysis are the modeled values reported in the SERA risk assessments. The small stream exposure analysis used WCR values for annual rainfall rates ranging from 15 to 100 inches per year, typical and maximum herbicide application rates, and effects threshold concentrations to calculate HQ values for fish. The rainfall range falls within the approximate precipitation rates on the east slope of the Olympic Mountains (Hoodsport: approximately 60 to 85 inches per year; Sequim: approximately 15 to 35 inches per year; Quilcene: approximately 40 inches per year).

The peak WCR values predicted by soil type were used to calculate the likely range of HQ values at typical and maximum herbicide application rates for all three rainfall levels (15, 50, and 100 inches per year). Numerous factors contribute uncertainty to point estimates of WCR values, such as modeling assumptions and input parameters, (and thus HQ values). The HQ exceedances for listed salmonids are discussed below by herbicide.

Table 17. Summary of exposure concentrations from riparian applications to small streams and stream margins, and salmonid HQ values based on typical and maximum herbicide application rates under the standard SERA risk assessment scenario.

		Riparian Application											
		Typical Application Rate						Maximum Application Rate					
		Clay		Loam		Sand		Clay		Loam		Sand	
Herbicide	Rainfall (inch/yr)	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value
	15	0.0007	0.0003	0.00000	0.0000	0.00000	0.0000	0.003	0.002	0.00000	0.0000	0.00000	0.0000
Chlorsulfuron	50	0.006	0.003	0.00002	0.0000	0.003	0.0004	0.03	0.01	0.0001	0.0001	0.003	0.002
	100	0.01	0.006	0.0001	0.0001	0.00000	0.001	0.05	0.02	0.0007	0.0003	0.009	0.004
	15	0.002	0.0003	0.00000	0.0000	0.00000	0.0000	0.002	0.0005	0.00000	0.0000	0.00000	0.0000
Clopyralid	50	0.004	0.0007	0.002	0.0005	0.006	0.001	0.005	0.001	0.004	0.0007	0.009	0.002
	100	0.004	0.0007	0.007	0.001	0.02	0.003	0.005	0.001	0.01	0.002	0.02	0.004
	15	0.002	0.02	0.005	0.05	0.01	0.1	0.009	0.09	0.02	0.2	0.05	0.5
Glyphosate	50	0.04	0.4	0.06	0.6	0.1	1.1	0.1	1.4	0.2	2.2	0.5	4.5
	100	0.1	1.1	0.2	1.5	0.3	2.8	0.4	4.2	0.6	6.2	1.1	11
	15	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000
Imazapic	50	0.00005	0.0000	0.00000	0.0000	0.00001	0.0000	0.00009	0.0000	0.00000	0.0000	0.00002	0.0000
	100	0.0001	0.0000	0.00001	0.0000	0.00002	0.0000	0.0002	0.0000	0.00002	0.0000	0.00004	0.0000
	15	0.00002	0.0000	0.00000	0.0000	0.00000	0.0000	0.00008	0.0000	0.00000	0.0000	0.00000	0.0000
Imazapyr	50	0.0003	0.0001	0.00000	0.0000	0.00007	0.0000	0.0009	0.0002	0.00000	0.0000	0.0002	0.0000
	100	0.0006	0.0001	0.00004	0.0000	0.0001	0.0000	0.002	0.0004	0.0001	0.0000	0.0005	0.0001
	15	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00002	0.0000	0.00000	0.0000	0.00000	0.0000
Metsulfuron	50	0.00004	0.0000	0.00000	0.0000	0.00001	0.0000	0.0002	0.0000	0.00001	0.0000	0.00004	0.0000
	100	0.00006	0.0000	0.00000	0.0000	0.00002	0.0000	0.0003	0.0001	0.00002	0.0000	0.00008	0.0000
	15	0.004	0.09	0.00000	0.0000	0.007	0.2	0.01	0.3	0.00000	0.0000	0.02	0.5
Picloram	50	0.03	0.9	0.004	0.1	0.02	0.4	0.1	2.5	0.01	0.3	0.05	1.2
	100	0.06	1.6	0.006	0.1	0.02	0.6	0.2	4.6	0.02	0.4	0.07	1.7
	15	0.001	0.02	0.0004	0.007	0.006	0.1	0.002	0.03	0.0007	0.01	0.009	0.1
Sethoxydim	50	0.02	0.3	0.04	0.6	0.03	0.5	0.02	0.4	0.06	1.0	0.04	0.7
	100	0.04	0.7	0.09	1.5	0.05	0.9	0.06	1.1	0.1	2.3	0.08	1.3
	15	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000	0.00000	0.0000
Sulfometuron	50	0.00002	0.0000	0.00000	0.0000	0.00000	0.0000	0.00002	0.0001	0.00000	0.0000	0.00000	0.0000
	100	0.00005	0.0000	0.00000	0.0000	0.00001	0.0000	0.00005	0.0001	0.00002	0.0000	0.00001	0.0000
	15	0.02	0.06	0.02	0.06	0.02	0.06	0.2	0.6	0.2	0.7	0.2	0.6
Triclopyr	50	0.1	0.5	0.09	0.2	0.05	0.2	1.3	4.8	0.9	3.6	0.5	2.1
	100	0.2	0.9	0.2	0.3	0.09	0.3	2.4	9.4	1.7	6.5	0.9	3.4

Shaded cells represent HQ values greater than one.

The data from the SERA risk assessments shows that modeled peak WCR values generally increased with higher application and rainfall rates. As mentioned above, the annual rainfall range within the action area is approximately 60 to 85 inches per year in Hoodsport, 40 inches per year in Quilcene, and 15 to 35 inches per year in Sequim.

The average annual rainfall rates in the action area approach but do not exceed100 inches per year. Table 17 above shows that at typical application rates, HQ exceedances for glyphosate, picloram, sethoxydim and triclopyr occurred primarily at rainfall rates of 100 inches per year or greater. At maximum application rates glyphosate, picloram and triclopyr exhibited HQ exceedances at rainfall rates greater than 50 inches per year. As displayed in Table 17, under the riparian application scenario no HQ exceedances occurred for fish from chlorsulfuron, clopyralid, imazapic, imazapyr, metsulfuron, or sulfometuron at any application rate or soil type.

Glyphosate HQ exceedances occurred for fish at rainfall rates of 50 to 100 inches per year. The HQ values for fish at 50 inches per year were exceeded on all soil types and ranged from 1.4 to 4.5 at the maximum application rate. At the typical application rate, on sandy soils, the HQ value at the 50 inches per year rainfall rate was slightly exceeded. The HQ values for fish at 100 inches per year across all soil types exceeded the HQ values, ranging from 1.1 to 11 when applied at both the typical and maximum rates. Thus the risk of exposure of listed fish to glyphosate is likely to occur at those treatment sites that are located adjacent to perennial and wet intermittent streams.

Picloram HQ exceedances for fish occurred at rainfall rates of 50 through 100 inches per year, at typical and maximum rates, on clay and sand soil types. The HQ exceedances ranged from a low of 1.2 on sand soils, at the maximum application rate, and a rainfall rate of 50 inches per year. The highest HQ exceedance (4.6) occurred on clay soils, at the maximum application rate, with a 100 inch per year rainfall rate.

The Sethoxydim HQ exceedances for fish occurred at rainfall rates of 50 through 100 inches per year, with HQ exceedance values ranging from 1.1 to 2.3. The HQ exceedance at 50 inches per year occurred only at the maximum application rate on loam soils. The HQ exceedance at 100 inches per year occurred only at the maximum application rates and at the typical application rate on loam soils.

Triclopyr HQ exceedances occurred for fish at rainfall rates of 50 through 100 inches per year. The HQ exceedance values for fish at 50 inches per year ranged from 2.1 to 4.8, primarily at maximum application rates on all soil types. The HQ exceedance values for fish at 100 inches per year ranged from 3.4 to 9.4, across all soil types at the maximum application rate. The HQ exceedances were greatest on clay soils.

Exposure from Treatment of Dry Intermittent Channels and Ditches. Herbicides applied within ditches and intermittent stream channels are delivered to places where fish or their food might be exposed by leaching into soil, dissolving directly into ditch or stream channel flow (when present), and erosion of exposed soil. The contribution from erosion is likely to vary considerably among sites. Hand or selective application of clopyralid, glyphosate (aquatic formulation), imazapic, imazapyr (aquatic formulation), metsulfuron methyl, and triclopyr (aquatic formulation) is proposed within ditches and dry intermittent channels. Hand or selective methods up to the bankfull level are allowed for chlorsulfuron, imazapyr and sulfometuron methyl. Hand or selective methods can be applied up to the maximum application rates in all instances. Spot spray application of glyphosate (aquatic formulation) and imazapyr is also proposed in ditches and dry intermittent channels. Spot spray of clopyralid, imazapic, and metsulfuron methyl are allowed up to the bankfull level. The primary determinants of exposure risk from ditch or intermittent channel treatments are herbicide properties, application rate, extent of application, application timing, precipitation amount and timing, and proximity to habitat for listed salmonids.

Monitoring of storm runoff has documented that the highest concentrations of pollutants occur during the first storm following treatment (Caltrans 2005, USGS 2001). More specifically, the highest pollutant concentrations generally occur during the early part of storm runoff, relative to concentrations later in the runoff event (Caltrans 2005). The discharge of ditch or intermittent channel runoff in the early stages of the storm hydrograph is generally low, but early runoff is exposed to the greatest amount of pollutants available for dissolution. The ratio of low discharge to highest amount of available pollutant results from the compositing of early runoff solute concentrations that are high relative to those occurring later in the runoff event. Runoff later in the hydrograph occurs at a higher discharge, and dissolved pollutant concentrations are lower, even though mass movement of pollutants can be greater. Therefore, exposure of listed salmonids and their critical habitat elements to the highest concentrations of herbicides resulting from application to ditches and intermittent channels is likely to occur early in storm runoff. The most significant exposure locations are at or near confluences with perennial streams.

The effects on pollutant concentration of the first flush of water in previously dry channels are well understood. In contrast, the agencies have little monitoring data regarding specific concentrations of herbicides likely to occur in runoff from treated ditches. The USGS (2001) monitoring report provides data for concentrations of sulfometuron and glyphosate in runoff from treated roadside plots into ditches in western Oregon. Sulfometuron was applied at a rate of 0.23 pounds per acre, and resulted in runoff concentrations of 0.119 to 0.253 milligrams/liter (mg/l) (corresponding to about 3 to 7 percent of amount applied) from simulated rainfall 24 hours following application. Glyphosate was applied at a rate of about 2 pounds per acre, and resulted in runoff concentrations of 0.323 to 0.736 mg/l (corresponding to about 1 to 2 percent of amount applied) from simulated rainfall 24 hours following application. The samples consisted of the initial 15 liters of runoff from simulated rainfall at a rate of 0.3 inches per hour, and lasting 0.5 to 1.4 hours. Given this sampling scenario, these concentrations are the best estimates available for what is likely to occur in runoff within 24 hours after application to ditches or dry, intermittent streams from "first flush" events for these herbicides (per amount applied, per unit area).

The likely herbicide runoff concentrations, for which data are not available (chlorsulfuron, clopyralid, imazapic, imazapyr, metsulfuron, sethoxydim, and triclopyr) can be estimated from the USGS (2001) data. Ramwell et al. (2002) and Huang et al. (2004) found that herbicides with high solubility and low K_{oc}[7] produced the highest peak concentrations and highest total yield of herbicides in roadside runoff. Krutz et al. (2005) stated that herbicide concentrations observed at vegetative filter strip outflows correlate positively with increasing solubility. If solubility and K_{oc} values are reasonable predictors of herbicide yield in ditch runoff, with high solubility and low K_{oc} increasing runoff risk, then it is reasonable to assume that herbicides with solubility values greater than, and K_{oc} values less than or equal to, sulfometuron are likely to be present in runoff at concentrations at least equal to that for sulfometuron. The shortest soil half-life of any of the herbicides is five days (sethoxydim), and the others are considerably longer, so it is reasonable to ignore half-life for estimating concentrations in runoff within 24 hours after application.

It is important to note that the USGS (2001) study also examined herbicide concentrations in water following natural rainfall events. Glyphosate was not detected in the roadside runoff following natural rainfall. However, the authors did not collect any samples during the first two rainfall events following the herbicide application, so the results are most relevant as an indicator of the long-term persistence of glyphosate in the environment, and do not represent a worse-case scenario of extensive roadside applications followed immediately by a rainfall event. Based on the results of the simulated rainfall experiments, the authors did calculate the potential herbicide concentrations within the adjacent stream channel under a worse-case scenario. These calculations resulted in a concentration of 0.0008 to 0.0018 mg/l of glyphosate within the stream (USGS 2001). These low concentrations are not unexpected, due to the dilution of roadside runoff within the stream and the fact that the calculations were based on roadside ditch treatment areas smaller than the proposed action. However, the concentration at a stream confluence may be significantly higher, and sufficient dilution may not occur for several meters below a stream confluence.

Table 18 summarizes herbicide soil mobility factors (solubility, and K_{oc} ratios) and application rates for the ten herbicides in the proposed action. The seven herbicides in the proposed action for which ditch runoff data is not available (chlorsulfuron, clopyralid, imazapic, imazapyr, metsulfuron, sethoxydim, and triclopyr) all have K_{oc} values similar to or less than sulfometuron, and much higher solubility. Sulfometuron solubility is low (70 mg/l) relative to the other herbicides, but a substantial portion of the amount applied appears in the initial runoff. Due to the relatively low application rate of 0.23 pounds per acre, the initial runoff only needs to reach 0.6 percent saturation to remove 10 percent of sulfometuron applied. Under circumstances where the ratio of water volume to a low-solubility organic chemical is very large, dissolution is seldom limited by solubility (Lyman 1995). Thus, at low herbicide application rates, solubility of the herbicides in the proposed action is likely to be less important than K_{oc} as a predictor of runoff risk. It is therefore reasonable to assume that the runoff efficiency of those herbicides will occur at a rate at least equal to that of sulfometuron following a rainstorm occurring 24 hours after application. This assumption is consistent with groundwater movement ratings from Vogue et al. (1994). In addition, foliar wash-off fractions of these seven herbicides were also approximately equal to or higher than for sulfometuron (Knisel 2000), indicating that an amount greater than or equal to sulfometuron will be available for dissolution.

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[7] Koc is summarily defined as the ratio of chemical absorbed in soil per unit organic carbon, while in equilibrium with the chemical dissolved in aqueous solution.

Table 18. Summary of herbicide soil mobility factors and application rates.

Herbicide	Solubility[1,2] (mg/l)	K_{oc}[2]	Maximum Application Rate (lbs/acre)[3]
Triclopyr	2,100,000	20	10
Imazapyr	500,000	100	1.5
Clopyralid	300,000	6	0.5
Metsulfuron	9,500	35	0.15
Chlorsulfuron	7,000	40	0.25
Sethoxydim	4,390	100	0.45
Imazapic	2,150	112	0.1875
Sulfometuron	70	78	0.38
Glyphosate	900,000	24,000	8

[1] Solubility values are for salts, if salts are typically the ingredient in commercial formulations
[2] From Vogue et al. (1994), located at http://npic.orst.edu/ppdmove.htm
[3] From product labels

Since the USGS (2001) study measured glyphosate runoff concentrations, and the K_{oc} value for glyphosate is well out of the range of the other herbicides, the glyphosate data was not used in estimating concentrations of the other herbicides. In addition, glyphosate is an anomaly in that the water solubility is high, yet sorption to soil organics, metals, and other soil components is also high (as reflected in K_{oc} values estimated in the thousands).

The USGS (2001) average sulfometuron concentration 24 hours after application was used to extrapolate likely concentrations of the herbicides for which comparable monitoring data was unavailable, predict exposure risk to listed salmonids and their habitat, and calculate HQ values. The equation for estimating the concentration of the remaining herbicides from the USGS (2001) sulfometuron was derived by treating application rate as the independent variable (x), runoff concentration as the dependent variable (y), and solving for the slope of the line intersecting y = 0, x = 0 (no herbicide was considered to be in runoff if none was applied). The average sulfometuron runoff concentration of the 24-hour simulated rainfall plots was 0.2 mg/l, and the application rate was 0.23 lbs/acre. The resulting estimate of runoff concentration is in mg/l.

Thus, where m = slope and b = y intercept:

y = mx + b
y = (runoff concentration/application rate) * x + 0
y = (0.2 mg/l)/0.23 lbs/acre) * x + 0
mg/l in runoff = 0.87 mg/l per lb/acre * application rate in lbs/acre

Table 19. Summary of potential exposure concentrations and salmonid hazard quotient HQ values based on typical and maximum herbicide application rates in ditches/dry channels and applications within occupied streams.

	Ditch/Dry Channel Application				Instream Application											
	Typical Application Rate		Maximum Application Rate		Typical Application Rate						Maximum Application Rate					
Herbicide	Exposure (mg/l)	HQ Value	Exposure (mg/l)	HQ Value	Conc in 1' of water	HQ Value	Conc in 1' water from emergent rinse	HQ Value	Conc in 1' water from emergent overspray	HQ Value	Conc in 1' of water	HQ Value	Conc in 1' water from emergent rinse	HQ Value	Conc in 1' water from emergent overspray	HQ Value
Chlorsulfuron	0.05	0.02	0.2	0.1												
Clopyralid	0.3	0.06	0.4	0.09												
Glyphosate	0.5	4.8	1.9	19	0.7	7.4	0.3	2.8	0.2	1.8	2.9	29	1.1	11	0.7	7.4
Imazapic	0.09	0.0009	0.2	0.002												
Imazapyr	0.4	0.08	1.3	0.3	0.2	0.03	0.1	0.02	0.04	0.01	0.6	0.1	0.4	0.07	0.1	0.03
Metsulfuron	0.03	0.01	0.1	0.03												
Sethoxydim	0.3	4.3	0.4	6.5												
Sulfometuron	0.03	0.01	0.3	0.07												
Triclopyr	0.9	3.3	8.7	33	0.4	1.4	0.3	1.0	0.1	0.4	3.7	14	2.6	10	0.9	3.5

Shaded cells represent HQ values greater than 1.

The results of the extrapolation and resulting HQ values are summarized in Table 19. Runoff rates in Table 19 for sulfometuron and glyphosate are those published in USGS (2001).

Based on the foregoing discussion of method and the presentation in Table 19, glyphosate, sethoxydim, and triclopyr exceed the fish HQ threshold level of 1 causing likely adverse effects on listed salmonids and their habitat from rain within 24 hours after application at ditch and intermittent channel confluences with perennial streams. For this consultation, NMFS assumed that this would occur for complete treatment of up to 660 feet of a ditch or dry channel that discharges to a perennial stream containing listed fish. During the first rain after application, the concentration of herbicides within the ditch would composite and subsequently increase (Huang et al. 2004). The GIS data show that within the fifth field watersheds with listed fish, known treatment areas contain a total of 97 stream crossings within 660 feet of PSS streams. In this case, stream crossings are used as a reasonable representative for potential ditch treatments. Of those 97 stream crossings within 660 feet of a PSS stream, only 14 crossing occur directly over mapped PSS streams. The South Fork Skokomish River contains four crossings over fish bearing waters, the most for any of the fifth field watersheds in the action area.

Actual exposure concentrations and durations at or near confluences with perennial streams will depend on a variety of factors, including the extent of the herbicide application within the ditch or intermittent stream, application rate, extent of riparian applications, and rainfall timing, intensity, amount and efficacy of PDFs and buffers. Riparian applications adjacent to ditch or intermittent stream channels may contribute additional herbicide, exacerbating exposures at confluences with perennial streams.

NMFS interpreted the projected runoff concentrations and HQ values displayed in Table 19 mindful of the precision and accuracy of the USGS (2001) data upon which they are based. Although the USGS (2001) results were based on relatively ambitious quality assurance, the author states "it is important to recognize that all of the data presented are semi-quantitative in nature and that interpretations should take this into account. These data can be relied on only for order-of-magnitude representations of concentrations, and possibly for trends." Thus, the runoff concentrations and HQ values in Table 19 should be considered as estimates that may vary by an order of magnitude lower or higher. However, the runoff concentrations projected in Table 19 for clopyralid are reasonably consistent (within an order of magnitude) with roadside ditch runoff data for clopyralid reported by Huang et al. (2004), and collected under similar conditions.

Exposure from Applications within Perennial Streams. Under the proposed action, only glyphosate, imazapyr, and triclopyr can be applied within the bankfull level of perennial streams, including channel bars and emergent vegetation. Glyphosate and imazapyr can be applied up to typical application rates with spot spray, and all three herbicides can be applied up to the maximum application rates with hand or selective methods.

Exposure from application within stream channels can occur from overspray, foliar rinse by rainfall, erosion, leaching, and site inundation. Juvenile and fry life stages are likely to be at the highest risk of exposure, and the highest risk sites for exposure are stream margins and areas immediately surrounding treated emergent plants. Exposure of juveniles in stream margins can result from overspray, upstream storms resulting in inundation of treatment sites, rainfall at the treatment sites delivering herbicide to stream margins via percolation or surface runoff, or a combination of these factors. Juveniles utilizing stream margin habitat are likely to be present in the low flow refuge near the water's edge as the stream level rises. As inundation of recently treated areas occurs, glyphosate overspray or wash-off present on the substrate surrounding treated plants, or on the treated plants, may enter solution.

Table 19 above shows the potential HQ values for the three herbicides proposed to be applied within perennial streams. Values were derived for concentrations of the three herbicides in: 1) 1 foot of water (1 square foot floodplain area), 2) 1 foot of water after rainfall rinse from emergent vegetation, (the amount of glyphosate amount available for dissolution (62.5 percent of the amount applied) is based on assumptions of a foliar wash-off fraction of 0.5 (SERA 2003a), the imazapyr amount assumes a 0.9 foliar wash-off fraction (SERA 1999) and the triclopyr amount assumes a 0.95 foliar wash-off fraction (SERA 2003b)), and 3) 1 foot of water resulting from overspray of emergent vegetation (an assumed 25 percent overspray rate). Of the three, glyphosate exhibits HQ exceedances at both typical and maximum application rates for all three scenarios, and triclopyr exhibits HQ exceedances at typical and maximum application rates for all scenarios except emergent overspray at the typical rate.

Numerous factors influence the actual concentration in stream margins associated with an application site. These include application rate, herbicide properties, rainfall proximity and intensity, time since application, soil permeability, and water turbulence and flow rate. Concurrent applications to adjacent riparian areas (above bankfull) are likely to result in additional exposure. Glyphosate is strongly sorbed by most soils (Yu and Zhou 2005), so exposure levels of glyphosate are likely to be attenuated when channel surface substrate contains a substantial soil component. For treatment of emergent plants, the amount of overspray or injection leakage, and water depth and flow are primary determinants of concentration.

Label instructions for the Aquamaster aquatic glyphosate formulation recommend to “always use the higher rate of this product per acre within the recommended range when weed growth is heavy or dense or weeds are growing in an undisturbed (noncultivated) area.” The product label allows an application rate up to 8 pounds/acre. Therefore, it is assumed that application at or near the label maximum is likely to be necessary in some situations for invasive plant control on gravel bars and other instream sites.

Exposure of listed fish from treatment of emergent plants is likely to occur via three pathways: overspray, foliar wash-off, and leakage of glyphosate from stem injections. Since delivery via each pathways is driven by different factors (overspray, rainfall, and plant death and breakage), exposure from all three pathways is very unlikely to overlap in time. However, since the proposed action does not contain any provisions for avoiding rainfall, overspray and foliar wash-off could occur concurrently.

Hazard quotient exceedances were determined for glyphosate and triclopyr, in all three instream exposure scenarios. At the one foot depth, glyphosate HQ values for typical and maximum application rates are estimated to be 7.4 and 29, respectively. These HQ exceedances could be observed as a result of a rain event closely following herbicide treatment. For triclopyr at the one-foot depth, the HQ values for typical and maximum applications rates are estimated as 1.4 and14, respectively.

Exposure from the Early Detection and Rapid Response Program. The EDRR element of the proposed action prescribes how the ONF plans to respond to infestations that arise or are discovered in the future. The EDRR program treatment techniques are effectively the same as those for the known sites, but the scope of treatment is limited by PDF H14 in Table 5. The prescribed limitation is spatial and temporal. For invasive plant sites above bankfull, within the aquatic influence zone, treatments will not exceed 10 acres along any 1.5 mile length of stream reach within a sixth field subwatershed in any given year. For invasive plant sites below bankfull, treatments would not exceed a total of 6 acres within a sixth field sub-watershed in any given year.

To strategically treat invasive plants, the ONF created a GIS database with mapped polygons identifying roads systems and other large areas that could be treated for invasive plants over the next 15 years. The database includes over 52,000 acres of mapped treatment areas located within the administrative boundary of the ONF. Because the GIS data includes over 99 percent of the roads within the listed salmon watersheds as known sites, NMFS used these mapped polygons to eliminate potential treatment areas under the EDRR program.

According to GIS data, the ONF has jurisdiction over total of 318,286 watershed acres (Appendix B, Table B3). Of those total acres the current total potential treatment area acres is 23,334.6 acres, leaving 294,951 acres in the ONF where invasive plants have yet to be identified. Within the total potential treatment area acres, 3169.2 are located in a 50 meter riparian buffer of mapped PSS streams. At present, the ONF has identified 147.7 acres for treatment that are located in a 50 meter riparian buffer of mapped PSS streams leaving 3021 acres within a 50 meter riparian buffer of mapped PSS streams that may potentially qualify for treatment under the EDRR program. The future maximum percentage of riparian treatment acres is approximately 1 percent of the remaining ONF watershed acres where invasive plants have yet to be identified (remaining riparian acreage along mapped PSS streams divided by remaining ONF watershed acres where invasive plants have yet to be identified).

The same GIS data (Appendix B, Table B1) have indicated the total number of road miles within ONF watersheds with listed fish as 802.21 miles. Of those miles, the total number of road miles located within known treatment areas are 794.08 miles. Ninety-nine percent of all roads within the ONF are within known treatment areas. However, within individual treatment areas, generally only small, isolated patches of plant infestations currently exist. The ONF has estimated the rate of spread of invasive plants at between 5 to 12 percent per year. Future infestations could occur on roads within the know treatment areas or on the remaining one percent of road miles in watersheds with listed fish. Because the current extent of treatment areas on roads constitutes almost all of the roads on the ONF, analysis of future roadside infestations is not necessary as it will be incorporated into analysis of the known treatment areas.

The Relationship Between Exposure and Effects of the Action. During consultation, the ONF and NMFS disagreed over the effects of the action beyond those from riparian and instream applications. To complete this consultation, NMFS considered the risks of exposure to all four endpoints, fish, aquatic invertebrates, algae, and aquatic macrophytes, relying on the ONF analysis of riparian and instream applications only, and further examining the risks from treatment of ditches and intermittently dry channels proximal to confluences with flowing streams.

To initiate consultation, the ONF employed the toxicity thresholds for listed fish as they were known in September 2005. At that time, for the exposure endpoints for glyphosate without surfactant, described by the best available science, were the following.

Table 20. Acute and chronic endpoints for glyphosate.

Duration	Endpoint	Dose	Species	Effect Noted at LOAEL[1]
Acute	NOEC[2]	0.5 mg/l (1/20th/LC50)	Rainbow Trout	LC50 at 10mg/l
Chronic	NOEC	2.57 mg/l[3]	Rainbow Trout	Life-cycle study in minnow; LOAEL not given

[1] LOAEL – Lowest observed adverse effect level- The lowest dose associated with an adverse effect.
[2] NOEC – No observed effect concentration – The exposure level at which there are not statistically or biologically significant difference in the frequency or severity of adverse effects between the exposed population and its appropriate control.
[3] Estimated from minnow chronic NOEC using the relative potency factor method (SERA 2003a).

The value of glyphosate acute NOEC (0.5mg/l) represents a fraction of the known LC_{50}. This method is often used when measured NOECs are unavailable. Recently, Tierney et al. (2006) researched the ability of glyphosate to impair salmonid parr olfactory function. This endpoint was used as numerous studies have determined that olfaction can be affected by pesticide exposure, and it is behaviorally indispensable, enabling behaviors such as imprinting and, thus, return migration. The investigators found that at a glyphosate concentration (glyphosate acid of 99 percent purity) of 0.1 mg/l the changes in the salmon electro-olfactogram during a 30 minute exposure and 60 minute recovery period did not differ from the control. However, other glyphosate concentrations, ranging from 0.1 mg/l to 100 mg/l, showed significant neurophysiological effects through the impairment of olfaction. As Tierney and researchers state: “because olfaction is tantamount to survival for anadromous salmonids, this sublethal toxicity endpoint would need to be considered in determining the no-observed-adverse-effect concentration (NOAEC). An olfactory NOAEC may be of regulatory use and serve to help preserve salmonid stocks, especially those at risk” (Tierney et al. 2006). This study represents the best available science reporting on the adverse effects of glyphosate, primarily as it provides empirical data versus estimation. Thus, this Opinion will replace the glyphosate effects threshold of 0.5 mg/l with 0.1 mg/l (Table 20).

Effects of Exposure to Physical Treatments Manual, Mechanical, and Restoration. As described above in the Exposure analysis, physical treatments will be carried out by workers in and near streams leading to possible physical contact and disturbance by proximity. In addition, the treatments themselves will remove vegetation, exposing soil to erosion with subsequent water quality effects. Finally, removal of even undesirable vegetation can reduce shade where the removed vegetation was the sole source of shade in the place it is removed. Each of these eventualities is considered remote, and any effects that do occur will be extremely minor.

Where people work in and around streams to complete treatments, physical contact and proximity may injure or kill fish or incubating eggs or fry. In addition, proximity may change normal local behavior, causing some fish to move in an effort to seek alternative and possibly suboptimal habitat for cover and juvenile forage. Fish that seek suboptimal forage and cover will experience increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates). Instream treatment activities are likely to cause some physical injury or death to juvenile fish that do not leave the activity area. In addition, physical effects of weed removal, including unintended effects on non-target plant species, could potentially affect riparian functions such as shade, cover and sediment filtering.

Physical treatments such as hand pulling will most likely only occur in areas with limited invasive vegetation given the inefficiency of the activity. Where they do occur, water quality could change causing some juveniles and adults to seek alternative habitat, which is likely to contain suboptimal cover and juvenile forage. Effects would be the same as for avoidance of human proximity, above. In addition, fish exposed to turbid water that stay put can experience a variety sub-lethal physical responses (increased respiration, reduced feeding success, reduced growth rates). As also mentioned previously, the extent of water quality change wrought by the proposed action from physical treatments will cause insignificant localized turbidity and the program ensures limitation of accrued effects by limiting extent of program activities both spatially and temporally.

Finally, the proposed action removes some riparian vegetation. Where removed vegetation is the sole source of local shade, exposure to solar radiation could warm water. Sustained high stream temperatures are considered potentially harmful to salmon because these species are adapted to the specific, natural temperature ranges of their natal streams. Laboratory studies concluded that changes in stream temperature ranges can alter salmon development, growth, survival, and the timing of life history phenomena (Beschta et al. 1987). Based on the conclusions of these laboratory studies, increased temperatures beyond those meeting the biological requirements of salmon could cause juvenile salmon to seek other rearing areas or decrease their rates of growth. Furthermore, Berman and Quinn (1991) reported that fecundity and the viability of spring Chinook salmon eggs were adversely affected by greatly elevated water temperatures above those meeting the biological requirements of Chinook. Severely high temperatures can inhibit the upstream migration of adult salmon and increase the incidence of disease throughout a salmon population. Finally, a study in coastal Oregon found that as stream temperatures increase, competition between rearing salmon and warm-water fish species can increase, potentially extirpating salmon populations through competitive pressure (Reeves et al. 1987). These results of vegetation removal are considered extremely remote. As noted in the environmental baseline section, places in and around the action area with elevated average stream temperatures occur mainly from other factors such as regional topography and water diversion for municipal use. Any effects from the proposed action would be minor and would add imperceptibly to the existing environmental baseline condition.

*Effects of the Action from Exposure to Herbicides (Toxicity)***.** The toxicological effects of each of the herbicides proposed for use are summarized in Appendix A. Toxic effects may potentially harm listed fish by killing them outright, through sublethal changes in behavior or physiology, or indirectly through a reduction in the availability of prey (Scholz et al. 2005). Although outright lethality is unlikely to occur from the proposed action, in locations where herbicides reach the water, salmon and steelhead may be harmed though sublethal effects or indirectly though toxic effects on other aquatic organisms. Sublethal effects from water contamination by herbicides cannot be discounted based on the available information. Water contamination by herbicides is likely to occur in occasional locations on the ONF and sublethal effects of herbicides or their adjuvants can occur within the range of concentrations likely to occur under the proposed action. Sublethal effects on salmon and steelhead, adverse effects such as increased respiration, reduced feeding success, and subtle behavioral changes that can increase predation risk to listed fish from short-term exposures to low (*i.e* single digit) HQ exceedances are reasonably likely to occur. When treatments occur that utilize two or more herbicides in close proximity, exposures to mixtures may follow. Where sublethal assays have been reported for salmonids, harmful effects occur at concentrations as much as several magnitudes of order less than the lethal endpoints used by EPA to assess pesticide risk (Scholz et al. 2000).

Riparian Application. All of the SERA risk assessments used a treatment site scenario of 10 acres of broadcast treatment. The ONF interpreted this to say that the WCR values from the risk assessments are overestimates of exposure to herbicide runoff and percolation when application methods other than broadcast are used. However, NMFS has observed that numerous sources of uncertainty are inherent in the WCR values in the risk assessments. The validity of the assertion that a single parameter (application method) outweighs the cumulative influence of all other sources of exposure uncertainty, and provides a basis for discounting adverse effects as indicated by HQ exceedances, is not documented. Numerous environmental factors are known to exist that can result in variation of the actual WCR values from those predicted (USDA Forest Service 2005; Berg 2004). Based on the lack of documentation regarding the uncertainty explained by application method in the context of all other sources of uncertainty, WCR-based HQ values greater than one are considered to represent an adverse effect in this Opinion. In addition, differences between site conditions and those modeled tend to result in actual herbicide delivery rates exceeding those modeled (Berg 2004). As a result of these uncertainties, an HQ value greater than one, based on application rate, soil, and annual rainfall, is considered to represent an adverse effect in this Opinion.

Application of glyphosate adjacent to stream channels at maximum application rates in areas of 50 inches of rainfall per year is likely to adversely affect listed salmonids when applied by hand or selective methods on all soil types (Table 20). Application of glyphosate adjacent to stream channels at rates greater than typical in locations of 100 inches of rainfall per year is likely to adversely affect listed salmonids on all soil types. Risks to listed salmonids from spot spraying exist in watersheds with rainfall approaching 100 inches per year.

Riparian application of picloram on soils other than loam is likely to adversely affect listed salmonids. The 50-foot and greater application buffer for picloram in the proposed action, as well as its prohibition on high risk road segments, last priority for use within aquatic influence zones, and no use on soils coarser than loam will reduce the likelihood and magnitude of the predicted adverse effects on fish, and is likely to eliminate any predicted adverse effects on aquatic macrophytes.

The HQ values for sethoxydim were calculated using the toxicity data for the Poast formulation, and incorporates the toxicity of naphtha solvent. The toxicity of sethoxydim alone for fish and aquatic invertebrates is generally much less than that of the formulated product (about 30 times less toxic for invertebrates, and about 100 times less toxic for fish). Since the naphtha solvent tends to volatilize or adsorb to sediments, using Poast formulation data to predict indirect aquatic effects from runoff leaching is likely to overestimate adverse effects (Durkin 2001). Given the properties of the naptha solvent discussed above, and the 50-foot application buffer for sethoxydim which is likely to reduce the amount of naphtha solvent, the sethoxydim concentrations reaching the stream system are likely biologically insignificant.

Application of triclopyr adjacent to stream channels at rates approaching the maximum in areas of 50 to 100 inches of rainfall per year is likely to adversely affect listed salmonids on all soil types. Application of triclopyr adjacent to stream channels at typical rates or greater in areas of up to 100 inches of rainfall per year is likely to adversely affect listed salmonids.

The conclusion of effects on listed salmonids from triclopyr exposure is based primarily on use of maximum application rates employed by hand or selective methods, in locations with rainfall rates between 50 to 100 inches per year. On the other hand, effects from application of glyphosate at both typical and maximum rates are likely to cause effects on listed salmonids. Appendix B identifies 20 known treatment sites located within the subwatersheds. Based on the identified invasive plants on those sites (Appendix A and Common Control Measures document of the 2006 ONF DEIS) glyphosate and/or triclopyr could potentially be applied in the riparian zone at every one of those know treatment sites.

Applications in Dry Ditches and Intermittent Channels. Table 19 shows that glyphosate sethoxydim, and triclopyr, when applied at both the typical and maximum application rates are likely to cause sublethal effects on listed salmonids, generally reducing their fitness and in the case of glyphosate, impairing their olfactory function. Given the properties of the naptha solvent discussed above, and the 50-foot application buffer for sethoxydim which is likely to reduce the amount of naphtha solvent, the sethoxydim concentrations reaching the stream system are likely biologically insignificant.

The attainment of HQ values presented in Table 19 is likely to require herbicide application to a segment of ditches or dry channels in either of two ways. Application directly adjacent to the confluence with a perennial stream with listed fish or critical habitat present or treatment of up to 660 feet of dry ditch or intermittent channel separated from the perennial channel by an appropriate buffer would have to occur (Tables 5 and 6). Appendix B, Table B4, supports the likelihood of these conditions showing that all of the known treatment sites either have at least one road crossing a PSS occupied stream, a crossing of a tributary closer than 660 feet from a PSS occupied stream, or a PSS occupied stream of some length within the treatment area. Because the BA does not identify specific herbicide type, application method or rate, the assumptions in this Opinion are that listed salmonids could be exposed to these three herbicides as a result of the treatment of dry channels and ditches. However, due to the generally patchy distribution of invasive plant infestations in ditches and intermittent channels (Metzger pers. comm. 2007), and use of conservative herbicide application methods, treatment of such large, contiguous areas near the maximum application rate is expected to be rare. Treatments of ditches or intermittent channel lengths greater than a few hundred feet at the typical rate are likely to be infrequent (Metzger pers. comm. 2007). However, given the scope of the proposed action and the uncertainty of occurrence, listed individual salmonids could be exposed to and affected by glyphosate and triclopyr from these applications.

Application within Perennial Streams: The application of glyphosate and triclopyr at typical and maximum application rates within perennial channels is likely to adversely affect listed salmonids. While the PDFs preclude application methods that would disturb spawning fish or redds, application of herbicides can occur while salmonids are rearing and migrating. In addition, Table 19 shows HQ exceedances of herbicides in 1 foot of water and for only that fraction of 1 foot of water representing foliar wash-off. Wash-off occurs as a result of rainfall. The proposed action does not contain a PDF limiting herbicide applications to periods outside of rainfall events. Herbicide labels frequently do not address application timing relative to rainfall, or recommend irrigation for increased efficacy. This Opinion, thus assumes that herbicide application can occur during periods of rainfall, causing the HQ values for glyphosate and triclopyr to potentially additively increase. If listed fish are in the system at the time of herbicide application, they could experience loss of olfactory capability, among other effects, which would hinder their ability to detect and avoid predation.

At this time, there are only two known treatment sites in the ONF that require treatment of emergent plants. Neither of those sites is located in proximity to listed salmonids. Thus, treatment of the known sites will not expose listed salmonid to adverse effects.

Applications under Early Detection and Rapid Response Program. The EDRR program could include manual, mechanical or restoration treatment methods, as well as application of the ten authorized herbicides within the riparian zone, six of the herbicides within dry channels and ditches, and three herbicides within perennial streams. The program limits the spatial and temporal scope of EDRR treatments (PDF H14, Table 5). To calculate the extent of this limitation for this consultation, the agencies conducted spatial analysis of the maximum treatment area permitted under the EDRR program.

For treatments above bankfull, each 1.5 stream mile segment could receive treatment on up to 54 total acres. However, the EDRR program limits treatments to not more than 10 acres along any 1.5 miles of stream in any given sixth field subwatershed, thereby confining the treatment area to no more than 18.5 percent of the total above bankfull acreage within a 1.5 stream mile segment.

For the analysis of treatments below bankfull, a number of assumptions were included. Average stream width for sixth field subwatersheds was assumed to be 20 feet. The EDRR program allows for treatment of not more than six acres below bankfull within any sixth field subwatershed, which translates into approximately 2.48 stream miles. Tables B5 and B6 (Appendix B) illustrate the range of estimated instream acres contained within each sixth field subwatershed and provide estimates of the percentage of instream acres in each subwatershed that could be treated in any given year. The average percentage of stream area that could be treated across all sixth field subwatersheds combined is 2.7 percent. The average area eligible for treatment in the individual subwatersheds ranges from 0.8 percent of total stream miles in the

Upper South Fork Skokomish River to 14 percent in the Upper Duckabush River. For the Lower North Fork Skokomish River and the Upper Duckabush River subwatersheds, the average areas eligible for treatment constitute 10.9 percent and 14 percent, respectively, of the total instream acreage (Table B6). When the sixth field subwatershed values are considered in the context of all fifth and sixth field instream miles combined, the weighted averages range from 1.63 percent in the Hamma Hamma River watershed to 4.05 percent in the Duckabush River watershed (Tables 25 and 26).

Additive or Synergistic Interactions of Mixtures of Chemicals. Additive or synergistic interactions with other chemicals are possible for both in-tank and in-situ mixing between upstream and downstream emergent treatment or surface and/or subsurface run-off. The ONF does not propose to use mixtures for the 2007 spray year, but the proposed action leaves open the opportunity to tank mix herbicides as the need arises. In addition, the Olympic National Park, up-stream of the ONF employs herbicides to treat noxious weeds within their jurisdiction.

Exposures to expected maximum concentrations of the other herbicides in the activity description are not likely to result in adverse effects on listed fish given the patchy nature of infestations. If mixing does occur, adverse effects are most likely to manifest as an additive, and not synergistic response in fish. Dose addition is considered most appropriate for mixtures with components that affect the same endpoint by the same mode of action, and are believed to behave similarly with respect to uptake, metabolism, distribution, and elimination (Choudhury et al. 2000). The precise toxic mechanism(s) in fish are not clearly documented for the ten herbicides contained in the proposed action, but effects on the kidney and liver are typical endpoints in terrestrial wildlife. In addition, the proposed herbicides have bioconcentration factors that fall within a range that does not indicate bioconcentration risk (all bioconcentration factors less than 32), are relatively soluble, and their chemical structure indicates that they are likely to behave similarly in salmonids.

It is further described in Choudhury et al. (2000) that the assumption of similar uptake, metabolism, distribution, and elimination is adequately met in fish for dose-addition analysis at low concentrations. Assuming that sethoxydim HQ values are an overestimation due to volatilization of the naphtha solvent (the primary toxic ingredient of the formulated product), the cumulative HQ values for the ten herbicides under realistic co-exposure scenarios are not likely to exceed that for instream application exposure in stream margins. The ONF will employ a mixture analysis (identified in Appendix B of the BA) if tank mixtures are proposed to be utilized.

Response of Fish to Effects of the Action. Most toxicological effects of the proposed action on salmon and steelhead are likely to be from sublethal exposure to herbicides, rather than outright mortality from herbicide exposure. Effects such as fish killed as a result of sub-lethal changes impairing normal behavioral patterns, otherwise known as ecological death could occur. Furthermore, some exposed fish will not respond in any observable or measurable way. The herbicide formulations proposed for use generally have not been tested to determine their effects on essential behavioral patterns or their underlying physiological processes. It is important to note that many sublethal toxicological endpoints or biomarkers may harm fish in ways that are not readily apparent. When small changes in the health or performance of individual fish are observed (e.g. a small percentage change in the activity of a certain enzyme, an increase in oxygen consumption, the formation of pre-neoplastic hepatic lesions, etc.), it may not be possible to infer an impaired normal behavioral pattern, even in circumstances where a significant loss could occur. Where sublethal tests have been conducted, they are typically reported for individual test animals under laboratory conditions that lack predators, competitors, certain pathogens, and numerous other hazards found in the natural environment that affect the survival and reproductive potential of individual fish.

The lethal endpoint has little predictive value for assessing whether pesticide exposure will cause sublethal neurological and behavioral disorders in wild salmon (Scholz et al. 2000), but in most cases, the LC_{50} is the only toxicity data available. Although little information is available on the sublethal effects of the herbicides on listed fish, there can be subtle sublethal effects that can potentially affect the survival or reproduction of large population segments. For example, Scholz et al. (2000), and Moore and Waring (1996) indicate that environmentally relevant exposures to diazinon can disrupt olfactory capacity in the context of survival and reproductive success of Chinook salmon, both of which are key management considerations under the ESA (Scholz et al. 2000, Tierney et al. 2006).

The ecological significance of sublethal toxicological effects on individual fish depends on the degree to which essential behavior patterns are impaired, and the number of individuals exposed to harmful effects. Sublethal effects could compromise the viability and genetic integrity of wild populations if the effects are widespread across an entire DPS or ESU, or if localized exposures result in the concentrated loss of fish in a geographic area occupied by a local population with unique genetic traits. The likelihood of population effects from sublethal effects of the chemicals in the proposed action are largely undocumented, but appreciable population effects can be ruled out if the potential exposure to harmful effects is limited to small numbers of fish and a spatial pattern that is not likely to cause the loss of a unique genetic stock.

Weis et al. (2001) reviewed published literature on consequences of changes in behavior of fish from exposure to contaminants and noted studies reporting impaired growth and population declines from altered feeding behavior and impaired predator avoidance. Potential sublethal effects, such as those leading to a shortened lifespan, reduced reproductive output, or other deleterious biological outcomes are a potential threat to listed species from the proposed action.

The toxicological endpoints identified below are possible for a variety of pesticides and are generally considered to be important for the fitness of salmonids and other fish species. They include:

- Direct mortality at any life history stage;
- An increase or decrease in growth;
- Changes in reproductive behavior;
- A reduction in the number of eggs produced, eggs fertilized, or eggs hatched;
- Developmental abnormalities, including behavioral deficits or physical deformities;
- Reduced ability to osmoregulate or adapt to salinity gradients;
- Reduced ability to tolerate shifts in other environmental variables (e.g. temperature or increased stress);
- An increased susceptibility to disease;
- An increased susceptibility to predation; and,

• Changes in migratory behavior.

Most of these endpoints have not been investigated for the herbicides used in the proposed action.

Adverse effects on individual listed fish could result from herbicide applications. Adverse effects such as increased respiration, reduced feeding success, and subtle behavioral changes that can increase predation risk to individuals will occur. Specifically, adverse effects from glyphosate such as diminished olfactory capacity, leading to increased predation risk will occur.

The ONF proposes to treat a limited number of known sites within each watershed containing populations of PSC, PSS, and HCC. Many of the known sites were determined to have insignificant effects on listed species and therefore did not require formal consultation. For the remaining known sites that are considered in this Opinion, the application rates and methods vary in the likelihood of causing adverse effects on individual listed fish. Most of the known sites occur along roadways. The overall percentage of all treatment area stream crossings that are within 660 feet of a PSS stream is 78 percent; however, the overall percentage of treatment area streams that are located directly over PSS streams is 11 percent (Table B4, Appendix B). Across all fifth field watersheds that contain PSS, only 4.7 percent of the total known treatment acres fall within the 50 meter riparian buffer (Table B3, Appendix B). As such, the potential effects on listed salmon and steelhead from known riparian treatments are likely to be limited to rare, minimizing the potential for adverse effects on populations.

The EDRR program will limit the number of treatment acres above bankfull within any 1.5 mile stream segment within a sixth field sub-watershed in any given year. The EDRR program analysis yielded a potential riparian treatment area of up to 18.5 percent within each sixth field subwatershed that could be treated annually. Given the breadth of PDFs, such as specific buffer widths and spatial limitation by individual herbicides, the likelihood of adverse effects on individual listed fish from riparian treatments of EDRR sites is low. Thus, the total number of invasive plant treatment projects that could occur above bankfull in a sub-watershed in any year, even when incorporating all the aggregate short-term negative effects, is not likely to adversely affect fish lifespan, reproductive output, predation risk, population structure or levels, or interfere with over-all watershed function. These prescriptions taken together were designed to ensure that these effects do not aggregate as a result of these treatments.

The EDRR also limits the number of acres proposed to be treated below bankfull to 6 acres within a sixth field sub-watershed in any given year. As such, EDRR program below bankfull has the potential to adversely affect listed PSC and PSS in some subwatersheds. As seen in Table B6, in Appendix B, the percent of instream acres treated annually at the sixth field subwatershed scale could exceed 10 percent in the Lower North Fork Skokomish River, and the Upper Duckabush River. Weighted averages at the fifth field watershed levels drop to below 5 percent (Tables 24 and 25).

All three species (PSC, PSS, and HCC) are found on the Lower North Fork Skokomish River and Upper Duckabush River. As seen in the status of the species section above, while the abundance is described as ranging between the critical and current capacity threshold, PSC short-term productivity in both subwatersheds is showing a positive trend (lambda of 1.04 and 1.17, respectively, (Table 9)). The Skokomish River PSC population is an important contributor to the ESU due to its high spatial structure. The HCC in the Upper Duckabush River is also showing a short-term positive productivity trend (lambda of 1.1 (Table 11)). On the other hand, PSS productivity in the Lower North Fork Skokomish River is exhibiting a negative short-term productivity trend of lambda 0.865 (Table 13) and the number of PSS in the Hood Canal subwatersheds remains around 100 spawners.

In addition to effects of direct exposure on listed fish, indirect effects of reduced food sources through the effects herbicides on aquatic non-target species, primarily in the form of reduced algae production and reduced aquatic macrophyte production can occur. The likelihood of adverse indirect effects is dependent on environmental concentrations, bioavailability of the chemical, and persistence of the herbicide in salmon habitat. For most pesticides, including the chemicals in the proposed action, there is limited information available on environmental effects such as negative impacts on primary production, nutrient dynamics, or the trophic structure of macroinvertebrate communities. Most available information on potential environmental effects must be inferred from laboratory assays conducted on a specific target endpoint; although a few observations of environmental effects are reported in the literature. Due to the paucity of information, there are uncertainties associated with the following factors: 1) The fate of herbicides in streams; 2) the specific effects on, and resiliency and recovery of aquatic communities; 3) the site-specific foraging habits of salmonids and the vulnerability of key prey taxa; 4) the effects of pesticide mixtures that include adjuvants or other ingredients that may affect species differently than the active ingredient; and 5) the mitigating or exacerbating effects of local environmental conditions.

Indirect effects of chemicals used to treat invasive plants on ecosystem structure and function are a key factor in determining a toxicant's cumulative risk to aquatic organisms (Preston 2002). Moreover, aquatic plants and macrophytes are generally more sensitive than fish to acute toxic effects of herbicides. Therefore, chemicals can potentially affect the structure of aquatic communities, at the primary production level, at concentrations below thresholds for direct impairment in salmonids.

Availability of food is essential to rearing and migrating fish and is an essential element of those PCEs of critical habitat. The decrease in primary productivity of streams and rivers resulting from herbicide applications will vary in space and in time. Detrimental effects on primary production have direct effects on aquatic invertebrates. Juvenile Pacific salmon feed on a diverse array of aquatic invertebrates, with aquatic insects, and crustaceans comprising the large majority of the diets of fry and parr in all salmon species (Higgs et al. 1995). Prominent taxonomic groups in the diet include *Chironomidae* (midges), *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), *Tricoptera* (caddisflies), and *Simuliidae* (blackfly larvae) as well as *amphipods, harpacticoid copepods*, and *daphniids*. Chironomids in particular are an important component of the diet of nearly all freshwater salmon fry (Higgs et al. 1995). With a few exceptions (e.g. daphniids), the impacts of pesticides on salmonid prey taxa have not been widely investigated.

Factors affecting prey species are likely to affect the growth of salmonids, which is largely determined by the availability of prey in freshwater systems (Mundie 1974). Food supplementation studies (e.g., Mason 1976) have shown a clear relationship between food abundance and the growth rate and biomass yield of juveniles in streams. Therefore, herbicide applications that kill or otherwise reduce the abundance of macrophytes and macroinvertebrates in streams can also reduce the energetic efficiency for growth in salmonids. Less food can also induce density-dependent effects, such as increased competition among foragers as prey resources are reduced (Ricker 1976). These considerations are important because juvenile growth is a critical determinant of freshwater and marine survival (Higgs et al. 1995). A study on size-selective mortality in Chinook salmon from the Snake River (Zabel and Williams 2002) found that naturally reared wild fish did not return to spawn if they were below a certain size threshold when they migrated to the ocean. There are two primary reasons mortality is higher among smaller salmonids. First, fish that have a slower rate of growth suffer size-selective predation during their first year in the marine environment (Parker 1971; Healey 1982; Holtby et al. 1990). Growth-related mortality occurs late in the first marine year and may determine, in part, the strength of the year class (Beamish and Mahnken 2001). Second, salmon that grow more slowly may be more vulnerable to starvation or exhaustion (Sogard 1997).

The primary indirect, adverse effects resulting from the proposed action are expected to be of varying duration (weeks to years). Degraded water quality, reflected by primary and secondary productivity loss, from herbicide applications will last a maximum of a few weeks. Recovery of algae and aquatic macrophytes can take weeks to months. Riparian disturbance and disturbed soils resulting from accessing work sites will stabilize and begin to revegetate in one year.

Effects on Critical Habitat

During consultation, NMFS considered each of several mechanisms for salmonid exposure to the effects of the proposed action. Each of those is described in detail in the "Effects on ESA-Listed Species" section, above. In turn, where the possibility of exposure is reasonably certain, NMFS considered whether exposed fish would respond to exposure. Through these sequential assessments, the consultation focused down on herbicide applications as the only significant effects mechanism bearing on ESA-listed fish. The same is true for the effects of the action on critical habitat and the review of effects mechanisms other than herbicide application is therefore not repeated here.

The proposed invasive plant treatment areas are scattered throughout the ONF and are of varying size. Potential effects of invasive plant treatment on designated critical habitat will vary at each location depending on the size of the treatment area, treatment type, the chemicals used, method of application, rate of application, distance from water, and vegetative characteristics of the treatment areas. Where chemicals reach the water and achieve effect threshold concentrations, they will change the functional condition of the elements of PCEs, and the ability of those places to meet the ecological needs of the species for which critical habitat is designated. These changes include changed water quality and diminished food availability.

The PCEs in the action area are: 1) freshwater spawning, 2) freshwater rearing, and 3) freshwater migration corridors. For the spawning PCE, water quality meeting the ecological needs of salmon and steelhead must support spawning, incubation, and larval development. For the rearing sites, there must be water quality and forage to support juvenile development. Finally, migration corridors, in addition to supporting free and protected movement of fish, must also have water quality supporting juvenile development as they progress downstream toward their transitional estuarine life history. The proposed action is likely to cause changes in individual PCEs in the action area by the introduction of herbicides and their agents into critical habitat that will influence to some degree, the conservation role of that critical habitat. Specifically, the proposed action will cause exposure to aquatic invertebrates, algae, and aquatic macrophytes, and responses in algae, and aquatic macrophytes.

Benthic algae are important primary producers in aquatic habitats and are thought to be the principal source of energy in many mid-sized streams (Minshall 1978; Vannote et al. 1980; Murphy 1998). Herbicides cause shifts in the composition of benthic algal communities at concentrations as low as in the low parts per billion. Herbicides can elicit significant effects on aquatic microorganisms at concentrations that may occur with normal usage under the label instructions (De Lorenzo et al. 2001). In most cases the sensitivities of algal species to herbicide formulations and their response to herbicide formulations are not known. However, human activities that modify the physical or chemical characteristics of streams can change the trophic system that ultimately reduces salmonid productivity (Bisson and Bilby 1998). Consequently, herbicides have the potential to affect salmonid productivity through their effects on the biotic community.

The results of HQ threshold exceedances are presented in Tables 21 and 22 below. Aquatic invertebrates are not listed as no HQ threshold exceedances were observed (See Appendix C).

Herbicide Applications—PCE Exposure from Riparian Application. This section addresses exposure risks to algae and aquatic macrophytes in both small streams and the margins of larger streams from runoff and percolation resulting from herbicide application in riparian areas. The analysis is based on the small stream scenario used in the risk assessments performed by SERA for the FS, and provides a higher risk exposure scenario. The exposure scenario is for a 10 acre herbicide application adjacent to a small stream (base flow of 1.8 cfs). The exposure analysis assumes pure soil types. In reality, soils on the ONF are loams mixed with clay and sand components. Therefore, the WCR values for the pure soil types may underestimate exposure for some soil types on the ONF.

Table 21. Summary of potential algae and aquatic macrophyte hazard quotient (HQ) values in adjacent streams based on typical and maximum herbicide application rates in riparian areas.

		Riparian Application											
		Typical Application Rate						Maximum Application Rate					
		Clay		Loam		Sand		Clay		Loam		Sand	
Herbicide	Rainfall Rate	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value	Algae HQ Value	Macrophyte HQ Value
Chlorsulfuron	15 inches	0.07	1.0	0.0000	0.0000	0.0000	0.0000	0.3	4.5	0.0000	0.0000	0.0000	0.0001
	50 inches	0.6	9.0	0.002	0.03	0.07	1.0	2.8	40	0.01	0.1	0.3	4.6
	100 inches	1.1	16	0.01	0.2	0.2	2.7	5.0	71	0.07	0.9	0.9	12
Clopyralid	15 inches	0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0003	0.0003	0.0000	0.0000	0.0000	0.0000
	50 inches	0.0005	0.0005	0.0004	0.0004	0.0009	0.0009	0.0008	0.0008	0.0005	0.0005	0.001	0.001
	100 inches	0.0005	0.0005	0.001	0.001	0.002	0.002	0.0008	0.0008	0.002	0.002	0.003	0.003
Glyphosate	15 inches	0.001	0.0000	0.002	0.0001	0.006	0.0003	0.004	0.0002	0.009	0.0004	0.03	0.001
	50 inches	0.02	0.0007	0.03	0.001	0.05	0.002	0.07	0.003	0.1	0.005	0.2	0.009
	100 inches	0.05	0.002	0.07	0.003	0.1	0.006	0.2	0.009	0.3	0.01	0.5	0.02
Imazapic	15 inches	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	50 inches	0.001	0.008	0.0000	0.0001	0.0002	0.001	0.002	0.02	0.0000	0.0002	0.0003	0.003
	100 inches	0.002	0.02	0.0002	0.001	0.0004	0.004	0.004	0.03	0.0003	0.003	0.0008	0.007
Imazapyr	15 inches	0.0001	0.001	0.0000	0.0000	0.0000	0.0000	0.0004	0.004	0.0000	0.0000	0.0000	0.0001
	50 inches	0.001	0.01	0.0000	0.0001	0.0004	0.003	0.005	0.04	0.0000	0.0002	0.001	0.01
	100 inches	0.003	0.03	0.0002	0.002	0.0007	0.006	0.01	0.08	0.0006	0.005	0.002	0.02
Metsulfuron	15 inches	0.0000	0.02	0.0000	0.0000	0.0000	0.002	0.0000	0.09	0.0000	0.0000	0.0000	0.01
	50 inches	0.0000	0.2	0.0000	0.007	0.0000	0.04	0.0002	0.8	0.0000	0.04	0.0001	0.2
	100 inches	0.0001	0.3	0.0000	0.02	0.0000	0.08	0.0004	1.4	0.0000	0.08	0.0001	0.3
Picloram	15 inches	0.004	0.0000	0.0000	0.0000	0.007	0.0000	0.01	0.0001	0.0000	0.0000	0.02	0.0001
	50 inches	0.04	0.0002	0.004	0.0000	0.02	0.0001	0.1	0.0006	0.01	0.0001	0.05	0.0003
	100 inches	0.07	0.0004	0.006	0.0000	0.03	0.0001	0.2	0.001	0.02	0.0001	0.07	0.0004
Sethoxydim	15 inches	0.006	0.006	0.002	0.002	0.02	0.02	0.008	0.008	0.003	0.003	0.04	0.04
	50 inches	0.07	0.07	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
	100 inches	0.2	0.2	0.4	0.4	0.2	0.2	0.3	0.3	0.6	0.6	0.3	0.3
Sulfometuron	15 inches	0.0005	0.0003	0.0000	0.0000	0.0000	0.0000	0.006	0.004	0.0000	0.0000	0.0000	0.0000
	50 inches	0.005	0.003	0.0000	0.0000	0.0008	0.0005	0.07	0.04	0.0001	0.0001	0.0000	0.006
	100 inches	0.01	0.007	0.0003	0.0002	0.002	0.001	0.1	0.08	0.004	0.002	0.02	0.01
Triclopyr	15 inches	0.003	0.002	0.003	0.002	0.003	0.002	0.03	0.02	0.03	0.02	0.03	0.02
	50 inches	0.02	0.01	0.02	0.01	0.009	0.006	0.2	0.1	0.2	0.1	0.09	0.06
	100 inches	0.04	0.03	0.03	0.02	0.01	0.01	0.4	0.3	0.3	0.2	0.1	0.1

Shaded cells represent HQ values greater than one.

Chlorsulfuron HQ exceedances were observed for aquatic macrophytes at rainfall rates between 15 and 100 inches per year. The HQ exceedances occurred at both typical and maximum chlorsulfuron application rates and on all soil types, with clay soils producing the highest exceedances, and sandy soils also producing HQ exceedances. Loam soils, the predominant soil type in the ONF appeared to produce no exceedances.

The HQ values for algae were exceeded at rainfall rates ranging between 50 and 100 inches per year. Clay soils appeared to produce the highest exceedances. At typical application rates, the HQ value for algae exhibited a minor exceedance. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall of 50 to 100 inches per year, is likely to adversely affect critical habitat by adversely affecting aquatic macrophyte and algal production when occurring on soils with poor infiltration.

Given the wide range of HQ values observed among soil types at a range of rainfall rates, soil type is clearly a major driver of exposure risk for chlorsulfuron, with low and high permeability soils markedly increasing exposure levels. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall of 50 to 100 inches per year, is likely to adversely affect critical habitat by adversely affecting aquatic macrophytes. Application on soils with low and high infiltration rates will have a substantially higher risk of resulting in adverse effects. The PDF H7 which requires avoidance of the use of chlorsulfuron on soils with high clay content will partially minimize adverse effects on algae and aquatic macrophyte production.

Metsulfuron HQ exceedances for aquatic macrophytes occurred at the maximum application rate on clay soils at rainfall rates of 100 inches per year. No exceedances were observed on any soils at the typical application rate or on loam or sandy soil at the maximum application rate.

Given the range of HQ values observed for metsulfuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with rainfall rates approximately 100 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to adversely affect critical habitat by adversely affecting aquatic macrophytes.

Herbicide Application—Exposure from Treatment of Dry Intermittent Channels and Ditches. The section above discusses the exposure risks to fish from herbicide treatment in dry intermittent channels and ditches describes those herbicides which can be hand/selected and spot sprayed within ditches and at bankfull levels. It also identifies the primary factors affecting exposure risk. Columns 2 through 5 of Table 22 summarize the HQ exceedances at both typical and maximum application rates for algae and aquatic macrophytes.

When chlorsulfuron is applied to ditches and dry, intermittent streams, at both typical and maximum rates, it exceeds HQ values for both algae and aquatic macrophytes. Chlorsulfuron ranges from an HQ exceedances of 4.9 for algae at the typical rate, to an HQ exceedance of 311 for aquatic macrophytes at maximum application rate.

Imazapic exhibited HQ exceedances for both algae and aquatic macrophytes at typical and maximum application rates (HQ range of 1.7 to 3.3 for algae and 14 to 27 for aquatic macrophytes).

Imazapyr HQ exceedances were identified for both algae and aquatic macrophytes when applied to ditches and dry channels under typical and maximum application rates (HQ value ranges of 2.0 to 6.5 for algae and 17 to 57 for aquatic macrophytes).

Metsulfuron can potentially be present in concentrations highly toxic to aquatic macrophytes at both typical and maximum application rates (HQ value range of 130 to 652).

Sethoxydim HQ exceedances are minimal. However, HQ exceedances do occur for both algae and aquatic macrophytes at typical and maximum application rates.

Sulfometuron HQ exceedances occurred for both algae and aquatic macrophytes when applied at typical and maximum application rates (HQ values ranging from 5.7 to 72 for algae and 3.5 to 44 for aquatic macrophytes).

Triclopyr application appears to exceed the effects threshold values only when applied at the maximum application rate. Both algae and aquatic macrophyte HQ values were minimally exceeded (HQ value 1.5 for algae, and 1.0 for aquatic macrophytes).

Table 22. Summary of potential algae and aquatic macrophyte hazard quotient (HQ) values based on typical and maximum herbicide application rates in ditches/dry channels and applications within occupied streams.

	Ditches and Dry Channels				Instream Application							
	Algae		Aquatic Macrophytes		Typical Application Rate				Maximum Application Rate			
Herbicide	Typ. Rate	Max. Rate	Typ. Rate	Max. Rate	HQ value for 1' deep water - instream rinse		HQ value for 1' deep water instream overspray		HQ value for 1' deep water - instream rinse		HQ value for 1' deep water - instream overspray	
	HQ Value	HQ Value	HQ Value	HQ Value	Algae	Aquatic Macrophytes	Algae	Aquatic Macrophytes	Algae	Aquatic Macrophytes	Algae	Aquatic Macrophytes
Chlorsulfuron	4.9	22	70	311								
Clopyralid	0.04	0.1	0.0	0.1								
Glyphosate	0.2	0.9	0.0	0.0	0.1	0.006	0.09	0.004	0.5	0.02	0.4	0.02
Imazapic	1.7	3.3	14	27								
Imazapyr	2.0	6.5	17	57	0.6	4.9	0.2	1.8	1.9	16	0.7	6.0
Metsulfuron	0.03	0.2	130	652								
Picloram	0.32	0.9	0.002	0.005								
Sethoxydim	1.0	1.6	1.0	1.6								
Sulfometuron	5.7	72	3.5	44								
Triclopyr	0.1	1.5	0.1	1.0	0.04	0.03	0.02	0.01	0.4	0.3	0.2	0.1

Shaded cells represent HQ values greater than one.

Herbicide Application—Exposure from Treatment in Perennial Streams. Table 22 above illustrates the potential HQ values associated with the application of glyphosate, imazapyr and triclopyr within the channel. Instream and gravel bar application of imazapyr can have direct lethal effects on aquatic macrophytes at both typical and maximum application rates in 1 foot of water after rainfall rinse from emergent vegetation, (the amount of glyphosate amount available for dissolution (62.5 percent of the amount applied) is based on assumptions of a foliar wash-off fraction plus overspray (SERA 2003a), the imazapyr amount assumes a 0.9 foliar wash-off fraction (SERA 1999) and the triclopyr amount assumes a 0.95 foliar wash-off fraction (SERA 2003b)), and 1 foot of water resulting from overspray of emergent vegetation (an assumed 25 percent overspray rate).

The only herbicide that exhibited HQ value exceedances resulting from direct application of herbicides within perennial streams for treatment of emergent plants was imazapyr. Imazapyr appears to pose a risk to aquatic macrophytes when applied at both the typical and maximum application rates. In addition, it did exhibit HQ exceedances for both foliar wash-off and overspray. The HQ exceedance for foliar wash-off for both typical and maximum application rates ranged from 4.9 to 16. In addition, imazapyr exhibits HQ exceedances for algae from foliar wash-off when applied at the maximum application rate.

Response of PCEs to Exposure. The following critical habitat analysis summarizes the effects of the proposed action on critical habitat PCEs, and evaluates how changes in PCEs affect conservation value at the watershed scale.

Freshwater Spawning Sites -- Water Quality. Short-term adverse effects on water quality are likely to occur when near or in-water invasive plant treatment occurs. Increased turbidity and increased levels of chemical contaminants resulting from treatment will last for a few hours to a maximum of a few weeks. Minor inputs of chemical herbicides as described above will degrade water quality for a period of hours to days. Impacts to freshwater spawning sites will be minimized through not conducting treatments during spawning periods. In the long-term, the removal of invasive plants is designed to improve water quality. Planting riparian areas creates shade and thus reduces summer stream temperatures.

Freshwater Rearing Sites--Water Quality. Water quality will be affected as described for spawning sites, above.

Freshwater Rearing Sites—Forage. Reductions in primary production are likely to occur as a result of increased herbicides and fine sediment generated by invasive plant treatment. Exposure to herbicides is predicted to occur from riparian applications in areas with average rainfall levels from 50 to 100 inches per year causing exceedances of the chlorsulfuron HQ value. In addition, application of herbicides to ditches and dry channels is predicted to create exposure of seven of the 10 proposed herbicides at levels that exceed the HQ values for algae and aquatic macrophytes. Lastly, instream invasive plant treatment is predicted to cause exceedances of the imazapyr HQ value at both typical and maximum application rates. While these effects are not likely to extend more than a few hundred feet below treatment sites, and these areas are likely to be recolonized by primary producers within a few months, the short-term could pose a significant lack of forage for PSC and especially PSS as they remain the longest in watersheds. In the long-term, all of the sites that have had treatment are likely to exhibit improved riparian function, reduced inputs of fine sediments, and enhanced establishment of healthy riparian plant communities resulting in increased terrestrial and aquatic forage.

Freshwater Migration Corridors--Water Quality. Water quality will be affected as described above.

Cumulative Effects

Cumulative effects are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). NMFS summarizes the cumulative effects in terms of certain future and ongoing, but presently incomplete actions in the action area or that might affect conditions there.

Watershed conditions in the action area will continue to be influenced by a variety of land-uses including recreation, agriculture and livestock grazing, forest management, building and conversion, and attendant road construction, use, and maintenance,. Detailed information on these activities and their influence in the action area are not specifically available. But based on patterns of growth and land use around Puget Sound, current levels of these uses are likely to persist or grow. The environmental results of land use changes at large include water quality issues such as turbidity, temperature increase, changed hydrology, increased sediment deposition, as well as habitat access issues due to physical barriers.

To deal with the issue of invasive species in the region, the ONF expects local county noxious weed boards to continue to focus on priority weeds that pose risks to areas, such as riparian corridors and recreational lakes. Knotweed is a common priority species within all counties. It is expected that the counties will work with ONF and ONP cooperatively to control invasive plants. If agreements are established with counties for noxious weed control outside of the boundaries of the ONF, FS standards from the documents described in the Background section of this Opinion will be incorporated into those agreements.

Cities, Counties, and Washington State all have ongoing weed treatment programs operating in the region that can affect conditions in the action area. While programs for the prevention of off-site or off-target herbicide spread are not known, the agencies presumed that the programs do not have prevention measures similar to the ONF. Weeds are treated along road rights-of-way annually by city, state, and county transportation departments, sometimes several times a year. Any herbicide contamination that occurs from the proposed ONF action could potentially combine with contaminants from other non-Federal activities, and contribute to formation of chemical mixtures or concentrations that could kill or harm listed steelhead or salmon. In addition, fish stressed by elevated sediment and temperatures and limited habitat due to lack of accessibility are more likely to be susceptible to toxic effects of herbicides. While the mechanisms for cumulative effects are clear, the actual effects cannot be quantified.

Synthesis

Adverse effects on listed fish, and to the algal and aquatic macrophyte critical habitat elements, are likely to occur from the use of herbicides at known and EDRR program sites (Table 23). The magnitude and frequency of adverse effects on listed fish will vary depending upon rate of application, application timing relative to fish presence and life history stage, and application timing relative to periods of rainfall. However, only two herbicides, (glyphosate and triclopyr) have been identified as likely to cause adverse effects on listed fish. The magnitude and frequency of adverse effects on aquatic macrophytes and algae will be high for some herbicides: primarily chlorsulfuron when applied at riparian treatment sites with sand and clay soils; chlorsulfuron, imazapic, imazapyr, metsulfuron, sulfometuron and triclopyr when applied in ditches and dry channels; and imazapyr when applied at instream treatment sites.

Table 23. Herbicide HQ exceedances for fish and critical habitat representatives according to application method at known and EDRR sites (synthesis from Tables 18, 20, 22, and 23).

	Riparian application	Application within ditches and dry channels	Application instream of emergent vegetation
Salmon and steelhead	Glyphosate Triclopyr	Glyphosate Triclopyr	Glyphosate Triclopyr
Critical habitat features	Chlorsulfuron Metsulfuron	Chlorsulfuron Imazapic Imazapyr Metsulfuron Sethoxydim Sulfometuron Triclopyr	Imazapyr

Direct adverse effects on individual listed fish are likely to result from glyphosate and triclopyr applications in all three treatment categories (riparian, ditch/dry intermittent streams, and perennial streams). Significant adverse effects, such as increased respiration, reduced feeding success, and subtle behavioral changes (diminished olfactory capacity) that can increase predation risk to listed fish from short-term exposures to low (*i.e.* single digit) HQ exceedances, are reasonably likely to occur. Indirect adverse effects on listed fish from loss of primary production are also reasonably likely to occur. Assessments of effects on specific populations and critical habitat are documented below.

When treatments occur that utilize two or more herbicides in close proximity, exposures to mixtures may follow. Simultaneous exposure to other herbicides may increase the level of adverse effects from glyphosate and triclopyr exposure. Additional adverse effects are most likely to manifest as an additive, and not synergistic, response in fish. However, the cumulative HQ values for the other eight herbicides under realistic co-exposure scenarios are not likely to exceed that for instream applications of glyphosate and triclopyr. In other words, defacto mixtures are not likely to substantially increase effects likely from glyphosate and triclopyr exposure alone.

Algae and macrophytes provide food for aquatic macroinvertebrates, particularly those in the scraper feeding guild (Williams and Feltmate 1992). These macroinvertebrates in turn provide food for rearing juvenile salmonids. Consequently, adverse effects on algae and aquatic macrophtye production may cause intermittent reductions in availability of forage for rearing juvenile salmonids. Juvenile salmonids that receive less food over time have lower body condition and smaller size at smoltification.

In general, most instream exposures of herbicides are short-lived, discreet events associated with overspray, rinse, or runoff events. Conditions such as diminished water quality are likely to return to normal within a few hours to a few days, once the source is eliminated. While water quality concentrations can shift quickly, loss of forage can take a few months to recover. Long-term changes in habitat features are possible as a result of changes in riparian vegetation. If there is a high frequency of repeat treatments of those herbicides which exhibited high HQ values the effects are poorly understood and could be subtle. Herbicide use may affect salmonid habitat detrimentally through the short-term loss of primary production of algae and aquatic macrophytes, and beneficially through long-term restoration where natural plant communities and disturbance regimes have been altered by weeds. None of the chemicals proposed for use would result in long-term adverse alteration of habitat as the natural and human mediated restoration is anticipated to occur.

Adverse effects on aquatic invertebrates are not likely to occur from herbicide exposure under any of the treatment categories however, adverse effects on algae and aquatic macrophytes are likely to result from herbicide application in riparian, ditch/intermittent channel, and instream applications, but not always from the same herbicides. Adverse effects on algae and aquatic macrophytes that translate to significant indirect adverse effects (via alteration in food supply, cover, etc.) to listed fish may result from brief exposures of aquatic macrophytes from application to ditches with chlorsulfuron, imazapic, imazapyr, metsulfuron, sethosydim, sulfometuron, and triclopyr. In these cases the aquatic macrophytes HQ values for ditch effluent at stream channel confluences can potentially reach levels that are likely to translate to significant indirect adverse effects on listed fish. Due to roads acting as the primary seed dispersion corridors, heavy invasive plant infestation of natural intermittent channels is less likely to occur than in ditches. Thus, intensive herbicide application within intermittent channels is also less likely to occur.

Table 24. Synthesis of population and baseline information, CHART findings, and effects of the action for known and future site treatment on Puget Sound Chinook.

PSC Population/ Watershed	VSP/Productivity (Lambda – short-term)	Spatial structure	Diversity	Abundance	CHART finding	Baseline condition	Ditch Analogy for known treatment sites		EDRR
							Total stream crossings in treatment areas	Stream crossings in treatment areas that are located w/in 660 ft of PSS streams***	Percent weighted average of instream acres treated annually ****
Skokomish	1.04* (weakly positive)	High – boundary stock	Poor compared to historic populations	Between critical and current capacity thresholds	High conservation rating	Warm temperatures in lower river. Turbidity high during peak flows and throughout year,	579	49	1.78%
Hamma Hamma	1.17* (combined with Duckabush and Dosewallips)	Important bridge between sub-regions	Low diversity	Critical thresholds	Medium conservation rating	May have some water temperature issues due to forest practices.	172	0	1.63%
Duckabush	1.17* (combined with Hamma Hamma and Dosewallips)	Important bridge between sub-regions	n/a	Critical thresholds	High conservation rating	Very good water temperatures. Turbidity high during peak flows.	32	6	4.05%
Dosewallips	1.17* (combined with Hamma Hamma and Duckabush)	Important bridge between sub-regions	n/a	Critical thresholds	High conservation rating	Very good water temperatures.	107	27	1.64%
Dungeness	1.09* (weakly positive)	High - boundary stock	Low	Critical thresholds	High conservation ratings	Very good water temperatures except in upper river, reflecting forest practices.	222	2	2.31%%

* Lambda due in large part to the reproductive success of naturally spawning hatchery origin Chinook.
** Elwha not analyzed since the action area does not extend downstream of the Elwha Dam, the furthest extent of presence.
** Lower West Hood Canal Frontal not analyzed since the action area does not extend into the furthest extent of presence.
*** Ditch analogy: Glyphosate, and triclopyr are likely to exceed the **fish** HQ threshold when applied within 660 ft of listed species occupied streams. Chlorsulfuron, imazapic, imazapyr, metsulfuron, sethoxydim, sulfometuron, and triclopyr are likely to exceed the **algae and aquatic macrophyte** HQ thresholds when applied within 660 feet of streams
**** Data compiled from Appendix B, Table B6 and based on PDF H14 which allows for no more than 6 acres within a sixth field sub-watershed in any given year to be treated. fifth field values were summed to arrive at sixth field values. Glyphosate and triclopyr are likely to exceed the **fish** HQ threshold when applied to emergent vegetation instream. Imazapyr is likely to exceed the **algae and aquatic macrophyte** HQ thresholds when applied to emergent vegetation instream.

Table 25. Synthesis of population, baseline condition information and effects of the action for known and future treatments on Puget Sound steelhead.

PSS Population/ Watershed	VSP/Productivity (Lambda – short-term)	Baseline condition	Ditch Analogy for known treatment sites		EDRR
(fifth field)			Total stream crossings in treatment areas	Stream crossings in treatment areas that are located w/in 660 ft of PSS streams***	Maximum percent of instream acres treated annually ****
Skokomish	0.865*	Warm temperatures in lower river. Turbidity high during peak flows & throughout year,	579	49	1.78%
Hamma Hamma	1.01**	May have some water temperature issues due to forest practices.	172	0	1.63%
Duckabush	N/A	Very good water temperatures. Turbidity high during peak flows.	32	6	4.05%
Dosewallips	N/A	Very good water temperatures.	107	27	1.64%
Dungeness	0.924	Very good water temperatures except in upper river, reflecting forest practices.	222	2	2.31%

* Estimate based on natural spawners only.
** Most likely due to a recently established supplementation hatchery program, rather than an increase in naturally produced steelhead.
*** Ditch analogy: Glyphosate, and triclopyr are likely to exceed the **fish** HQ threshold when applied within 660 ft of listed species occupied streams. Chlorsulfuron, imazapic, imazapyr, metsulfuron, sethoxydim, sulfometuron, and triclopyr are likely to exceed the **algae and aquatic macrophyte** HQ thresholds when applied within 660 ft of streams.
**** Data compiled from Appendix B, Table B6 and based on PDF H14 which allows for no more than 6 acres within a sixth field sub-watershed in any given year to be treated. fifth field values were summed to arrive at sixth field values. Glyphosate and triclopyr are likely to exceed the **fish** HQ threshold when applied to emergent vegetation instream. Imazapyr is likely to exceed the **algae and aquatic macrophyte** HQ thresholds when applied to emergent vegetation instream.

Three things influence the adverse effects on listed species and designated critical habitat, from treatment of known and EDRR program sites. The first is timing of application relative to rainfall, and species' life history stage. The second is size of treatment areas and number of potential road crossings relative to size of entire watershed and distribution of species. The last is the amount of treatment of future emergent vegetation relative to the listed species' status, value of critical habitat, and the environmental baseline condition.

Timing of Treatments: In some circumstances, herbicides are likely to wash into streams from rainfall occurring during or shortly after herbicides are applied along road ditches or on low permeability soils. Rainstorms are likely to occur within the watersheds containing listed salmonids. In such instances, adverse effects on fish could occur particularly in small tributary streams where the herbicide-laden flows would not be readily diluted. On certain occasions when rainfalls occur during or soon after herbicide application, listed fish are likely to be exposed to herbicide concentrations leading to the occurrence of sublethal effects. Outright mortality of fish from herbicide exposure as a result of the proposed action is unlikely. In some circumstances, isolated reductions of primary productivity could occur. While it is reasonably certain that individual PSC and PSS will express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be too intermittent, based on the ONF's proposed action and its incorporated PDF minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level. The isolated cases of reduction of the freshwater rearing forage PCE also is not likely to decrease the conservation value of critical habitat, nor detrimentally affect the productivity of the PSC freshwater life cycle.

Size and Distribution of Known Treatment Areas: Some treatments from both known sites and EDRR program sites would create isolated effects on fish and critical habitat. According to the ONF, the size of known treatment areas throughout the Forest overestimates the size of the actual infestations or the size of the sites that will be treated (Metzger pers. comm. 2007). The delineation of treatment areas was employed by the ONF as a measure of convenience for incorporation into a GIS database. The known treatment sites above bankfull account for only one percent of the entire ONF lands. On the ground, the infestations are patchy and scattered within each of the large treatment area polygons. Some known treatment sites, however, are located immediately adjacent to PSC and/or PSS spawning or rearing grounds. In addition, at this time there are no known below bankfull treatment sites in the vicinity of listed fish or their designated critical habitat. Potential adverse effects to individual listed fish from exposure to herbicides from road ditch stream crossings could also occur. The number of stream crossings within any fifth-field watershed does not exceed eight. Some of the treatments within a fifth field watershed would occur within 660 feet of a PSS stream within the same spray season (Tables 24 and 25). While it is reasonably certain that individual PSC and PSS could express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be intermittent, based on the ONF's proposed action and its incorporated PDF minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level.

The analysis of the annual above bankfull EDRR program treatment yielded potential riparian treatment acreage of up to 18.5 percent within each sixth field subwatershed. For the below bankfull EDRR program weighted averages at the fifth field watershed levels yield less than 5 percent of the instream acreage potentially being treated. Some treatments would create isolated effects on fish and critical habitat. While it is reasonably certain that individual PSC and PSS will express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be intermittent, based on the ONF's proposed action and its incorporated PDF minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level.

Amount of Treated Future Emergent Vegetation: The amount of treatment of future emergent vegetation has the potential to degrade freshwater rearing conditions for PSC's forage PCE and to directly affect the already low productivity of PSS. As seen in Table 25, the Dungeness River fifth field watershed could experience up to 2.31 percent of the instream acres treated annually with herbicides, Duckabush River fifth field watershed could experience up to 4.05 percent, and the Skokomish River fifth field watershed could experience up to 1.78 percent. Based on the findings in Table 22, reductions in the production of algae and aquatic macrophytes could be elicited through the treatment of emergent vegetation with imazapyr at typical and maximum rates. The ability of the PSC populations to overcome these effects on the forage PCE is uncertain. While these three population productivity levels are greater than 1 (Table 24), the populations are at critical abundance thresholds and their habitats have been determined by the CHART to have high conservation value. If the sites are scattered across the sub-watersheds, then the intensity of the adverse effects will not likely reduce the conservation value of critical habitats at the watershed scale. If the ONF finds an emergent vegetation site that equates to the full extent of the PDF H14 of no more treatment than six acres in any sixth field subwatershed annually the function of the PCEs at the local level could be reduced. However, the spatial and temporal prescription of the program prevents the aggregation of effects on PCEs on the local level from rising to a level that would reduce the conservation value of the watersheds. While it is reasonably certain that individual PSC will express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be intermittent, based on the ONF's proposed action and its incorporated PDF minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level.

The amount of treatment of future emergent vegetation has the potential to directly affect the productivity of PSS. Based on the findings above, effects on fish from direct exposure to glyphosate and triclopyr, could cause sublethal effects. As seen in Table 25, the Duckabush River fifth field watershed could experience up to 4.05 percent of the instream acres treated annually with herbicides, the Skokomish River fifth field watershed could experience up to 1.78 percent, and the Dungeness River fifth field watershed could experience up to 2.31 percent. While the short-term productivity for the Duckabush River population of PSS is not known, the rates of replacement for both the Dungeness and Skokomish populations are less than one. NMFS assumes that the short-term productivity of naturally spawning PSS in the Duckabush River watershed is also below 1. This is based on the fact that most of the populations in Hood Canal and along the Strait of Juan de Fuca have abundances averaging less than 100 spawners annually, in some populations, far below historical levels (NMFS 2005a; WDFW 2006)).

The decline in productivity of the Dungeness and Skokomish populations is likely due to limited spawning and rearing habitat due to blockages in both watersheds, which led in part to its listing as threatened under the ESA. In the Skokomish River watershed, warm water baseline conditions could be an important contributor to the very low productivity lambda of 0.865 (based on natural spawners only). While the Dungeness River watershed has not been determined to have water temperature issues, it does have a history of forestry practices and urban development which have the potential to adversely impact the species' spawning and rearing habitat. Due to the recent listing of PSS, the contribution of these populations to the genetic and life history variability of the ESU is unknown but assumed to be high (WDFW 2006).

The proposed EDRR program will cause further degradation of the chemical habitat quality throughout the action area through the use instream of glyphosate and triclopyr. Treatment of emergent vegetation, at both typical and maximum herbicide rates, could occur along margins of any stream where juvenile PSS are rearing. Given their characteristic of spending one to four years in freshwater prior to emigrating to the sea, and their strong use of side-channel habitat, the likelihood of exposure is high. The cumulative effects of other pesticide use downstream of the ONF enhances the exposure risks to both juvenile and adult PSS, and brings in the factor of pesticide mixtures, further adding to the potential sublethal effects. While it is reasonably certain that individual PSC will express impaired normal behavioral patterns, be injured, or suffer ecological death, these outcomes will be limited because exposures will be intermittent, based on the ONF's proposed action and its incorporated PDF minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level.

Combining the species' status and the environmental baseline in the above-discussed watersheds with the largest treatment areas, and with the percentage of known treatment area within 50 meters of occupied streams, it becomes reasonable to conclude that while treatment of some of the known sites is reasonably certain to modify habitat for individual fish that would change their behavior, or injure or kill them, the effects on populations and subsequently the ESUs is not likely to rise to the level of jeopardy. The EDRR analysis across fifth field watersheds showed that the percentage of riparian area in the ONF that could be treated under the EDRR program is less than one percent of the total ONF administered watershed acres. In addition, the analysis of known treatment sites revealed that approximately 99 percent of the existing roads miles on the ONF that contain listed species are identified as treatment sites. Thus, the number of potential EDRR program sites located along roads will be minimal. Lastly, when considering the risk of treatment of future potential emergent vegetation under the EDRR program, treatment of some of the sites is reasonably certain to impair normal behavioral patterns and injure, or kill listed salmon or steelhead; however, these outcomes will be limited because exposures will be intermittent, based on the ONF's proposed action and its incorporated PDF minimization measures. As a result, these outcomes are not likely to produce an observable change in the abundance, distribution, diversity, or productivity of these species at either the population or species level.

Conclusion

After reviewing the best scientific and commercial data available on status of the affected species and their designated critical habitats, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, NMFS concludes that the action as proposed is not likely to jeopardize the continued existence of PSC, HCC, or PSS. A small number of fish are likely to suffer impaired normal behavior, or be injured or suffer ecological death by the proposed action during treatment of the known and EDRR sites. However, due to dispersed use of chemicals, manual, mechanical and restoration activities, caps on types and amounts of treatments in any given watershed and in any given year, and many safeguards designed to prevent or minimize introduction of herbicides into streams, this action will not rise to the level of jeopardizing the continued existence or hindering the ability to achieve recovery of the PSS, PSC or HCC species.

Similarly, limited freshwater rearing and spawning areas of designated critical habitat will be adversely affected. However, NMFS also determines that the action is not likely to result in the adverse modification or destruction of designated critical habitat of PSC or HCC. These determinations are based principally on a likelihood of water contamination from herbicides resulting in adverse effects that are likely to be limited in area, duration, and in severity.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. The following recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the FS:

1. NMFS has adopted recovery plans for PS Chinook (January 19, 2007) and HCC summer-run (May 24, 2007). The final recovery plans can be found at the following websites:
   http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Puget-Sound/PS-Chinook-Plan.cfm
   http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Puget-Sound/Hood-Canal-Plan.cfm
   NMFS encourages the FS to consider the recommended actions and prioritization plans found in the final recovery plans when planning invasive plant treatment projects on the ONF.

2. The ONF should use herbicides with the least toxicity to listed fish and other non-target organisms whenever possible.

3. The ONF should investigate the utility of alternative forms of weed control that do not involve the use of chemicals toxic to aquatic organisms.

4. The applicator should only use surfactants or adjuvants in riparian areas where the effects of the ingredients have been tested on salmonids and have been found to be of low toxicity and the products do not contain any ingredients on EPA's List 1 or 2.

5. Minimize the use of combining herbicides where practicable.

Please notify NMFS if these recommendations are carried out so that we will be kept informed of actions that minimize or avoid adverse effects, and those that benefit listed species or their designated critical habitats.

Reinitiation of Consultation

To ensure that the effects of the proposed action remain within the scope of those analyzed in this Opinion over the duration of the proposed action, reinitiation of formal consultation is required after 5 years. In addition, reinitiation of formal consultation is required and shall be requested by the ONF or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of taking specified in the ITS is exceeded; (2) 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; (3) 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 Opinion; (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR. 402.16); or (5) the timing and finding of the Technical Review Panel's final review warrants it. If reinitiation of consultation appears warranted due to one or more of the above circumstances, contact the WSHO of NMFS and refer to the NMFS Tracking Number assigned to this consultation.

Incidental Take Statement

Presently, NMFS is preparing the ESA section 4(d) rulemaking prohibiting take of threatened Puget Sound steelhead, and that rulemaking should be completed in the near future. While take is not yet prohibited, the following section assesses the amount or extent of take of Puget Sound steelhead. Furthermore, the terms and conditions would minimize the effects of any anticipated take. Thus, should the action agency retain discretion over the proposed action after NMFS completes the rulemaking prohibiting take, the exemption from the prohibition will become effective for Puget Sound steelhead, concurrent with the publication of the final rule prohibiting their take.

Section 9(a)(1) of the ESA prohibits the taking of endangered species without a specific permit or exemption. Protective regulations adopted pursuant to section 4(d) extend the prohibition to threatened species (July 10, 2000, 65 FR 42422). Among other things, an action that harasses, wounds, or kills an individual of an ESA-listed species or harms a species by altering habitat in a way that significantly impairs its essential behavioral patterns is a taking (50 CFR 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 CFR 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.

Amount or Extent of Take

Recent and historical surveys indicate that listed species occur in the action area, in places where they will be exposed to the effects of the action. Some exposed fish will respond to these effects by changing normal behaviors, in some cases to their detriment, by injury or by dying through sublethal effects. These results are not the purpose of the proposed action. Therefore, incidental take of those animals is reasonably certain to occur.

As mentioned in the Consultation History section of the Opinion, NMFS previously concurred with ONF's determination that the treatment of 25 known infested sites according to the described program is not likely to adversely affect listed species. Therefore, those treatments will not cause incidental take of listed species and are not included within the scope of this ITS. NMFS therefore need not assess the amount or extent of take for those treatments and sites.

In contrast, NMFS could not derive the same certainty for the remaining known treatment sites or the future EDRR program treatment sites. Chemicals are most likely to reach streams when they are applied instream, or to riparian areas, dry ditches and intermittent streams when immediately followed by rainfall. Consequently, the spatial limitations on treatment of the known and EDRR program sites on an annual basis represent the absolute maximal area of chemical treatment-based habitat modification that could rise to the level of harm of listed fish. As described below, there is no practical alternative to using this spatial measure of take, given that the precise treatment needs of and site-specific features affecting individual sites, as well as weather conditions, cannot be accurately predicted in advance.

Despite the use of best scientific and commercial data available, NMFS cannot quantify the specific number of fish or incubating eggs or fry that may be taken by the proposed action. The number of animals exposed to chemical concentrations sufficient to change their behavior, or injure or kill them, depends on several variables. These variables include the specific times and locations that invasive plant treatments will occur, rainfall, wind, humidity, and proximity of treatment sites to individual fish or redds. Additionally, we cannot predict how those fish or redds that would be exposed would responds to that exposure, because response would greatly vary, from no response to sublethal changes in normal behavior, to injury, or ecological death.

The difficulty of estimating take as a number of affected fish was recognized early during consultation. This recognition is acknowledged in the framework of the proposed action itself. The action incorporates substantial safeguards to ensure that program activities are carried out in a manner that minimizes the negative effects of invasive weed treatments on listed species by restricting chemical use and treatment methods to those minimally necessary to achieve program objectives and by strictly limiting the extent of acreage that may be treated within riparian buffer areas. Therefore, the likelihood of incidental take is reduced or avoided as a threshold matter. Nevertheless, because some level of incidental take may occur, NMFS must estimate the extent of that take so as to frame the limits of the take exemption provided in this Incidental Take Statement and set a threshold which, if exceeded, would be a basis for reinitiating consultation.

To derive that threshold, NMFS assessed the extent of treatment sites contemplated by the proposed action. As such the extent equates to the 74 known sites previously discussed, and the annual extent of EDRR program treatment sites. This represents a coarse (and likely overestimated) extent of habitat modified by the proposed action. The extent of incidental take exempted in this Incidental Take Statement is the extent of habitat modified:

1. for known sites the acreage where herbicides are proposed to be applied to riparian area, ditches and dry channels, and instream for emergent vegetation management,

2. above bankfull, within the aquatic influence zone, up to 10 acres along any 1.5 mile of stream reach within a sixth field subwatershed in any given year, and

3. below bankfull up to six total acres within each sixth field subwatershed in any given year.

Based on the existence of 25 sixth field watersheds in the action area, the maximum annual extent of habitat that could be modified by EDRR program treatments in the action area is 250 acres for treatments above bankfull and 150 acres for treatments below bankfull. Presently the total acres within a 50 meter riparian buffer that might be treated in the ONF under the EDRR program that could result in the take of listed salmon or steelhead is 3021.5 acres.

The foregoing figures are measures of the extent of habitat that could be modified by the proposed action. In that these figures can be planned, observed, and measured, the action agency can readily determine if they are exceeded at any time during the program. Therefore, they represent the limit of the exemption from the prohibition on incidental take provided by this Incidental Take Statement, and if exceeded, the reinitiation provisions of the consultation apply.

Reasonable and Prudent Measures

The Reasonable and Prudent Measures (RPMs) are non-discretionary measures to avoid or minimize take that must be carried out for the exemption in section 7(o)(2) to apply. The ONF 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 ONF 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.

NMFS believes that full application of the PDFs and buffers included as part of the proposed action, together with use of the RPMs and terms and conditions described below, are necessary and appropriate to minimize the likelihood of incidental take of ESA-listed species due to the proposed action.

The ONF shall minimize incidental take by:

1. Minimizing the amount and extent of incidental take from use of herbicides by implementing precautionary measures that keep chemicals out of water.

2. Reporting annual invasive plant control proposals to NMFS via the Level 1 Team by March 1, prior to the start of each spray season (2008 to 2013). The proposals will include the treatment methods, herbicide application methods and rates, objectives of treatments, locations, maps of treatment areas, acreages, proposed start and stop dates, and special mitigation measures that will be applied.

3. Ensuring completion of an annual weed treatment monitoring program by January 31 following each of the 2008 to 2013 spray seasons.

4. Annually reporting by January 31 to NMFS activities implemented during the 2007 to 2013 seasons and the results of their monitoring including acreage of herbicide treatment within the aquatic influence zone, within ditches and dry channels, and instream and along gravel bars to confirm that this Opinion is meeting its objective of limiting the extent of take and minimizing take from permitted activities. If no activities occur, a report of no action is still required by January 31, following each spray season (2008 to 2013).

<u>Terms and Conditions</u>

1. To implement Reasonable and Prudent Measure No. 1, the ONF shall:

   a. Within 3 months of the signing of this Opinion, develop and obtain NMFS's approval, for a rational, implementable rainfall delay approach. Soil active herbicides are excluded from a rain delay when the label states that rainfall soon after application is necessary for effective treatment. If Level 1 Staff are unable to complete the rain delay approach, Level II will complete the task within an additional 60 days.

   b. Implement the rainfall delay approach for the duration of this Opinion.

   c. Within the Lower North Fork Skokomish River and Upper Duckabush River sixth field subwatersheds, ensure that the percentage of instream acres treated annually does not exceed 10 percent of stream area.

   d. Minimize the use of herbicides at maximum application rates (specifically glyphosate and triclopyr), and also limit the use of glyphosate and triclopyr to application rates below typical in any form of spray application.

   e. Minimize the use of all forms of chlorsulfuron, imazapic, imazapyr metsulfuron, sethoxydim, sulfometuron, and triclopyr in designated critical habitat.

   f. Ensure that all proposed project design features for each activity type be implemented as proposed.

   g. Do not use products other than those products evaluated in this Opinion and identified in Table 3.

2. To implement Reasonable and Prudent Measure No. 2, the ONF shall:

   a. Conduct Level 1 review of annual invasive plant treatment plans including treatment methods, herbicide application methods and rates, objectives of treatments, locations, maps of treatment areas, acreage, proposed start and completion dates, sensitive areas, and special mitigation for activities involving herbicides by March 1, prior to the spray season. This reporting requirement will commence on March 1, 2008; will follow for each subsequent spraying season by March 1; and will end for this consultation on March 1, 2012.

   b. Use the NMFS CIRS (http://www.nmfs.noaa.gov/pcts) when this online system becomes available (anticipated date, late 2007), and ONF staff have been trained to use it.

   c. Prior to the CIRS becoming available, the ONF shall provide the following information in paper form to the NMFS Washington State Habitat Office (WSHO) for all projects. The following information shall be provided:
      (1) A batch of project notification reports will be provided at least 30 days prior to implementation of any proposed project. The reports should contain the following:

         a. Location: sixth field HUC, 12 digit code, and name
         b. Timing: Anticipated project start and dates
         c. Treatment/Restoration Type: Identify all proposed activity types that apply.
         d. Project Description: Brief narrative of the project and objectives
         e. Extent: Number of stream miles, road miles along streams, acres adjacent to streams, and number of riparian acres to be treated
         f. Species Affected: Listed fish and or wildlife species, critical habitat, and or EFH affected by the project.

3. To implement Reasonable and Prudent Measure No. 3, the ONF shall:

   a. For application of aquatic glyphosate, aquatic triclopyr, and/or aquatic imazapyr along with herbicide treatments of stream emergent vegetation using spot or hand/selective methods, submit as candidates for monitoring via the R6 2005 ROD Monitoring Framework to ensure the PDFs for such treatments are effective.

   b. If the R6 2005 ROD Monitoring Framework is not completed by December 31, 2007, the ONF will develop, and submit to NMFS for review and approval, a forest-specific Monitoring Framework by December 31, 2008.

   c. Implement either the R6 2005 ROD or forest specific Monitoring Framework for the duration of this Opinion.

   d. Each applicator shall maintain a daily log of all invasive treatments, and including the following information:

      (1) The number of acres treated within 50 meters of live water.

(2) The number of road miles and/or acres.
(3) The number of acres of instream emergent plant herbicide treatment.
(4) Identify treatment areas by sixth field HUC.
(5) The product names, herbicide formulations, including adjuvants and surfactants, used.
(6) The herbicide application rate.
(7) The application method.
(8) Wind speed and air temperature at the time of application.
(9) Rainfall timing and application dates.
(10) Additional information required on the FS Herbicide Application Data Form (dated 9/28/06).

e. The daily logs shall be retained by the ONF administrative units, and be available annually in summary form by January 31 for review by NMFS, if they are needed.

4. To implement Reasonable and Prudent Measure No. 4, the ONF shall:

a. Annually report to NMFS by January 31, following the end of each spray season for the duration of this Opinion (2008 to 2013 spray seasons), the results of the monitoring plan described in Term and Conditions 3a, 3b, 3c, and 3e.

b. Use the NMFS CIRS (http://www.nmfs.noaa.gov/pcts) when this online system becomes available (anticipated launch date April 15, 2007) and ONF staff have been trained to use it.

c. Prior to the CIRS becoming available, the ONF shall provide the following information in paper form to the NMFS WSHO for all projects. The following information shall be provided:

(1) Project Completion Report will be provided within 120 days of project completion. This report should contain the elements of term and condition 3d above, as well as the following:

a. Timing: Actual project start and end dates
b. ONF contact information: Project lead name.
c. Post-project assessment: The results of the ONF' monitoring efforts should be reported to NMFS.
d. Prior to the launch of the CIRS system, the ONF shall track implementation of this programmatic consultation to ensure that the amount and extent of take identified above is not exceeded.

NOTICE: If knowledgeable field personnel identifies that steelhead or salmon appears injured or killed as a result of herbicide exposure or other project-related activities, the finder should leave the fish alone, make note of any circumstances likely causing the death or injury, location and number of fish involved, and take photographs, if possible. Adult fish should generally not be disturbed unless circumstances arise where an adult fish is obviously injured or killed by herbicide exposure, or some unnatural cause. The finder must contact the Washington Field

Office of NMFS Law Enforcement at (360)753-4409 as soon as possible. The finder may be asked to carry out instructions provided by Law Enforcement to collect specimens or take other measures to ensure that evidence intrinsic to the specimen is preserved.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Federal agencies are required, under section 305(b)(2) of the MSA and its implementing regulations (50 CFR 600 Subpart K), to consult with NMFS regarding actions that are authorized, funded, or undertaken by that agency that may adversely affect Essential Fish Habitat (EFH). The MSA section 3 defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." If an action would adversely affect EFH, NMFS is required to provide the Federal action agency with EFH conservation recommendations (section 305(b)(4)(A)). This consultation is based, in part, on information provided by the Federal agency and descriptions of EFH for Pacific coast groundfish, coastal pelagic species, and Pacific salmon contained in the Fishery Management Plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

The Pacific Fishery Management Council (PFMC) designated EFH for Pacific groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998), and Pacific salmon (PFMC 1999). The proposed action and covered area are detailed above in the Introduction Section of this document. The USDA Forest Service is the action agencies for the proposed Program for the Invasive Plant Treatment Project – Olympic National Forest. The covered area includes habitats designated as EFH for various life-history stages of Pacific salmon, groundfish, and coastal pelagic species (Table 26). The geographic extent of EFH on the ONF is defined as all currently viable waters and most of the habitat historically accessible to Chinook, coho (*O. kisutch*), and pink salmon (*O. gorbuscha*) within the watersheds identified in the BA. Salmon EFH excludes areas upstream of longstanding, naturally impassable barriers. Salmon EFH includes aquatic areas above all artificial barriers.

Table 26. Species of salmon with designated EFH occurring in Puget Sound, Columbia River estuary.

Pacific Salmon Species
Chinook salmon *Oncorhynchus tshawytscha*
coho salmon
O. kisutch
Puget Sound pink salmon *O. gorbuscha*

Effects of the Proposed Action on Essential Fish Habitat

Based on information provided in the BA, and the Effects of the Action section of this document, the proposed action may result in adverse impacts to a variety of habitat parameters important to salmonids. The effects analysis for ESA found that herbicide treatment may adversely affect habitat quality for Puget Sound Chinook in instances where herbicides would be applied in drainages, riparian areas, and ditches upstream from occupied habitat. In addition, herbicides that enter streams are occasionally expected to reach concentrations that could cause transient sublethal toxic effects in Chinook salmon. However, appreciable water contamination is expected to be infrequent and limited in area and duration due to the relatively small amounts and rates of chemicals that will be applied in a given area, implementation of PDFs to reduce water contamination, and the limited amount of acreage treated relative to the overall watersheds.

Water contamination from herbicides is expected to occur when precipitation carries the herbicides to water through overland flow, percolation, or in shallow ground water; and when herbicides fall directly in the water from spray drift stemming from treatments within ditches, dry channels, and perennial streams or along the riparian corridor, or by accidentally directing the application stream into water. The likelihood of contamination is minimized in the proposed action through the use of PDFs but contamination cannot be completely avoided since the likelihood of contamination is partly dependant on the weather at the time of, and following herbicide application. The herbicides proposed for use are generally transported readily in water and circumstances where herbicides are mobilized such as wind, rain and snow are likely to occur before all of the herbicides have broken down. Consequently, site-specific circumstances such as soil characteristics, vegetation, topography and weather during and following herbicide application will determine the frequency, severity, and duration of habitat impairment due to water contamination by herbicides. The exact locations where water contamination will occur and concentrations of herbicides once they reach water cannot be predicted since none of the above factors affecting chemical transport are known ahead of time.

When water contamination occurs, it is likely to be transient and localized. For an herbicide to have an adverse effect on EFH, the chemical must be of sufficient concentration or duration in water to cause a reduction in the quantity or quality of EFH. A reduction in quality or quantity of EFH from herbicide contamination is indicated by exposures that are sufficient to cause a behavioral or physiological effect in Chinook salmon. In the limited circumstances where toxic thresholds are reached, the effects are likely to be sublethal and herbicide concentrations are likely to rapidly drop with increasing distance from the treatment area due to dispersion of the herbicides and increasing stream discharge. Most of the herbicides proposed for use break down chemically in a matter of months, although clopyralid and picloram may be present in the environment for much longer. Under the worst possible contamination scenario under the proposed action, herbicides are not likely to reach lethal concentrations; sublethal concentrations would likely occur in only a few treatment locations, and sublethal effects would persist for no longer than roughly one year or less.

The conservation measures included as part of the proposed action to address ESA concerns are adequate to avoid, minimize, or otherwise offset potential adverse effects on the EFH of Pacific salmon in Table 27.

The BA clearly identifies anticipated impacts to the EFH for Pacific salmon that are likely to result from the proposed activities and the measures that are necessary and appropriate to minimize those impacts. These effects include delivery of sediments and herbicides to streams through in-water and riparian invasive plant treatment, and temporary loss of riparian vegetation prior to full riparian vegetation restoration.

NMFS determined that the action may have adverse effects on EFH for Chinook salmon, coho salmon, and pink salmon as follows:

1. Short-term degradation of water quality (chemical) from in-water, ditch and riparian herbicide treatments.
2. Short-term reduction in salmon food sources as a result of herbicide treatments to control invasive plant species.

All of these effects influence the ability of affected areas to support salmonid spawning, incubation, larval development, juvenile growth and mobility, and adult mobility. For a more detailed description and analysis of these effects, see Effects of the Action section of this document.

Essential Fish Habitat Conservation Recommendations

NMFS believes that the following conservation measures are adequate to avoid, minimize, or otherwise offset the potential adverse effects, described above, from these activities to designated EFH for Chinook salmon, coho salmon, and Puget Sound pink salmon. NMFS understands that the FS intends to implement these conservation measures to minimize potential adverse effects on the maximum extent practicable. NMFS recommends tracking the implementation of invasive plant treatment actions that occur in EFH. The Action Agencies implement the following conservation recommendation:

1. Reasonable and Prudent Measure No. 1, and associated terms and conditions 1a. to 1h. in the Opinion above.
2. Reasonable and Prudent Measure No. 2, and associated terms and conditions 2a. to 2d. in the Opinion above.
3. Reasonable and Prudent Measure No. 3, and associated terms and conditions 3a. to 3e. in the Opinion above.
4. Reasonable and Prudent Measure No. 4, and associated terms and conditions 4a. to 4e. in the Opinion above.

Statutory Response Requirement

Federal agencies are required to provide a detailed written response to NMFS' EFH conservation recommendations within 30 days of receipt of these recommendations [50 CFR 600.920(j)(1)]. However, since NMFS did not provide conservation recommendations for this action, a written response to this consultation is not necessary.

Supplemental Consultation

The Action Agency must reinitiate EFH consultation if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(k)]. This consultation expires on December 31, 2011.

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 (DQA)) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

Utility: This ESA section 7 Consultation and Magnuson-Stevens Fishery Conservation and Management Act EFH Consultation on proposed herbicide treatments by the ONF, concluded that the action is not likely to jeopardize the continued existence of Puget Sound Chinook, Hood Canal summer-run chum, or Puget Sound steelhead, or result in the adverse modification or destruction of designated critical habitat. The intended user of this consultation is the ONF and the information in this consultation will be useful to citizens and groups with interest in land management activities carried out on the ONF. These include Washington residents, local and county government officials and employees.

Integrity: This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

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 ESA *Consultation Handbook*, ESA Regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the literature cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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Appendix A – Description of herbicides proposed for use.

Chemical/Selected Brand Names/Action	Properties	General Uses/Known to be Effective on:
Chlorsulfuron (Telar,Glean,Corsair)/ Sulfonylurea-Interferes with enzyme acetolactate synthase w/ rapid cessation of cell division and plant growth in shoots and roots.	Glean -Selective pre-emergent or early post-emergent Telar – Selective pre- and post-emergent. Both are for many annual, biennial and perennial broadleaf species. Safe for most perennial grasses, conifers. Some soil residue.	Use at very low rates on annual, biennial and perennial species; especially dalmation toadflax, and houndstongue and perennial pepperweed.
Clopyralid (Transline)/ Synthetic auxin -Mimics natural plant hormones.	A highly translocated, selective herbicide active primarily through foliage of broadleaf species. Little effect on grasses.	Particularly effective on Asteraceae, Fabaceae, Polygonaceae, Solanaceae. Some species include knapweeds, yellow starthistle, Canada thistle, hawkweeds. Provides control of new germinants for one to two growing seasons.
Dicamba (Banvel , Vanquish) Synthetic auxin -Mimics natural plant hormones.	Used for the control of a variety of broadleaf and woody vegetation. Banvel is more likely to generate dicamba vapor than Vanquish.	Selective against many annual and perennial broadleaf species including woody and vine species (e.g. gorse, hawkweeds, tansy ragwort).
Glyphosate (RoundUp, Rodeo etc.)/ Inhibits three amino acids and protein synthesis.	A broad spectrum, non-selective translocated herbicide with no apparent soil activity. Adheres to soil which lessens or retards leaching or uptake by non-targets.	Low volume applications are most effective. Translocates to roots and rhizomes of perennials. While considered non-selective, sensitivities do vary depending on species. Main control for purple loosestrife, herb Robert, English ivy and reed canarygrass. Aquatic labeled formulations can be used near water.
Imazapic (Plateau)/Inhibits the plant enzyme acetolactate, which prevents protein synthesis.	Used for the control of some broadleaf plants and some grasses.	Use at low rates can control leafy spurge, cheatgrass, medusa head rye, toadflaxes and houndstongue
Imazapyr (Arsenal, Chopper, Stalker Habitat)/ Inhibits the plant enzyme acetolactate, which prevents protein synthesis.	Broad spectrum, non-selective pre- and post-emergent for annual and perennial grasses and broadleaved species.	Most effective as a post-emergent. Has been used on cheatgrass, whitetop, perennial pepperweed, dyers woad, tamarisk, woody species, and spartina. Aquatic labeled formulations can be used near water.

Chemical/Selected Brand Names/Action	Properties	General Uses/Known to be Effective on:
Metsulfuron methyl (Escort)/ Sulfonylurea - Inhibits acetolactate synthesis, protein synthesis inhibitor, block formation of amino acids.	Used for the control of many broadleaf and woody species. Most susceptible crop species in the Lily family (i.e. onions, Allium). Safest sulfonylurea around non-target grasses.	Use at low rates to control such species as houndstongue, sulfur cinquefoil perennial pepperweed.
Picloram (Tordon) Restricted Use Herbicide Synthetic auxin - Mimics natural plant hormones.	Selective, systemic for many annual and perennial broadleaf herbs and woody plants.	Use at low rates to control such species as knapweeds, Canada thistle, yellow starthistle, houndstongue, toadflaxs, sulfur cinquefoil, and hawkweeds. Provides control of new germinants for two to three growing seasons.
Sethoxydim (Poast)/ Inhibits acetyl co-enzyme, a key step for synthesis of fatty acids.	A selective, post-emergent grass herbicide.	Will control many annual and perennial grasses such as cheatgrass.
Sulfometuron methyl (Oust)/ Sulfonylurea -Inhibits acetolactase synthase, a key step in branch chain amino acid synthesis.	Broad spectrum pre- and post-emergent herbicide for both broadleaf species and grasses.	Used at low rates as a pre-emergent along roadsides. Known to be effective on canary reedgrass. (but not labeled for aquatic use) cheatgrass, medusahead.
Triclopyr (Garlon, Pathfinder, Remedy)/ Synthetic auxin - Mimics natural plant hormones.	A growth regulating selective, systemic herbicide for control of woody and broadleaf perennial weeds. Little or no impact on grasses.	Not for broadcast application under proposed action. Effective for many woody species such as scotch broom and blackberry. Also effective on English ivy, Japanese knotweed. Amine formulation may be used near water
2,4-D (Weedone, Weedar, many more) Synthetic auxin - Mimics natural plant hormones.	Readily absorbed and metabolized. Used for the control of many broadleaf species.	Effective for many broadleaf species (such as Canada thistle, Russian knapweed, sulfur cinquefoil, hoary cress). Aquatic labeled formulations can be used near water.

Risk information found in SERA documents (2,4-D 1998, Triclopyr 2003, Picloram 2003, Sethoxydim 2001, Glyphosate 2003, all others 2004) for each active ingredient. Information on species effectiveness in Tu et al. (2001) or from product labels.

Copied from the Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants Final Environmental Impact Statement - April 2005.

Appendix B – GIS data tables

Table B1. Summary of Road Miles within Invasive Plant Treatment Areas on the Olympic National Forest (ONF) by fifth-Field Watersheds with Puget Sound Steelhead (PSS) Habitat.

5th Field Watershed	5th Field HUC	Total ONF road miles in watershed	Average road density (mi/sq. mi.) on ONF	Total ONF road miles located within treatment areas in watershed	Percent of ONF road miles in watershed located in treatment areas	Road miles located within 50 meter riparian buffers of mapped PSS streams	Percent of total road miles located within 50 meter riparian buffers of mapped PSS streams
NF SKOKOMISH RIVER	1711001701a	34.21	1.00	33.84	98.9%	0.57	1.7%
SF SKOKOMISH RIVER	1711001701b	237.28	2.55	191.03	80.5%	1.45	0.6%
SKOKOMISH RIVER	**Subtotals**	**271.49**	**2.13**	**224.86**	**82.8%**	**2.02**	0.7%
LOWER WEST HOOD CANAL FRONTAL	1711001802	42.17	2.49	39.74	94.2%	0.00	0.0%
HAMMA HAMMA RIVER	1711001803	77.89	1.20	62.28	80.0%	0.00	0.0%
DUCKABUSH RIVER	1711001804	28.10	1.04	19.24	68.5%	0.76	2.7%
DOSEWALLIPS RIVER	1711001805	38.03	1.11	38.02	100.0%	2.26	5.9%
BIG QUILCENE RIVER	1711001806	88.13	1.47	86.10	97.7%	0.00	0.0%
UPPER WEST HOOD CANAL FRONTAL	1711001807	37.42	1.58	33.77	90.2%	0.29	0.8%
DISCOVERY BAY	1711002001	35.02	2.31	29.71	84.8%	0.00	0.0%
SEQUIM BAY	1711002002	48.32	2.88	39.00	80.7%	0.87	1.8%
DUNGENESS RIVER	1711002003	100.88	1.15	100.30	99.4%	0.27	0.3%
PORT ANGELES HARBOR	1711002004	10.15	1.64	10.14	99.9%	0.00	0.0%
ELWHA RIVER	1711002007	24.63	1.41	20.81	84.5%	0.98	4.0%
	Totals	**802.21**	**1.61**	**794.08**	**99.0%**	**7.45**	**0.9%**

Notes:

Acres, stream miles, and road miles listed for the Olympic National Forest are gross estimates that include inholdings within the ONF administrative boundary.

This table was created using Olympic National Forest GIS data. Due to inherent inconsistencies in GIS analyses, the figures reported here may differ slightly from figures reported elsewhere.

North Fork and South Fork Skokomish subwatersheds were calculated separately for analysis purposes.

Vince Harke, USFWS - May 10, 2007

Table B2. Summary of treatment acres, road miles, and stream crossings in Olympic National Forest Treatment Areas (TA) located within 660 feet of Puget Sound steelhead (PSS) streams.

Treatment ID	Site Description	Total Acres in Treatment Area	Treatment Acres located within 660 ft of PSS streams	Total Road Miles in Treatment Area	Total Road Miles within 660ft of PSS streams	Road crossings over PSS streams in TA	Total road-stream crossings located within 660 ft of PSS streams	Total length of PSS streams within the TA boundary (miles)	Total streams within TA boundary (miles) within 660 feet of PSS streams (includes PSS stream lengths)	5th WATERSHED_	**5th Field HUC**
9H-08b	RoadPlus	388.99	5.40	23.14	5.35	0	1	0.00	0.00	BIG QUILCENE RIVER	1711001806
9H-09b	RoadPlant	3,223.60	19.61	6.74	0.82	0	0	0.07	0.18	BIG QUILCENE RIVER	1711001806
9H-10	RoadPlus	643.56	4.15	44.18	6.34	0	2	0.00	0.05	BIG QUILCENE RIVER	1711001806
		4,256.15	**29.15**	**74.06**	**12.51**	**0**	**3**	**0.07**	**0.23**		1711001806
9H-05	RoadPlant	1,477.09	15.26	30.80	1.60	0	0	0.00	0.00	DISCOVERY BAY	1711002001
9H-11	RoadPlus	182.58	118.80	12.25	10.64	3	27	0.47	1.09	DOSEWALLIPS RIVER	1711001805
9H-13	RoadPlus	1,237.56	153.45	19.24	7.00	1	6	1.11	1.85	DUCKABUSH RIVER	1711001804
9H-02	RoadForest	276.77	8.81	16.04	6.85	1	1	0.03	0.03	DUNGENESS RIVER	1711002003
9H-06a	RoadPlus	268.74	23.55	17.12	8.83	1	1	0.04	0.05	DUNGENESS RIVER	1711002003
9H-07	RoadPlus	314.67	0.79	18.48	8.27	0	0	0.00	0.00	DUNGENESS RIVER	1711002003
		860.19	**33.15**	**51.64**	**23.96**	**2**	**2**	**0.06**	**0.08**		1711002003
9P-40	RoadPlus	119.42	42.29	8.90	4.15	1	5	0.02	0.11	ELWHA RIVER	1711002007
9H-03	RoadPlus	231.45	22.31	17.12	6.70	1	5	0.06	0.15	SEQUIM BAY	1711002002
9H-17	RoadPlus	568.97	76.49	20.78	11.19	1	5	0.23	0.50	NF SKOKOMISH RIVER	1711001701a
9H-17a	RoadPlus	311.65	10.32	19.31	6.51	1	2	0.03	0.03	NF SKOKOMISH RIVER	1711001701a
		880.61	**86.81**	**40.08**	**17.70**	**2**	**7**	**0.26**	**0.53**		1711001701a
9H-18	RoadPlus	764.87	68.94	55.39	21.86	3	15	0.06	0.36	SF SKOKOMISH RIVER	1711001701b
9H-19	RoadPlus	153.44	31.55	10.29	5.91	0	9	0.00	0.15	SF SKOKOMISH RIVER	1711001701b
9H-20	RoadPlus	392.11	4.76	29.16	4.20	0	0	0.00	0.00	SF SKOKOMISH RIVER	1711001701b
9H-21	RoadPlus	500.78	6.33	5.77	1.10	0	0	0.00	0.00	SF SKOKOMISH RIVER	1711001701b
9H-22	RoadPlus	185.92	4.91	14.06	2.34	1	1	0.02	0.02	SF SKOKOMISH RIVER	1711001701b
9H-23	RoadPlus	1,566.49	46.83	96.64	21.87	0	3	0.00	0.09	SF SKOKOMISH RIVER	1711001701b
9H-30	Meadow	57.13	21.89	0.00	0.00	0	0	0.16	0.29	SF SKOKOMISH RIVER	1711001701b
		3,620.74	**185.22**	**211.31**	**57.29**	**4**	**28**	**0.24**	**0.92**		
	Totals	**5,381.96**	**358.84**	**291.48**	**92.69**	**8.00**	**42.00**	**2.29**	**1.98**		
Harke May 1, 2007											

Table B3. Summary of Invasive Plant Treatment Areas on the Olympic National Forest (ONF) by fifth-Field Watersheds with Puget Sound Steelhead (PSS) Habitat

5th Field Watershed	5th Field HUC	Total Watershed Acres (all ownerships)	ONF watershed acres	Percent of Watershed Acres in ONF	Total Proposed Treatment Area Acres in Watershed	Percent of ONF watershed acres within treatment areas	Total ONF acres located within 50 meter riparian buffers of mapped PSS streams	Treatment Area acres located within 50 meter riparian buffers of mapped PSS streams	Percent of PSS 50m riparian buffers within ONF treatment areas
NF SKOKOMISH RIVER	1711001701a	59,301	21,988	37.1%	662.1	3.0%	258.6	13.79	5.3%
SF SKOKOMISH RIVER	1711001701b	97,547	59,515	61.0%	3,291.5	5.5%	1,213.2	16.33	1.3%
SKOKOMISH RIVER	**Subtotals**	**156,848**	**81,504**	**52.0%**	**3,953.6**	**4.9%**	**1,471.8**	**30.12**	**2.0%**
LOWER WEST HOOD CANAL FRONTAL	1711001802	49,199	10,826	22.0%	1,149.4	10.6%	0.0	0.00	0.0%
HAMMA HAMMA RIVER	1711001803	53,724	41,518	77.3%	944.0	2.3%	0.0	0.00	0.0%
DUCKABUSH RIVER	1711001804	50,416	17,296	34.3%	1,237.6	7.2%	237.2	41.49	17.5%
DOSEWALLIPS RIVER	1711001805	74,355	21,975	29.6%	1,678.7	7.6%	308.1	38.41	12.5%
BIG QUILCENE RIVER	1711001806	44,754	38,419	85.8%	3,749.5	9.8%	107.5	9.06	8.4%
UPPER WEST HOOD CANAL FRONTAL	1711001807	82,182	15,184	18.5%	2,435.3	16.0%	18.0	0.00	0.0%
DISCOVERY BAY	1711002001	51,128	9,690	19.0%	1,456.8	15.0%	49.7	0.43	0.9%
SEQUIM BAY	1711002002	34,471	10,730	31.1%	590.1	5.5%	54.4	10.67	19.6%
DUNGENESS RIVER	1711002003	138,092	56,004	40.6%	5,358.4	9.6%	627.0	9.90	1.6%
PORT ANGELES HARBOR	1711002004	100,493	3,960	3.9%	499.1	12.6%	0.0	0.00	0.0%
ELWHA RIVER	1711002007	205,663	11,180	5.4%	282.0	2.5%	295.5	7.69	2.6%
	Totals	**1,041,325**	**318,286**	**30.6%**	**23,334.6**	**7.3%**	**3,169.2**	**147.77**	**4.7%**

Notes:

Acres, stream miles, and road miles listed for the Olympic National Forest are gross estimates that include inholdings within the ONF administrative boundary.

This table was created using Olympic National Forest GIS data. Due to inherent inconsistencies in GIS analyses, the figures reported here may differ slightly from figures reported elsewhere.

North Fork and South Fork Skokomish subwatersheds were calculated separately for analysis purposes.

Vince Harke, USFWS - May 10, 2007

Table B4. Summary of Stream Crossings within Invasive Plant Treatment Areas on the Olympic National Forest (ONF) by fifth-Field Watersheds with Puget Sound Steelhead (PSS) Habitat

5th Field Watershed	5th Field HUC	Total ONF Stream Crossings in Watershed	Average Stream Crossings per mile of road	Total Stream Crossings in Treatment Areas	Percent of stream crossings located in treatment areas	Treatment Area Stream Crossings that Flow directly to PSS streams	Percent of Crossings in Treatment Areas that flow directly to PSS streams	Treatment Area High Potential Delivery Stream Crossings that Flow directly to PSS streams	Stream crossings in treatment areas that are located within 660 feet of PSS streams	Stream crossings in treatment areas that are located within 50 meters of PSS streams	Treatment Area Stream Crossings over mapped PSS Streams
NF SKOKOMISH RIVER	1711001701a	89	2.6	86	97%	19	22%	17	7	3	2
SF SKOKOMISH RIVER	1711001701b	563	2.4	493	88%	127	26%	82	42	5	4
SKOKOMISH RIVER	**Subtotals**	**652**	**2.4**	**579**	**89%**	**146**	**25%**	**99**	**49**	**8**	**6**
LOWER WEST HOOD CANAL FRONTAL	1711001802	117	2.8	117	100%	0	0%	0	0	0	0
HAMMA HAMMA RIVER	1711001803	219	2.8	172	79%	0	0%	0	0	0	0
DUCKABUSH RIVER	1711001804	50	1.8	32	64%	12	38%	8	6	2	1
DOSEWALLIPS RIVER	1711001805	110	2.9	107	97%	25	23%	1	27	8	3
BIG QUILCENE RIVER	1711001806	241	2.7	233	97%	10	4%	10	3	0	0
UPPER WEST HOOD CANAL FRONTAL	1711001807	77	2.1	58	75%	0	0%	0	0	0	0
DISCOVERY BAY	1711002001	48	1.4	42	88%	4	10%	0	0	0	0
SEQUIM BAY	1711002002	82	1.7	67	82%	9	13%	0	5	3	1
DUNGENESS RIVER	1711002003	228	2.3	222	97%	17	8%	6	2	2	2
PORT ANGELES HARBOR	1711002004	26	2.6	25	96%	1	4%	0	0	0	0
ELWHA RIVER	1711002007	31	1.3	26	84%	9	35%	0	5	1	1
	Totals	**1,881**	**2.3**	**1,680**	**89%**	**233**	**14%**	**124**	**97**	**24**	**14**

Notes:
Acres, stream miles, and road miles listed for the Olympic National Forest are gross estimates that include inholdings within the ONF administrative boundary.
This table was created using Olympic National Forest GIS data. Due to inherent inconsistencies in GIS analyses, the figures reported here may differ slightly from figures reported elsewhere.
North Fork and South Fork Skokomish subwatersheds were calculated separately for analysis purposes.
Vince Harke, USFWS - May 10, 2007, Updated June 4, 2007

Table B5. Treatment area estimates associated with Olympic National Forest project design feature H14 which limits instream and riparian herbicide treatments within individual sixth field subwatersheds per year.

Stream Width (ft)	Stream Length (ft)	Area (sq.ft.)	Stream Acres
10	5,280	52,800	1.21
15	5,280	79,200	1.82
20	5,280	105,600	2.42
25	5,280	132,000	3.03
30	5,280	158,400	3.64
35	5,280	184,800	4.24
40	5,280	211,200	4.85
45	5,280	237,600	5.45
50	5,280	264,000	6.06
60	5,280	316,800	7.27
70	5,280	369,600	8.48
80	5,280	422,400	9.70
90	5,280	475,200	10.91
100	5,280	528,000	12.12

Stream Acres	Area (sq.ft.)	Stream Width (ft)	Stream Length (ft)	Stream Length (miles)
6	261,360	10	26,136	4.95
6	261,360	15	17,424	3.30
6	261,360	20	13,068	2.48
6	261,360	25	10,454	1.98
6	261,360	30	8,712	1.65
6	261,360	35	7,467	1.41
6	261,360	40	6,534	1.24
6	261,360	45	5,808	1.10
6	261,360	50	5,227	0.99
6	261,360	60	4,356	0.83
6	261,360	70	3,734	0.71
6	261,360	80	3,267	0.62
6	261,360	90	2,904	0.55
6	261,360	100	2,614	0.50

1 acre =	43,560	sq. ft.
1 mile =	5,280	ft.

Aquatic Influence Zone = 150 ft.
1.5 miles = 7,920 ft x 150 ft = 27 acres of riparian area for each side of a stream, or 54 acres total along each 1.5 mi stream section.
10 acres represents about 18.5 percent of riparian area for each 1.5 miles stream reach.

PDF H14:
Treatments above bankfull, within the aquatic influence zone, would not exceed 10 acres along any 1.5 mile of stream reach within a 6th field subwatershed in any given year.
In addition, treatments below bankfull would not exceed 6 acres total within a 6th field sub-watershed in any given year.

Vince Harke, USFWS June 4, 2007

Table B6. Estimate of Maximum Stream Miles and Aquatic Influence Zone Acres Treated Annually for Invasive Plant Treatments on the Olympic National Forest (ONF) by sixth-Field Watersheds with Puget Sound Steelhead (PSS) Habitat

5th Field Watershed	6th Field Subwatershed	HUC6	Total ONF Stream Miles (all stream types)	Estimated Aquatic Influence Area (Acres)	Maximum Annual Treatment Acres in Aquatic Influence Zone	Percent of Riparian Area Treated Annually	Estimated Instream Acres Treated Annually (assumes 20 ft width for all streams)	Maximum Annual Instream Treatment in 6th field (acres)	Percent of Instream Acres Treated Annually
SKOKOMISH RIVER	RTH FORK SKOKO	171100170101	33.1	1,202	220	18.3%	80	6	7.5%
SKOKOMISH RIVER	RTH FORK SKOKO	171100170102	138.0	5,018	920	18.3%	335	6	1.8%
SKOKOMISH RIVER	RTH FORK SKOKO	171100170103	22.7	825	151	18.3%	55	6	10.9%
SKOKOMISH RIVER	JTH FORK SKOKO	171100170104	315.0	11,455	2,100	18.3%	764	6	0.8%
SKOKOMISH RIVER	JTH FORK SKOKO	171100170105	187.0	6,798	1,246	18.3%	453	6	1.3%
WEST HOOD CANAL F	LILLIWAUP CREEK	171100180201	19.8	719	132	18.3%	48	6	12.5%
WEST HOOD CANAL F	REEK/WAKETICKE	171100180202	65.2	2,369	434	18.3%	158	6	3.8%
HAMMA HAMMA RIVER	EFFERSON CREE	171100180301	104.1	3,787	694	18.3%	252	6	2.4%
HAMMA HAMMA RIVER	EM HAMMA HAMM	171100180302	199.6	7,259	1,331	18.3%	484	6	1.2%
DUCKABUSH RIVER	ER DUCKABUSH R	171100180401	17.7	645	118	18.3%	43	6	14.0%
DUCKABUSH RIVER	ER DUCKABUSH R	171100180402	104.1	3,785	694	18.3%	252	6	2.4%
DOSEWALLIPS RIVER	R DOSEWALLIPS	171100180502	151.1	5,495	1,007	18.3%	366	6	1.6%
BIG QUILCENE RIVER	R BIG QUILCENE	171100180601	228.5	8,308	1,523	18.3%	554	6	1.1%
BIG QUILCENE RIVER	R BIG QUILCENE	171100180602	79.1	2,877	527	18.3%	192	6	3.1%
WEST HOOD CANAL F	R CREEK/MARPLE	171100180701	33.4	1,214	222	18.3%	81	6	7.4%
WEST HOOD CANAL F	TLE QUILCENE RI	171100180702	66.3	2,410	442	18.3%	161	6	3.7%
DISCOVERY BAY	CREEK/SALMON	171100200101	72.5	2,635	483	18.3%	176	6	3.4%
SEQUIM BAY	Y-COME-LATELY C	171100200201	62.3	2,264	415	18.3%	151	6	4.0%
DUNGENESS RIVER	ER DUNGENESS R	171100200301	120.9	4,398	806	18.3%	293	6	2.0%
DUNGENESS RIVER	LE DUNGENESS R	171100200302	125.4	4,561	836	18.3%	304	6	2.0%
DUNGENESS RIVER	ER GRAY WOLF R	171100200304	105.5	3,838	704	18.3%	256	6	2.3%
DUNGENESS RIVER	ON CREEK/PATS C	171100200305	76.6	2,787	511	18.3%	186	6	3.2%
ORT ANGELES HARBO	LD CREEK/SIEBER	171100200401	31.0	1,128	207	18.3%	75	6	8.0%
ELWHA RIVER	RIVER/HUGHES C	171100200507	25.2	915	168	18.3%	61	6	9.8%
ELWHA RIVER	OWER ELWHA RIV	171100200508	37.0	1,345	247	18.3%	90	6	6.7%
		Totals	**2421.1**	**88,040**	**16,141**	**18.3%**	**5,869**	**156**	**2.7%**
	Assumptions								
Aquatic Influence Zone = 150 ft of each side of stream channel									
tream channel area = Assume 20 ft average channel width for all streams									
acres of riparian area are treated along each 1.5 mile of stream in 6th field.									
Forest are gross estimates that include inholdings within the ONF administrative boundary.									
ds in the Elwha River is considered potential habitat									
of potential habitat above barrier dam on the N.F. Skokomish.									
well Reservoirs) are included in stream length estimates.									
consistencies in GIS analyses, the figures reported here may differ slightly from figures reported elsewhere.									
subwatersheds were calculated separately for analysis purposes.									
Harke, USFWS - June 7, 2007									

Table B7. Weighted average percent of instream acres treated annually within fifth field watersheds (weighted average).

5th Field Watershed	Number of 6th Field subwatersheds per 5th Field watershed	Total ONF Stream miles (all stream types)1	Total ONF Stream feet (all stream types)	Total ONF Stream area (sq. ft.)	Total ONF Stream acres	Average instream acres treated annually	Average percent of instream acres treated annually
Dosewallips	1	151	797,280	15,945,600	366.06	0.02	1.64
Duckabush	2	122	644,160	12,883,200	295.76	0.04	4.05
Dungeness	4	428	2,259,840	45,196,800	1037.58	0.02	2.31
Skokomish	5	696	3,674,880	73,497,600	1687.27	0.02	1.78
Hamma Hamma	2	304	1,605,120	32,102,400	736.97	0.02	1.63
1 Harke, USFWS - June 7, 2007							
1 mile =	5,280	ft.					
1 acre =	43,560	sq. ft.					
Instream channel area = Assume 20 ft average channel width for all streams							

Appendix C – HQ exceedance derivation tables

Table C1 – Small stream effects thresholds for four endpoints under soil types and rainfall levels.

			Fish	Inverts	Algae	Aq. Plants	Clay		Loam		Sand	
	App. Rate (pounds/acre)	Precipitation Rate	Effects Threshold (mg/l)				WCR	Wa Conc (mg/l)	WCR	Wa Conc (mg/l)	WCR	Wa Conc (mg/l)
Chlorsulfuron	Typical											
	0.056	15	2	89	0.01	0.0007	0.012	0.0007	0.0000	0.00000	0.0000	0.00000
		50	2	89	0.01	0.0007	0.113	0.0063	0.0004	0.00002	0.0130	0.00073
		100	2	89	0.01	0.0007	0.199	0.0111	0.0026	0.00015	0.0342	0.00191
		150	2	89	0.01	0.0007	0.202	0.0113	0.0043	0.00024	0.0449	0.00251
	Maximum											
	0.25	15	2	89	0.01	0.0007	0.012	0.0031	0.0000	0.00000	0.0000	0.00000
		50	2	89	0.01	0.0007	0.113	0.0282	0.0004	0.00010	0.0130	0.00325
		100	2	89	0.01	0.0007	0.199	0.0497	0.0026	0.00065	0.0342	0.00855
		150	2	89	0.01	0.0007	0.202	0.0505	0.0043	0.00107	0.0449	0.01122
Clopyralid	Typical											
	0.35	15	5	225	6.9	6.9	0.005	0.0016	0.0000	0.00000	0.0000	0.00000
		50	5	225	6.9	6.9	0.011	0.0037	0.0070	0.00245	0.0180	0.0063
		100	5	225	6.9	6.9	0.010	0.0036	0.0210	0.00736	0.0445	0.0156
		150	5	225	6.9	6.9	0.010	0.00353	0.0261	0.00913	0.0584	0.0204
	Maximum											
	0.5	15	5	225	6.9	6.9	0.005	0.0023	0.0000	0.00000	0.0000	0.00000
		50	5	225	6.9	6.9	0.011	0.0053	0.0070	0.00350	0.0180	0.0090
		100	5	225	6.9	6.9	0.010	0.0052	0.0210	0.01052	0.0445	0.0222
		150	5	225	6.9	6.9	0.010	0.00504	0.0261	0.01304	0.0584	0.0292
Glyphosate	Typical											
	2	15	0.1	37	2.1	48.4	0.0011	0.00225	0.0023	0.00468	0.0066	0.0133
		50	0.1	37	2.1	48.4	0.0181	0.03614	0.0281	0.05612	0.0566	0.1133
		100	0.1	37	2.1	48.4	0.0528	0.10556	0.0775	0.15495	0.1404	0.2809
		150	0.1	37	2.1	48.4	0.0924	0.18489	0.1323	0.26453	0.2271	0.4542
	Maximum											
	8	15	0.1	37	2.1	48.4	0.0011	0.00900	0.0023	0.01871	0.0066	0.0532
		50	0.1	37	2.1	48.4	0.0181	0.14454	0.0281	0.22447	0.0566	0.4531
		100	0.1	37	2.1	48.4	0.0528	0.42225	0.0775	0.61981	0.1404	1.1235
		150	0.1	37	2.1	48.4	0.0924	0.73957	0.1323	1.05811	0.2271	1.8166
Imazapyr	Typical											
	0.45	15	5	100	0.2	0.0228	0.00005	0.0000	0.00000	0.00000	0.0000	0.00000
		50	5	100	0.2	0.0228	0.0006	0.0003	0.00000	0.00000	0.0002	0.00007
		100	5	100	0.2	0.0228	0.0013	0.0006	0.00008	0.00004	0.0003	0.00014
		150	5	100	0.2	0.0228	0.002	0.0008	0.00011	0.00005	0.0004	0.00017
	Maximum											
	1.5	15	5	100	0.2	0.0228	0.00005	0.0001	0.00000	0.00000	0.0000	0.00000
		50	5	100	0.2	0.0228	0.0006	0.0009	0.00000	0.00000	0.0002	0.00024
		100	5	100	0.2	0.0228	0.0013	0.0019	0.00008	0.00012	0.0003	0.00047
		150	5	100	0.2	0.0228	0.002	0.0026	0.00011	0.00016	0.0004	0.00058
Metsulfuron	Typical											
	0.03	15	4.50	150	0.85	0.0002	0.0001	0.0000	0.00000	0.00000	0.0000	0.00000
		50	4.50	150	0.85	0.0002	0.0012	0.0000	0.00005	0.00000	0.0003	0.00001
		100	4.50	150	0.85	0.0002	0.0020	0.0001	0.00012	0.00000	0.0005	0.00002
		150	4.50	150	0.85	0.0002	0.0021	0.0001	0.00014	0.00000	0.0006	0.00002
	Maximum											
	0.15	15	4.50	150	0.85	0.0002	0.0001	0.0000	0.00000	0.00000	0.0000	0.00000
		50	4.50	150	0.85	0.0002	0.0012	0.0002	0.00005	0.00001	0.0003	0.00004
		100	4.50	150	0.85	0.0002	0.0020	0.0003	0.00012	0.00002	0.0005	0.00008
		150	4.50	150	0.85	0.0002	0.0021	0.0003	0.00014	0.00002	0.0006	0.00009
Sethoxydim	Typical											
	0.3	15	0.06	2.6	0.25	0.25	0.00462	0.00139	0.00147	0.0004	0.0198	0.0059
		50	0.06	2.6	0.25	0.25	0.05490	0.01647	0.1280	0.0384	0.0957	0.02871
		100	0.06	2.6	0.25	0.25	0.14100	0.04230	0.3060	0.0918	0.1740	0.05220
		150	0.06	2.6	0.25	0.25	0.229	0.06870	0.4060	0.1218	0.2260	0.06780
	Maximum											
	0.45	15	0.06	2.6	0.25	0.25	0.0046	0.00208	0.00147	0.0007	0.0198	0.0089
		50	0.06	2.6	0.25	0.25	0.0549	0.02471	0.1280	0.0576	0.0957	0.04307
		100	0.06	2.6	0.25	0.25	0.1410	0.06345	0.3060	0.1377	0.1740	0.07830
		150	0.06	2.6	0.25	0.25	0.2290	0.10305	0.4060	0.1827	0.2260	0.10170
Sulfometuron	Typical											
	0.03	15	4.5	12.5	0.0046	0.0075	0.0001	0.0000	0.00000	0.00000	0.0000	0.00000
		50	4.5	12.5	0.0046	0.0075	0.0008	0.0000	0.00000	0.00000	0.0001	0.00000
		100	4.5	12.5	0.0046	0.0075	0.0016	0.0000	0.00004	0.00000	0.0003	0.00001
		150	4.5	12.5	0.0046	0.0075	0.0021	0.0001	0.00005	0.00000	0.0003	0.00001
	Maximum											
	0.38	15	4.5	12.5	0.0046	0.0075	0.0001	0.0000	0.0000	0.00000	0.0000	0.00000
		50	4.5	12.5	0.0046	0.0075	0.0008	0.0003	0.0000	0.00000	0.0001	0.00005
		100	4.5	12.5	0.0046	0.0075	0.0016	0.0006	0.0000	0.00002	0.0003	0.00010
		150	4.5	12.5	0.0046	0.0075	0.0021	0.0008	0.0000	0.00002	0.0003	0.00013
Imazapic	Typical											
	0.1	15	5	100	0.05	0.0061	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
		50	5	100	0.05	0.0061	0.0005	0.0000	0.0000	0.00000	0.0001	0.00000
		100	5	100	0.05	0.0061	0.0010	0.0000	0.0001	0.00000	0.0002	0.00000
		150	5	100	0.05	0.0061	0.0014	0.0000	0.0001	0.00000	0.0003	0.00000
	Maximum											
	0.1875	15	5	100	0.05	0.0061	0.0000	0.0000	0.0000	0.00000	0.0000	0.00000
		50	5	100	0.05	0.0061	0.0005	0.0000	0.0000	0.00000	0.0001	0.00000
		100	5	100	0.05	0.0061	0.0010	0.0000	0.0001	0.00000	0.0002	0.00000
		150	5	100	0.05	0.0061	0.0014	0.0000	0.0001	0.00000	0.0003	0.00000
Picloram	Typical											
	0.35	15	0.04	68.30	0.94	164	0.0102	0.0036	0.0000	0.00000	0.0194	0.00678
		50	0.04	68.30	0.94	164	0.0980	0.0000	0.0116	0.00000	0.0482	0.00000
		100	0.04	68.30	0.94	164	0.1840	0.0000	0.0165	0.00000	0.0680	0.00000
		150	0.04	68.30	0.94	164	0.1871	0.0000	0.0179	0.00000	0.0745	0.00000
	Maximum											
	1	15	0.04	68.30	0.94	164	0.0102	0.0102	0.0000	0.00000	0.0194	0.01936
		50	0.04	68.30	0.94	164	0.0980	0.0000	0.0116	0.00000	0.0482	0.00000
		100	0.04	68.30	0.94	164	0.1840	0.0000	0.0165	0.00000	0.0680	0.00000
		150	0.04	68.30	0.94	164	0.1871	0.0000	0.0179	0.00000	0.0745	0.00000
Triclopyr	Typical											
	1	15	0.26	133	5.9	8.8	0.0166	0.0166	0.0184	0.01838	0.0167	0.01675
		50	0.26	133	5.9	8.8	0.1254	0.0000	0.0940	0.00000	0.0548	0.00000
		100	0.26	133	5.9	8.8	0.2441	0.0000	0.1687	0.00000	0.0878	0.00000
		150	0.26	133	5.9	8.8	0.3169	0.0000	0.2221	0.00000	0.1145	0.00000
	Maximum											
	10	15	0.26	133	5.9	8.8	0.0166	0.1657	0.0184	0.18383	0.0167	0.16746
		50	0.26	133	5.9	8.8	0.1254	0.0000	0.0940	0.00000	0.0548	0.00000
		100	0.26	133	5.9	8.8	0.2441	0.0000	0.1687	0.00000	0.0878	0.00000
		150	0.26	133	5.9	8.8	0.3169	0.0000	0.2221	0.00000	0.1145	0.00000

Table C2- Floodplain wedge analysis.

Floodplain Wedge Analysis for One Acre Site

General Formula: (# lbs a.i./acre X mg/lb conversion) / (flow in cubic meters/second X cu. meter to liter conversion X # seconds of application) = mg/l

Glyphosate

Application amount (lbs/acre converted to mg) | Max. concentrations in a floodplain wedge, at 0.25 cu.m/s (8.8 cfs), and 1.0 cu.m/s (35.3 cfs)

0.5 lbs/acre	226796 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.13
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.03
2 lbs/acre	907185 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.50
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.13
8 lbs/acre	3628738 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	2.02
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.50

Imazapyr

Application amount (lbs/acre converted to mg) | Max. concentrations in a floodplain wedge, at 0.25 cu.m/s (8.8 cfs), and 1.0 cu.m/s (35.3 cfs)

0.45 lbs/acre	204117 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.11
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.03
1.5 lbs/acre	680388 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.38
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.09

Triclopyr

Application amount (lbs/acre converted to mg) | Max. concentrations in a floodplain wedge, at 0.25 cu.m/s (8.8 cfs), and 1.0 cu.m/s (35.3 cfs)

0.1 lbs/acre	45359 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.03
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.01
1 lbs/acre	453592 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	0.25
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.06
6 lbs/acre	2721554 mg	8.8 cfs for 2 hours =	1800000 liters	total mg/total flow =	1.51
		35.3 cfs for 2 hours =	7200000 liters	total mg/total flow =	0.38

Table C3 – Microsite analysis.

Micro-site Analysis

1 pound per acre in 1 cu ft of water = 0.368 mg/l, which = 368 ug/l

General Formula: ((lbs/acre X mg/lb)/(sq.ft/acre))/(l/cu.ft) = mg/l

Results in mg/l in a sq.ft of 1 foot deep floodplain area.

Columns below are for emergent vegetation rain rinse (in mg/l)

Glyphosate

lbs/acre	mg/lb	mg/acre	mg/sq.ft	mg/l (per cf)	* concentration in 1' from rinse	** concentration in 4" from rinse	*** Emergent overspray
0.5	453592	226796	5.207	0.184	0.069	0.21	0.05
2	453592	907184	20.826	0.735	0.28	0.83	0.18
8	453592	3628736	83.304	2.942	1.1	3.31	0.7

Imazapyr

lbs/acre	mg/lb	mg/acre	mg/sq.ft	mg/l (per cf)	* concentration in 1' from rinse	** concentration in 4" from rinse	*** Emergent overspray
0.45	453592	204116.4	4.686	0.165	0.11		0.04
1.5	453592	680388	15.620	0.552	0.37		0.14

Triclopyr

lbs/acre	mg/lb	mg/acre	mg/sq.ft	mg/l (per cf)	* concentration in 1' from rinse	** concentration in 4" from rinse	*** Emergent overspray
0.1	453592	45359	1.041	0.037	0.026	0.079	0.009
1	453592	453592	10.413	0.368	0.26	0.79	0.09
10	453592	4535920	104.130	3.677	2.6	7.9	0.92

* formula is (mg/l per cu.ft) * wash-off fraction * (1 - 0.25); where
(1 - 0.25) is the amount on emergent plant (25% was considered overspray)

*** E cell (total 1' conc) - J cell (conc from rinse fraction)
Represents the concentration in 1' of water from 25% overspray

** J cell number X 3

Appendix D – Toxicity Indices for Listed Fish from the Biological Assessment

Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available. Numbers in red indicate the toxicity index used in calculating the hazard quotient for exposures to listed fish. Generally, the lowest toxicity index available for the species most sensitive to effects was used. Measured chronic data (NOEC) was used when they were lower than 1/20th of an acute LC50 because they account for at least some sublethal effects, and doses that are protective in chronic exposures are more certain to be protective in acute exposures.

Herbicide	Duration	Endpoint	Dose	Species	Effect Noted at LOAEL
Chlorsulfuron	Acute	NOEC	**2 mg/L** (1/20th of LC50)	Brown trout	LC50 at 40 mg/L
	Chronic	NOEC[1]	3.2 mg/L	Brown trout	rainbow trout length affected at 66mg/L
Clopyralid	Acute	NOEC	**5 mg/L** (1/20th of LC50)	Rainbow trout	LC50 at 103 mg/L
	Chronic				none available
Glyphosate (no surfactant)	Acute	NOEC	**0.5 mg/L** (1/20th/LC50)	Rainbow trout	LC50 at 10 mg/L
	Chronic	NOEC	2.57 mg/L[2]	Rainbow trout	Life-cycle study in minnows; LOAEL not given
Glyphosate with POEA surfactant	Acute	NOEC	**0.065 mg/L** (1/20th of LC50)	Rainbow trout	LC50 at 1.3 mg/L for fingerlings (surfactant formulation)
	Chronic	NOEC	0.36 mg/L	salmonids	estimated from full life-cycle study of minnows (surfactant formulation)
Imazapic	Acute	NOEC	100 mg/L	all fish	at 100 mg/L, no statistically sig. mortality
	Chronic	NOEC	**100 mg/L**	fathead minnow	No treatment related effects on hatch or growth
Imazapyr	Acute	NOEC	**5 mg/L** (1/20th LC50)	trout, catfish, bluegill	LC50 at 110-180 mg/L for North American species
	Chronic	NOEC	43.1 mg/L	Rainbow	"nearly significant" effects on early life stages at 92.4 mg/L
Metsulfuron methyl	Acute	NOEC	10 mg/L	Rainbow	lethargy, erratic swimming at 100 mg/L
	Chronic	NOEC	**4.5 mg/L**	Rainbow	standard length effects at 8 mg/L
Picloram	Acute	NOEC	**0.04 mg/L** (1/20th LC50)	Cutthroat trout	LC50 at 0.80 mg/L
	Chronic	NOEC	0.55 mg/L	Rainbow trout	body weigh and length of fry reduced at 0.88 mg/L
Sethoxydim	Acute	NOEC	**0.06 mg/L** (1/20th LC50)	Rainbow trout	LC50 of Poast at 1.2 mg/L
	Chronic	NOEC			none available
Sulfometuron methyl	Acute	NOEC	7.3 mg/L	Fathead minnow	No signs of toxicity at highest doses tested
	Chronic	NOEC	**1.17 mg/L**	Fathead minnow	No effects on hatch, survival or growth at highest doses tested
Triclopyr acid	Acute	NOEC	**0.26 mg/L**	Chum	LC50 at 5.3 mg/L[3]

Indices represent the most sensitive endpoint from the most sensitive species for which adequate data are available. Numbers in red indicate the toxicity index used in calculating the hazard quotient for exposures to listed fish. Generally, the lowest toxicity index available for the species most sensitive to effects was used. Measured chronic data (NOEC) was used when they were lower than 1/20th of an acute LC50 because they account for at least some sublethal effects, and doses that are protective in chronic exposures are more certain to be protective in acute exposures.					
Herbicide	**Duration**	**Endpoint**	**Dose**	**Species**	**Effect Noted at LOAEL**
			(1/20th LC50)	salmon	
	Chronic	NOEC	104 mg/L	Fathead minnow	Reduced survival of embryo/larval stages at 140 mg/L
Triclopyr BEE	Acute		**0.012 mg/L**	Bluegill sunfish	LC50 at 0.25 mg/L
	Chronic[4]	NOEC	104 mg/L	Fathead minnow	Reduced survival of embryo/larval stages at 140 mg/L
NPE Surfactants	Acute[5]	NOEC	**0.2 mg/L** (1/20th LC50)	fathead minnow, rainbow trout	LC50 at 4.0 mg/L
	Chronic[6]	NOEC	1.0 mg/L	trout	no LOEL given

1 Chronic value for brown trout (sensitive sp.) was estimated using relative potency in acute and chronic values for rainbow trout, and the acute value for brown trout.
2 Estimated from minnow chronic NOEC using the relative potency factor method (SERA 2003a).
3 Using Wan et al. (1989) value for lethal dose.
4 Chronic and subchronic data for triclopyr are limited to triclopyr TEA. No data is available for triclopyr BEE.
5 Exposure includes small percentage of NP and NP1-2E (Bakke, 2003).
6 Chronic exposure is from degredates NP1EC and NP2EC, because NPE breaks down rapidly and NPEC's are more persistent (Bakke, 2003).