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Olympic National Forest Draft Environmental Impact Statement

Beyond Prevention: Site-Specific Invasive Plant Treatment Project

Clallam, Grays Harbor, Jefferson, and Mason Counties in the State of Washington

Draft Environmental Impact Statement
Site-Specific Invasive Plant Treatment Project

Clallam, Grays Harbor, Jefferson and Mason Counties, State of Washington

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Comments are due 45 days following publishing of the legal notice of availability in the **Federal Register.**

Reviewers should provide the Forest Service with their comments during the review period of the DEIS. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the Final EIS, thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act (NEPA) process so that it is meaningful and alerts the agency to the reviewers' position and contentions. *Vermont Yankee Nuclear Power Corp. v. NRDC*, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the Final EIS *City of Angoon v. Hodel (9th Circuit, l986) and Wisconsin Heritages, Inc. v. Harris*, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the DEIS should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

Abstract

This Draft Environmental Impact Statement (DEIS) discloses the effects of treating invasive plants on the Olympic National Forest. Invasive species were identified by the Chief of the Forest Service as one of the four threats to forest health (for more information see http://www.fs.fed.us/projects/four-threats). Invasive plants are displacing native plants, destabilizing streams, reducing the quality of fish and wildlife habitat; and degrading natural areas. While invasive plant prevention is an integral part of the invasive plant program, the focus of this Draft Environmental Impact Statement (DEIS) is on the part of the program that has a need for action beyond prevention.

Strong public concern has been expressed regarding Forest Service response (or lack of response) to invasive plants. Several organizations and individuals have offered to cooperate with the Forest Service in this endeavor. The Forest Service is responding to a crucial need for timely containment, control, and/or eradication of invasive plants, including those that are currently known and those discovered in the future. The purpose of this project is to treat invasive plants in a cost-effective manner that complies with environmental standards.

Approximately 3,830 acres are currently estimated to need treatment, including but not limited to knapweeds, hawkweeds, knotweeds, and reed canary grass. This Draft Environmental Impact Statement includes detailed consideration of four alternatives.

No Action (also referred to as Alternative A) would implement treatments according to existing plans; no new invasive plant treatments would be approved. The Proposed Action (also referred to as Alternative B) would apply an initial prescription, along with re-treatment in subsequent years, until the site was restored with desirable vegetation. Herbicide treatments would be part of the initial prescription for most sites, but the use of herbicides would be expected to decline in subsequent entries as populations became small enough to treat manually or mechanically.

Ongoing inventories would confirm the location of specific invasive plants and effectiveness of past treatments. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, while flexible enough to adapt to changing conditions over time.

Two action alternatives were developed in response to public issues related to herbicide use. Alternative C resolves most concerns related to herbicide use by eliminating herbicide application on about two-thirds of the National Forest system lands. Under Alternative C, only very limited herbicide use would be permitted within Riparian Reserves and near roadside ditches. Alternative C would minimize herbicide impacts, but would increase treatment costs and decrease treatment effectiveness.

Alternative D was developed to increase treatment flexibility by allowing broadcast treatments along wet intermittent streams and roadside ditches; broadcast would not be approved in these situations under the Proposed Action. Alternative D reduces the costs of treatments, but may not fully comply with environmental standards because under worst-case conditions, herbicides could enter streams and other water bodies and harm aquatic organisms.

The Forest Service Preferred Alternative is the Proposed Action (Alternative B).

Cover photo: Knotweed growing near Lake Quinault, Olympic National Forest. Knotweed is an invasive plant often used in landscaping. Once established, knotweed can out-compete native vegetation with serious adverse impacts to the environment.

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Summary

Land managers for the Olympic National Forest propose to treat invasive plants via a combination of manual, mechanical, and herbicide methods and site restoration (seeding/mulching/planting). Invasive species were identified by the Chief of the Forest Service as one of the four threats to forest health (for more information see http://www.fs.fed.us/projects/four-threats). Invasive plants are displacing native plants, destabilizing streams, reducing the quality of fish and wildlife habitat and degrading natural areas. The invasive plant management program includes treatment of existing infestations, early detection and rapid response to new infestations, restoration of treated sites, reducing the rate of spread of invasives through adopting prevention practices, and interagency and public education and coordination.

Strong public concern has been expressed regarding Forest Service response (or lack of response) to invasive plants. Several organizations and individuals have offered to cooperate with the Forest Service in this endeavor. The focus of this Draft Environmental Impact Statement (DEIS) is on the part of the program related to treatment and restoration of invasive plants on the Olympic National Forest.

With this project, the Forest Service is responding to a crucial need for timely suppression, containment, control, and/or eradication of invasive plants, including those that are currently known and those discovered in the future. The purpose of this project is to treat invasive plants in a cost-effective manner that complies with environmental standards.

Approximately 3,830 acres are currently estimated to need treatment, including but not limited to knapweeds, hawkweeds, knotweeds, and reed canary grass. Under the Proposed Action (also referred to as Alternative B), infested areas would be treated with an initial prescription and retreated in subsequent years until the site was restored with desirable vegetation. Herbicide treatments would be part of the initial prescription for most sites; however, use of herbicides would be expected to decline in subsequent entries. Ongoing inventories would confirm the location of specific invasive plants and effectiveness of past treatments. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, while flexible enough to adapt to changing conditions over time.

This DEIS has been prepared to consider the site-specific environmental consequences of treating invasive plants 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). This EIS is tiered to a broader scale analysis (the Pacific Northwest Region Final Environmental Impact Statement for the Invasive Plant Program, USDA 2005a, hereby referred to as the R6 2005 FEIS).

The R6 2005 FEIS culminated in a Record of Decision (USDA 2005b, hereby referred to as the R6 2005 ROD), which added management direction relative to invasive plants to the Olympic National Forest Plan. The management direction applied to the broader Forest invasive plant program, establishing goals, objectives and standards for public education and coordination, prevention of the spread of invasive plants during land uses and activities, reducing reliance on herbicides over time, and treatment and restoration.

This project level EIS is focused on issues related to treatment and minimizing the adverse effects of treatment. In total, four alternatives are considered, including No Action (also referred to as Alternative A), the Proposed Action (also referred to as Alternative B), and two action alternatives (Alternatives C and D).

Under No Action (Alternative A), no new treatments would be implemented, beyond those previously approved. The Proposed Action (Alternative B) is the Preferred Alternative. Under Alternative B, known infestations of invasive plants could conceivably be controlled within five years (assuming an unlimited funding level which is at least five times greater than current projections). Control would take longer (30 years) assuming a more likely and sustainable funding level, with lower priority areas unlikely to be treated. Alternative B minimizes environmental and human health risks through adherence to Project Design Features that abate herbicide and site-specific hazards.

Two action alternatives were developed in response to public issues related to herbicide use (Alternatives C and D). Alternative C resolves most concerns related to herbicide use by eliminating herbicide application on about two-thirds of the National Forest system lands. Alternative D was developed to increase treatment flexibility and reduce costs.

Under Alternative C, only very limited herbicide use[1] would be permitted within Riparian Reserves. In addition, no herbicides would be used within roadside treatment areas with high potential to deliver herbicides. Alternative C would minimize herbicide impacts, but would increase treatment costs and decrease treatment effectiveness.

Alternative D was developed to increase treatment flexibility by allowing broadcast treatments along wet intermittent streams and roadside ditches; broadcast would not be approved in these situations under the Proposed Action. Alternative D reduces the costs of treatments, but may not fully comply with environmental standards because under worst-case conditions, herbicides could enter streams and other water bodies and harm aquatic organisms.

The Proposed Action (Alternative B) is the Preferred Alternative. Although Alternative B assumes more risk to non-target organisms, water quality, wildlife and fish from herbicide use than Alternative C, the risks are small compared to the benefits. Alternative B is predicted to cost about five percent more to implement than Alternative D, but otherwise is similarly effective. This cost savings is small, especially compared to the additional risk associated with broadcast treatments near intermittent streams and ditches that would be allowed in Alternative D.

Chapter 1 of this project level EIS describes the purpose and need for action, the decision to be made, a brief outline of the proposed action, the public involvement process, and key public issues. Chapter 2 describes and compares the four alternatives considered in detail. Chapter 3 provides the analytical basis for the alternative comparison in Chapter 2.

[1] Existing agreements allow for the use of aquatic-labeled glyphosate within streams to treat knotweed.

Chapter 1. Purpose of and Need for Action

1.1 Introduction

Land managers for the Olympic National Forest propose to treat invasive plants over the next five to fifteen years via a combination of manual, mechanical, and herbicide methods and site restoration. This Environmental Impact Statement (EIS) has been prepared to consider the site-specific environmental consequences of taking this action. The main body of the EIS is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* The chapter includes information on the background and purpose of and need for the project. This section also details how the Forest Service informed the public of the proposal and the issues identified through public scoping.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for meeting the need for action. These alternatives were developed based on issues raised by the public and other agencies. This section provides a summary table of the design components that compares the relative risks and benefits of each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the current situation and the resources that are at risk from invasive plants on the Olympic National Forest. It also details the environmental effects of implementing the Proposed Action and other alternatives.
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies and people consulted during the development of the environmental impact statement.

This EIS summarizes specialist input and other technical documentation used to support the analysis and conclusions in this EIS. Analysis was completed for botany, hydrology, fisheries, soils, wildlife, cost effectiveness, human health, and heritage resources. A separate biological evaluation was completed for threatened, endangered, and sensitive botanical species. Biological Assessments were completed for aquatic species and terrestrial wildlife species as part of the consultation process with the National Marine Fisheries Service and the US Fish & Wildlife Service. The project record is located at the Olympic National Forest.

This EIS is tiered to a broader scale analysis (the Pacific Northwest Region Final Environmental Impact Statement for the Invasive Plant Program, 2005, hereby referred to as the R6 2005 FEIS). The R6 2005 FEIS culminated in a Record of Decision (R6 2005 ROD) that amended the Olympic National Forest Plan by adding management direction relative to preventing and treating invasive plants. This project is intended to comply with the new management direction. Despite our best efforts at prevention (see Appendix G), invasive plants currently grow and without treatment, will continue to spread.

1.2 Project Area

The project area is the entire Olympic National Forest. The Forest comprises 632,300 acres of the Olympic Peninsula, the northwestern-most portion of land in the Continental United States.

1.3 Purpose and Need for Action

Invasive species were identified by the Chief of the Forest Service as one of the four threats to forest health (for more information see http://www.fs.fed.us/projects/four-threats). Invasive plants are adversely impacting approximately 3,830 acres, scattered across the Olympic National Forest. Invasive plants are displacing native plants, destabilizing streams, reducing the quality of fish and wildlife habitat; and degrading natural areas on the Olympic National Forest. Strong public concern has been expressed regarding Forest Service response (or lack of response) to invasive plants. Several organizations and individuals have offered to cooperate with the Forest Service in this endeavor. The Forest Service is responding to the crucial need for timely suppression, containment, control, and/or eradication of invasive plants, including those that are currently known and those discovered in the future. The purpose of this project is to treat invasive plants in a cost-effective manner that complies with environmental standards.

The R6 2005 ROD added the following Desired Future Condition Statement to the Olympic National Forest Plan:

> …Healthy native plant communities remain diverse and resilient, and damaged ecosystems are being restored. High quality habitat is provided for native organisms throughout the [Forest]. Invasive plants do not jeopardize the ability of [the Olympic] National Forest to provide goods and services communities expect. The need for invasive plant treatment is reduced due to the effectiveness and habitual nature of preventative actions, and the success of restoration efforts.

Treatment of invasive plants and restoration of treated sites is needed to meet this desired condition. Currently, invasive plants are degrading habitat for native plant communities in or near special places such as the Colonel Bob, Mount Snohomish and Buckhorn Wilderness Areas; Matheny Pond, Matheny Prairie, Bill's Bog, and Cranberry Bog Botanical Areas; Quinault and Crescent Lakes; and a host of trails, campgrounds, and other popular recreation areas.

Without treatment, invasive plants will continue to spread within these and other special areas on and adjacent to the National Forest. Invasive plants on National Forest system lands also have the potential to spread to neighboring lands including the Olympic National Park, tribal lands, and private properties. Chapter 3 details site-specific values at risk from invasive plants, and describes places where invasive plants are most likely to spread to neighboring lands.

Not all invasive plants are equally threatening to environmental and social values; priority for treatment and treatment strategy[2] varies depending on the biology of the invasive species, size of the infestation, and the values at risk from the infestation now and in the future. Treatment intensity and restoration requirements are highly variable. As a result, the need for action is multi-faceted and more complex than simply "killing weeds."

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[2] Definitions of these treatment strategies are adapted from the 2005 R6 FEIS. Two additional objectives (tolerate and suppress) are also discussed in the 2005 R6 FEIS; neither these objectives have been applied to infestations on the Olympic National Forest.
Eradicate: Totally eliminate an invasive plant species from a site. This strategy generally applies to the hardest to control invasive species and highest-valued sites over about 11 percent of the infested acreage.
Control: Reduce the acreage of the infestation over time. This strategy applies to about 39 percent of the project area.
Contain: No increase in acreage infested. This objective applies to about 50 percent of the infested acreage.
Priority is further discussed in Chapter 2.

The R6 2005 ROD provided an updated approach to invasive plant management, including standards for preventing invasive plants and using new herbicides. While invasive plant prevention is an integral part of the invasive plant program, the focus of this DEIS is on the part of the program that has a need for action beyond prevention: the R6 2005 FEIS found that prevention practices alone will not result in reaching invasive plant program goals and objectives (listed in table 1). The proposed treatment/restoration prescriptions include a combination of herbicide and non-herbicide methods; however, key public issues are primarily related to the use of the new herbicides.

Invasive plants are currently spreading at a rate of 8 to 12 percent annually (R6 2005 FEIS). Invasive plant spread is unpredictable and actual locations of target species may change abruptly over time. Thus, the Forest Service needs the flexibility to adapt to changing conditions, and rapidly respond to invasive plant threats that may be currently unknown. Timeliness of action is an important factor because the cost, difficulty, and potential adverse effects of controlling invasive plants increases with the size and extent of the population. The smaller the population is when treated, the more likely the treatment will be effective.

1.3.1 Regulatory Basis for Project/Environmental Standards

Several broad federal policies require the control of invasive plants. Executive Order 13112 (1999) directs federal agencies to reduce the spread of invasive plants. The Forest Service Pesticide Use Handbook (FSH 2109.14) provides agency guidance on planning, implementation, and reporting of projects that include herbicide (see Appendix E for more information).

The R6 2005 ROD added invasive plant management direction (displayed in tables 1 and 2) to the existing direction for the Olympic National Forest Plan (displayed in table 3). Land uses and activities, including invasive plant treatments, would be designed to comply with the R6 2005 ROD standards. Standards for preventing invasive plants are in Appendix G.

Beyond Prevention: Invasive Plant Treatment Project
Vicinity Map
Olympic National Forest

Table 1. Goals and Objectives from the R6 2005 ROD

Goals and Objectives	
Goal 1 - Protect ecosystems from the impacts of invasive plants through an integrated approach that emphasizes prevention, early detection, and early treatment. All employees and users of the National Forest recognize that they play an important role in preventing and detecting invasive plants.	
Objective 1.1	Implement appropriate invasive plant prevention practices to help reduce the introduction, establishment and spread of invasive plants associated with management actions and land use activities.
Objective 1.2	Educate the workforce and the public to help identify, report, and prevent invasive plants.
Objective 1.3	Detect new infestations of invasive plants promptly by creating and maintaining complete, up-to-date inventories of infested areas, and proactively identifying and inspecting susceptible areas not infested with invasive plants.
Objective 1.4	Use an integrated approach to treating areas infested with invasive plants. Utilize a combination of available tools including manual, cultural, mechanical, herbicides, biological control.
Objective 1.5	Control new invasive plant infestations promptly, suppress or contain expansion of infestations where control is not practical, conduct follow up inspection of treated sites to prevent reestablishment.
Goal 2 - Minimize the creation of conditions that favor invasive plant introduction, establishment and spread during land management actions and land use activities. Continually review and adjust land management practices to help reduce the creation of conditions that favor invasive plant communities.	
Objective 2.1	Reduce soil disturbance while achieving project objectives through timber harvest, fuel treatments, and other activities that potentially produce large amounts of bare ground.
Objective 2.2	Retain native vegetation consistent with site capability and integrated resource management objectives to suppress invasive plants and prevent their establishment and growth.

Goals and Objectives	
Objective 2.3	Reduce the introduction, establishment and spread of invasive plants during fire suppression and fire rehabilitation activities by minimizing the conditions that promote invasive plant germination and establishment.
Objective 2.4	Incorporate invasive plant prevention as an important consideration in all recreational land use and access decisions. Use Forest-level Access and Travel Management planning to manage both on-highway and off-highway travel and travel routes to reduce the introduction, establishment and spread of invasive plants.
Objective 2.5	Place greater emphasis on managing previously "unmanaged recreation" (OHVs, dispersed recreation, etc.) to help reduce creation of soil conditions that favor invasive plants, and reduce transport of invasive plant seeds and propagules.
Goal 3 - Protect the health of people who work, visit, or live in or near National Forests, while effectively treating invasive plants. Identify, avoid, or mitigate potential human health effects from invasive plants and treatments.	
Objective 3.1	Avoid or minimize public exposure to herbicides, fertilizer, and smoke.
Objective 3.2	Reduce reliance on herbicide use over time in Region Six.
Goal 4 – Implement invasive plant treatment strategies that protect sensitive ecosystem components, and maintain biological diversity and function within ecosystems. Reduce loss or degradation of native habitat from invasive plants while minimizing adverse effects from treatment projects.	
Objective 4.1	Maintain water quality while implementing invasive plant treatments.
Objective 4.2	Protect non-target plants and animals from negative effects of both invasive plants and applied herbicides. Where herbicide treatment of invasive plants is necessary within the riparian zone, select treatment methods and chemicals so that herbicide application is consistent with riparian management direction, contained in Pacfish, Infish, and the Aquatic Conservation Strategies of the Northwest Forest Plan.
Objective 4.3	Protect threatened, endangered, and sensitive species habitat threatened by invasive plants. Design treatment projects to protect threatened, endangered, and sensitive species and maintain species viability.
Goal 5 – Expand collaborative efforts between the Forest Service, our partners, and the public to share learning experiences regarding the prevention and control of invasive plants, and the protection and restoration of native plant communities.	

Goals and Objectives	
Objective 5.1	Use an adaptive management approach to invasive plant management that emphasizes monitoring, learning, and adjusting management techniques. Evaluate treatment effectiveness and adjust future treatment actions based on the results of these evaluations.
Objective 5.2	Collaborate with tribal, other federal, state, local and private land managers to increase availability and use of appropriate native plants for all land ownerships.
Objective 5.3	Work effectively with neighbors in all aspects of invasive plant management: share information and resources, support cooperative weed management, and work together to reduce the inappropriate use of invasive plants (landscaping, erosion control, etc.).

In addition, Standards 11 through 23 from the R6 2005 ROD apply to invasive plant treatment and restoration (see table 2). Standards 1 through 10 apply to invasive plant prevention. These standards and additional information about prevention on the Olympic National Forest are displayed in Appendix G. All alternatives assume prevention practices will be implemented as directed. The R6 2005 ROD standards require that prevention practices be considered in land management activities and decisions. Some people and groups have expressed the opinion that treatment decisions cannot be made without evaluating the effectiveness of prevention practices. Prevention practices are not considered connected actions because they will occur regardless of alternative selected for invasive plant treatment. The R6 2005 FEIS demonstrated that treatments and prevention practices are needed to effectively control invasive plants. This project EIS focuses on issues and alternatives related to treatment and tiers to the R6 2005 FEIS programmatic analysis of prevention.

Table 3 shows additional standards from the 1990 Olympic National Forest Plan (as amended by the 1994 Northwest Forest Plan[3]) that apply to municipal watersheds, and Riparian Reserves (a land allocation including Olympic National Forest system lands within an area reaching upslope approximately 1 to 2 times the average height of a tree on either side of a creek or water body).

Part of compliance with the Northwest Forest Plan relates to considering watershed analysis recommendations in project planning. Nineteen watershed assessments have been prepared on the Olympic National Forest since 1994. Of these, 13 discuss invasive plants/noxious weeds. Invasive species were also identified as a threat to native plant ecosystems in six Late Successional Reserve (LSR) Assessments. The watershed assessments and LSR Assessments provide evidence of the presence of invasive plants, their adverse impact, and the need for treatment. [4]

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[3] The Northwest Forest Plan is formally referred to as the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (USDA/USDI 1994).
[4] Watershed assessment and LSR Assessment references and excerpts pertaining to invasive plant management are available in the project files.

Table 2. Standards from the R6 2005 ROD and How the Project Complies with these Standards

Standard #	Forest Plan Standard	How Project Complies with Standard
11	Prioritize infestations of invasive plants for treatment at the landscape, watershed or larger multiple forest/multiple owner scale.	Treatment priorities are described in Chapter 2 and depicted on the treatment area maps in Appendix A.
12	Develop a long-term site strategy for restoring/revegetating invasive plant sites prior to treatment.	Treatment strategies and restoration plans are described in Chapter 2. Appendix B includes common control measures for invasive target species and Appendix F outlines the restoration approach.
13	Native plant materials are the first choice in revegetation for restoration and rehabilitation where timely natural regeneration of the native plant community is not likely to occur. Non-native, non-invasive plant species may be used in any of the following situations: 1) when needed in emergency conditions to protect basic resource values (e.g., soil stability, water quality and to help prevent the establishment of invasive species), 2) as an interim, non-persistent measure designed to aid in the re-establishment of native plants, 3) if native plant materials are not available, or 4) in permanently altered plant communities. Under no circumstances will non-native invasive plant species be used for revegetation.	Revegetation (seeding and planting) would occur as needed to replace invasive plants with native plant communities. Non-native, non-persistent species may be used infrequently as an interim measure to control erosion or prevent target species from returning on treated sites. Appendix F outlines the restoration approach including use of native plant materials.

Standard #	Forest Plan Standard	How Project Complies with Standard
14	Use only USDA Animal and Plant Health Inspection Service (APHIS) and State-approved biological control agents. Agents demonstrated to have direct negative impacts on non-target organisms would not be released.	APHIS and Washington state approved Biological Agents currently released within or near Olympic National Forest are listed in Chapter 2. Agents found to have negative impacts may not be distributed on the Olympic National Forest; this list will be updated annually and discussed with adjacent landowners.
15	Application of any herbicides to treat invasive plants will be performed or directly supervised by a State or Federally licensed applicator. All treatment projects that involve the use of herbicides will develop and implement herbicide transportation and handling safety plans.	The elements of herbicide transportation and handling safety plans are listed in Chapter 2. Policies/compliance monitoring and reporting forms related to herbicide use are further discussed in Appendix E.

<table>
<tr><th>Standard #</th><th>Forest Plan Standard</th><th>How Project Complies with Standard</th></tr>
<tr><td>16</td><td>Select from herbicide formulations containing one or more of the following 10 active ingredients: chlorsulfuron, clopyralid, glyphosate, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, and triclopyr. Mixtures of herbicide formulations containing 3 or less of these active ingredients may be applied where the sum of all individual Hazard Quotients for the relevant application scenarios is less than 1.0. *

All herbicide application methods are allowed including wicking, wiping, injection, spot, broadcast and aerial, as permitted by the product label. Chlorsulfuron, metsulfuron methyl, and sulfometuron methyl will not be applied aerially. The use of triclopyr is limited to selective application techniques only (e.g., spot spraying, wiping, basal bark, cut stump, injection).

Additional herbicides and herbicide mixtures may be added in the future at either the Forest Plan or project level through appropriate risk analysis and NEPA/ESA procedures.</td><td rowspan="2">See Chapter 2 for details about Project Design Features (PDFs), which add layers of caution and minimize or eliminate adverse effects related to use of herbicides and adjuvants.

The herbicide formulations listed in this document are approved for use according to the PDFs.

Table 28 lists the herbicide formulations that currently meet Standards 16 and 18, based on analysis by Bakke (2003a and 2003b) and SERA (various, see Chapter 3.1.5) and disclosures herein.

Habitat is the name for the aquatic formulation for Imazapyr. It is not currently available for use because inert ingredients in Habitat have not been reviewed as per Standard 18. An assessment is underway, and once completed, assuming acceptable risks, Habitat would become available.

Policies/compliance monitoring and reporting forms related to herbicide use are further discussed in Appendix E.</td></tr>
<tr><td>18</td><td>Use only adjuvants (e.g. surfactants, dyes) and inert ingredients reviewed in Forest Service hazard and risk assessment documents.</td></tr>
</table>

Standard #	Forest Plan Standard	How Project Complies with Standard
19	To minimize or eliminate direct or indirect negative effects to non-target plants, terrestrial animals, water quality and aquatic biota (including amphibians) from the application of herbicide, use site-specific soil characteristics, proximity to surface water and local water table depth to determine herbicide formulation, size of buffers needed, if any, and application method and timing. Consider herbicides registered for aquatic use where herbicide is likely to be delivered to surface waters.	Chapter 3 discusses how risks from herbicide use are abated by Project Design Features including buffers and restrictions on herbicide use and method of application in Aquatic Influence Zones and roadside treatment areas that have high potential to deliver herbicide to streams and other water bodies. .
20	Design invasive plant treatments to minimize or eliminate adverse effects to species and critical habitats proposed and/or listed under the Endangered Species Act. This may involve surveying for listed or proposed plants prior to implementing actions within unsurveyed habitat if the action has a reasonable potential to adversely affect the plant species. Use site-specific project design (e.g. application rate and method, timing, wind speed and direction, nozzle type and size, buffers, etc.) to mitigate the potential for adverse disturbance and/or contaminant exposure.	Chapter 3 discusses how potential adverse effects to Endangered Species and critical habitats from herbicide use are abated by Project Design Features.
21	Provide a minimum buffer of 300 feet for aerial application of herbicides near developed campgrounds, recreation residences and private land (unless otherwise authorized by adjacent private landowners).	No aerial application is proposed.

Standard #	Forest Plan Standard	How Project Complies with Standard
22	Prohibit aerial application of herbicides within legally designated municipal watersheds.	No aerial application is proposed. Coordination with water users would occur in accordance with Municipal Watershed Plans (more information in Chapter 3).
23	Prior to implementation of herbicide treatment projects, National Forest staff will ensure timely public notification. Treatment areas will be posted to inform the public and forest workers of herbicide application dates and herbicides used. If requested, individuals may be notified in advance of spray dates.	Chapter 2 lists Project Design Features, including public notification requirements. Policies/compliance monitoring and reporting forms related to herbicide use are further discussed in Appendix E.

*ATSDR, 2004. Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. U.S. Department Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry.

Table 3. Additional Olympic National Forest Plan Standards and How the Project Complies with These Standards

Forest Plan Standard	How Project Complies with Standard
Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives.	Invasive species are degrading native plant communities and habitats. The adverse impacts of invasive plants are discussed under "Affected Environment" in each section of Chapter 3. Invasive plants can retard or prevent recovery of native plant communities, which may structural diversity of plant communities in riparian areas (see "Affected Environment" section of Soils and Water and Aquatic Organisms). Vegetation management is necessary within Riparian Reserves to restore native plant communities that have been affected by invasive plants.
Herbicides, insecticides, and other toxicants, and other chemicals shall be applied [within Riparian Reserves] only in a manner that avoids impacts that retard or prevent attainment of Aquatic Conservation Strategy objectives.	The Project Design Features (including buffers) for Soil, Water and Aquatic Organisms under Alternatives A, Alternative B and C are associated with low risk of herbicide concentrations of concern from accumulating in streams or other water bodies. Alternative D allows use of herbicides with higher risks to aquatic organisms near intermittent streams and broadcast of herbicide/use of picloram within roadside treatment areas with high potential to deliver herbicide. As currently designed, Alternative D would not meet this standard (more information in Chapter 3.4).
Herbicides and pesticides should not be used in municipal watersheds. Chemicals should be used as a last resort, and only where analysis demonstrates water quality will not be adversely affected.	Herbicide use is proposed in municipal watersheds as a part of this project. While herbicide use is discouraged by this standard, this DEIS demonstrates that it is necessary to meet the purpose and need for action. Water quality and other analysis in Chapter 3 shows that adverse effects would be minimal and drinking water sources would be fully protected through adherence to Project Design Features that apply to municipal watersheds in accordance with individual municipal watershed agreements.

1.4 Decision Framework

The Forest Supervisor for the Olympic National Forest is the Responsible Official for this EIS. The Forest Supervisor will review the environmental consequences to decide whether to implement the Proposed Action (aka Alternative B), another action alternative, or continue to implement the No Action alternative (aka Alternative A).

Factors influencing the decision include:

(1) Effectiveness in reaching controlling invasive plants, as indicated by the acreage of invasive plants estimated for the year 2012 (under the most ambitious conceivable treatment scenario as defined in Chapter 3.1).

(2) Potential adverse effects to human health and the environment, as indicated by the effects analysis throughout Chapter 3, and

(3) Monetary costs and financial efficiency, as indicated by the economic efficiency analysis displayed in Chapter 3.7.

1.5 Proposed Action

The Forest Service Proposed Action is to treat invasive plants on Olympic National Forest system lands with a combination of manual, mechanical, and herbicide and restoration (seeding/mulching/planting) treatments. Site-specific treatment prescriptions would be tied to control objectives (suppress, contain, control, eradicate), the values at risk from invasive species; the biology of particular invasive plant species, the proximity to water and other sensitive resources, and the size of the infestation (these factors may change over time). A variety of invasive plant species would be treated, including but not limited to knapweeds, hawkweeds, knotweeds, and reed canary grass.

All 3,830 acres of current infestations would be treated within the next 5 to 15 years. Infested areas would be treated with an initial prescription, and retreated in subsequent years, dependant upon the results, until control objectives are met. Herbicide treatments are part of the initial prescription for most sites; however, use of herbicides would be expected to decline in subsequent entries (see section 3.1.3).

The Proposed Action would also allow for treatment of infestations that are not currently inventoried. Ongoing inventories would confirm the location of specific invasive plants and effectiveness of past treatments. Treatment prescriptions would be strict enough to ensure that adverse effects are minimized, while flexible enough to adapt to changing conditions over time.

A decision to implement the Proposed Action (or action alternative) would replace the management direction provided in the Environmental Assessment for the Management of Noxious Weeds, Olympic National Forest (USDA Forest Service, 1998).

For a full description of the Proposed Action (also referred to as Alternative B), see Chapter 2.

1.6 Public Involvement

This project has been in development for several years. The project was first listed in the Olympic National Forest January 2004 Schedule of Proposed Actions. A Notice of Intent (NOI) to prepare an EIS requesting public input was published in the Federal Register on February 23, 2004. The NOI proposed a project with a geographic scope covering the Olympic National Forest, along with two other National Forests in western Washington and Oregon and the Columbia River Gorge National Scenic Area. Individuals, organizations, agencies, businesses, and local and Tribal governments were contacted by letter and solicited for comments on the proposal. Approximately 150 comments were received and reviewed and the Forest Service identified key concerns.

One concern was the large geographical scope of the project. Another concern was the timing of the site-specific analysis in relation to work on the programmatic R6 2005 FEIS, which would result in management direction pertinent to the project.

In response, the Forest Service decided to prepare an EIS specific to the Olympic National Forest, and to reinitiate scoping in August 2005, following the public release of the R6 2005 FEIS. A new NOI was published on August 25, 2005, and a letter describing an updated proposal was widely circulated. The public was advised that their original comments would still be considered, along with any new comments. Approximately 15 comments were received during the second scoping period. The following section (1.6.1) summarizes the significant issues identified through the scoping process and discusses how they are addressed in the EIS analysis. The issues are grouped into broad resource categories. Issue Group 1 relates to human health, Issue Group 2 relates to the effectiveness of treatments, Issue Group 3 relates to social and economic issues, Issue Group 4 relates to effects on non-target terrestrial plant and animal species, and Issue Group 5 relates to soils, water quality and aquatic organisms. Table 4 displays how each significant issue is addressed and the factors for alternative comparison. The project file includes scoping comments received during both scoping periods and copies of NOIs.

The topics listed here do not reflect issues raised with this proposal, but are required disclosures for EIS documents. These are addressed in Chapter 3.

- Congressionally Designated Areas
- Prime Farm and Forest Lands
- Cultural Resources
- Relationship Between Short-term Uses and Long-term Productivity
- Conflicts with Other Policies, Plans, Jurisdictions
- Irretrievable and Irreversible Commitment of Resources

1.6.1 Issue Group 1: Human Health and Worker Safety

Issue Components:

1a: Exposure to Herbicides
1b: Drinking Water
1c: Worker Safety

1a: Exposure to Herbicides

Issue Statement: People, including neighbors, visitors and herbicide applicators, may become exposed to herbicides from invasive plant treatments and experience adverse health effects.

This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan, as amended by the R6 2005 ROD. The R6 2005 FEIS provided detailed assessments of the risks associated with various chemicals that considered people who are especially chemically sensitive; additives and metabolites; and inert ingredients. The standards restricting herbicide selection and certain restrictions on methods (such as no broadcast of triclopyr) minimize risks to human health. Public notification required by the R6 2005 ROD reduces the likelihood of inadvertent exposures.

Risks are further minimized at the project scale by limiting the maximum application rate of the herbicide; favoring formulations with lower risk, using an application method that results in less potential exposure (e.g. hand/selective or spot treatment methods), and temporarily closing areas like campgrounds or berry-picking sites to ensure no inadvertent contact. Chapter 2 describes the Project Design Features and Chapter 3 explains why potential adverse health effects are mitigated in all alternatives.

1b: Drinking Water

Issue Statement: Herbicides may contaminate drinking water through direct contact (a spill into a drinking water source), or indirectly through leaching, percolation or run off.

This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan, as amended by the R6 2005 ROD, and pesticide use policies of the US Forest Service (see FSH 2109.14, Appendix E). Project Design Features ensure that herbicide handling occurs away from streams and water sources. Transportation, handling and spill containment would be addressed during implementation, with specific documentation requirements as per Appendix E. No herbicide use is currently proposed within 1000 feet of municipal water intakes. Chapter 3 provides detailed discussion about why potential drinking water effects are mitigated in all alternatives.

1c: Worker Injuries

Issue Statement: Workers may be injured (sprains, strains, cuts and falls) during invasive plant treatments.

This issue is addressed by adherence to OSHA guidelines in all alternatives. Some people perceive that risks to workers are greatest from herbicide treatments due to potential chemical exposure (see Issue 1a). Others perceive that non-herbicide treatments are more likely to result in physical injuries since these methods tend to be more labor-intensive. However, injuries associated with non-herbicide work are not considered unusual and are mitigated through accepted field safety practices. Therefore, this issue will not be tracked through the analysis.

1.6.2 Issue Group 2 – Treatment Strategy and Effectiveness

Issue Components:

2a – Effectiveness of Treatment Methods
2b – Long-term Strategy
2c – Treatment Priority
2d – Adaptive Management/Early Detection-Rapid Response

2a – Effectiveness of Treatment Methods

Issue Statement: Restrictions on herbicide use tend to reduce treatment effectiveness and increase cost. Many invasive plants do not respond effectively to manual and mechanical treatments without herbicide.

The Proposed Action and Alternative D allow for the use of herbicides in most invasive plant situations. With unlimited funding, existing infestations would largely be controlled by 2012. [5]

Alternative C, however, would rely on manual and mechanical methods on a greater proportion of the infested acreage, which decreases the likelihood that control objectives may be met, especially for sites having a control objective of eradicate. If control objectives are not met, adverse effects of invasives would continue.

This is a key issue tracked throughout this document. The alternatives are compared by:

- The number of herbicides formulations available for use
- The proportion of infested acres that may be treated using herbicide
- Acres of invasives predicted for the year 2012

2b – Long-term Strategy, Reduce Reliance on Herbicides Over Time

Issue Statement: Treated sites need to be restored to hasten recovery of native vegetation and reduce reliance on herbicides over time.

Treatment prescriptions in all alternatives include site restoration (passive revegetation, mulching, seeding, and planting). Manual and mechanical follow-up treatments would be favored, especially when populations are small enough to control without herbicides.

Restoration is described in Chapter 2 and Appendix F. Restoration prescriptions do not vary significantly between action alternatives. Multi-year treatment scenarios demonstrating declining reliance on herbicides are displayed in Chapter 3.1.

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[5] The most ambitious treatment scenarios for each alternative are described in Chapter 3.1 and used as the basis for comparison of effects. This scenario is unlikely to occur because it would require at least a five-fold increase in expected funding, however it provides a basis for analysis and highlights differences in effectiveness between the alternatives.

2c – Treatment Priority

Issue Statement: Treatments must be prioritized so that available funding can be utilized as efficiently as possible.

This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. The standards require that invasive plant treatments sites be prioritized. Treatment priorities are described in Chapter 2.5. Treatment priorities do not vary between alternatives.

2d – Adaptive Management/Early Detection-Rapid Response

Issue Statement: The Forest Service needs the ability to respond rapidly to new infestations and improve effectiveness through adaptive management.

This issue is addressed through inclusion of an adaptive management plan and early detection-rapid response strategy in all action alternatives. The adaptive management plan and early detection-rapid response strategy is described in Chapter 2 and does not vary significantly between alternatives.

1.6.3 Issue Group 3 – Social and Economic

Issue Components:

3a – Treatment Costs and Financial Efficiency
3b – More Jobs Associated with Manual Treatments
3c – Effects on Scenic, Recreation, and Wilderness Values
3d – Effects on Special Forest Products
3e – Effects on American Indian Tribes and Treaty Rights, Civil Rights and Environmental Justice

3a – Treatment Costs and Financial Efficiency

Issue Statement: Treatment costs vary depending on method. Non-herbicide methods tend to be more expensive than herbicide methods. Spot and hand herbicide application methods tend to be more expensive that broadcast herbicide methods.

This issue is addressed through the development of Alternative D, which emphasizes use of broadcast herbicide methods. In contrast, the Proposed Action restricts broadcast herbicide application methods in many situations and Alternative C does not allow any broadcast treatment. Alternative C also relies on non-herbicide methods on about 70 percent of currently infested acreage, which increases treatment costs. This is a key issue tracked throughout this document. The alternatives are compared by:

- Total cost for the most ambitious conceivable project over a 5 year period
- Average annual cost for the most ambitious conceivable project over a 5 year period
- Average cost per acre of treatment over a 5 year period

3b – More Jobs Associated with Manual Treatments

Issue Statement: Manual treatments tend to be more labor-intensive and employ more workers than herbicide treatment methods.

This issue is addressed through the development of Alternative C, which has the greatest relative proportion of manual treatments compared to the other action alternatives.

This is a key issue tracked throughout this document. The alternatives are compared by:

- The estimated number of jobs provided by the most ambitious treatment scenario

3c – Effects of Invasive Plant Treatment on Scenic, Recreation and Wilderness Values

Issue Statement: Invasive plant treatments may be visible along road corridors and in recreation and Wilderness areas.

This issue is addressed through adherence to invasive plant treatment management direction in the Olympic National Forest Plan as amended by the R6 2005 ROD. These standards require public education and a public notification strategy if herbicides are used. The Project Design Features described in Chapter 2 deals with potential conflicts. Over the long term, controlling invasive plants would improve scenic, recreation and Wilderness values. Potential effects on these values are described in Chapter 3.

3d – Effects of Herbicide on Special Forest Products and Gatherers

Issue Statement: Herbicide treatments may leave residues on special forest products making them unsafe for consumption or unsuitable for collection.

This issue is addressed through adherence to invasive plant treatment management direction in the Olympic National Forest Plan as amended by the R6 2005 ROD. These standards require public education and a public notification strategy if herbicides are used. The Project Design Features described in Chapter 2 ensure that conflicts between treatments and special forest products and gathering areas are minimized. Potential effects on special forest products and gatherers are described in Chapter 3.

3e – Effects on American Indian Tribes and Treaty Rights, Civil Rights and Environmental Justice

Issue Statement: Invasive plant treatments may harm culturally important plants or have disproportionate effects on cultures that rely on subsistence or special forest product gathering. Asian, Hispanic, and Native American communities may be impacted by invasive plant treatments.

Executive Order 12898 (1994) requires federal agencies to identify and address adverse effects to human health and the environment that may disproportionately impact minority and low-income people. Also, the Executive Order directs agencies to consider patterns of subsistence hunting and fishing when an agency action may affect fish and wildlife.

This issue is addressed in all alternatives through Project Design Features described in Chapter 2. These include ongoing consultation with American Indian Tribes, outreach with subsistence and special forest product gathering communities, and public notification of herbicide treatments through the newspaper, onsite posting, and use of flyers.

1.6.4 Issue Group 4 – Effects on Non-Target Plants and Wildlife

Issue Components:

4a – Effects on Non-Target Botanical Species of Local Interest

4b – Effects of Herbicides on Terrestrial Wildlife Species of Local Interest

4a – Effects of Herbicide on Non-Target Botanical Species of Local Interest

Issue Statement: Herbicides may harm native plants due to drift (especially from broadcast treatments), runoff, and/or leaching. The potential for adverse effects to non-target species are dependent on the type of herbicide used and the application method chosen. Non-target vascular plants, lichens, bryophytes, and fungi in close proximity to invasive plants, especially species of local interest, are at particular risk.

This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. The R6 2005 FEIS provided detailed assessments of the risks to non-target vegetation from herbicide. Chapter 2 describes the Project Design Features intended to avoid potential harm and Chapter 3 explains why the potential for adverse effects to non-target plants are minimized in all alternatives.

However, effects on non-vascular plants are especially uncertain when broadcast herbicide application methods are used. This uncertainty cannot be fully mitigated.

This is a key issue tracked throughout this document. The alternatives are compared by:

- Estimated Proportion of Project With Potential Broadcast Application

4b – Effects of Herbicide on Terrestrial Wildlife Species of Local Interest

Issue Statement: Invasive plant treatments may disturb wildlife or trample wildlife habitat. Wildlife may contact herbicides or ingest invasive plants treated with herbicide and become sick or even die.

This issue is generally addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. Chapter 2 describes the Project Design Features intended to avoid potential harm to wildlife and Chapter 3 explains why the potential for adverse effects to wildlife is minimized in all alternatives. However, herbicide effects on specific wildlife species of local concern may be uncertain because studies are limited.

1.6.5 Issue Group 5 – Effects on Soils, Water and Aquatic Organisms

Issue Components:

5a – Potential Adverse Effects of Invasive Plant Treatment on Soils

5b – Potential for Herbicide Delivery to Streams, Lakes, Rivers, Floodplains and Wetlands

5c – Potential for Herbicides to Result in Adverse Effects to Aquatic Ecosystems

5a – Potential Adverse Effects of Invasive Plant Treatment on Soils

Issue Statement: Invasive plants provide ground cover that may be disturbed by treatments. Herbicide use may harm soil organisms or soil biology. This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. Chapter 2 describes the Project Design Features intended to avoid potential harm and Chapter 3 explains why the potential for adverse effects to soils are minimized in all alternatives.

5b – Potential for Herbicide Delivery to Streams, Lakes, Rivers, Floodplains and Wetlands

Issue Statement: Herbicides used near or along streams, lakes, rivers, floodplains and wetlands may enter surface or ground waters through drift, runoff, leaching or direct contact. Road with high potential to deliver herbicides can function as conduits for herbicide delivery to these water bodies.

This issue is primarily addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. Chapter 2 describes the Project Design Features intended to minimize the chance that herbicide concentrations of concern would enter streams. Broadcast treatments have the greatest potential for off site movement of herbicides; spot and hand treatments result in far less risk of herbicide delivery to water bodies. Thus, Project Design Features and buffers are proposed to limit broadcast within the Aquatic Influence Zone (an area defined as half the distance of a Riparian Reserve.

The alternatives are compared by:

- Character of herbicide use within Aquatic Influence Zones
- Estimated acres of herbicide use within Aquatic Influence Zones
- Estimated acreage of herbicide treatment on roadside treatment areas with high potential to deliver herbicides
- Estimated proportion of project where broadcast treatment may occur on roadside treatment areas with high potential to deliver herbicides

5c – Potential for Adverse Effects to Aquatic Organisms from Herbicide

Issue Statement: Herbicides that enter water bodies may harm aquatic organisms, including fish species of local interest.

This issue is addressed through adherence to invasive plant treatment standards in the Olympic National Forest Plan as amended by the R6 2005 ROD. Chapter 2 describes the Project Design Features intended to minimize or eliminate risk of concentrations of concern to aquatic organisms or their habitat, because treatment situations likely to result in herbicide concentrations of concern to aquatic organisms would be avoided. While all alternatives would be designed to meet environmental standards, they also vary as to the degree of risk to fish and other aquatic organisms. The alternatives are compared by:

- Potential for herbicides to enter streams in concentrations above the threshold of concern for aquatic organisms and ecosystems.

1.6.6 Summary of Significant Public Issues and Alternative Comparison Factors

Table 4 summarizes how the issues are addressed and factors used to compare the effects of the alternatives.

Table 4. Significant Issues, How Issue are Addressed, and Factors for Alternative Comparison

Issue Group	Issue Component	How Issue is Addressed	Factors for Alternative Comparison
1 – Human Health and Worker Safety	1a – Exposure to Herbicides	Exposure scenarios that may harm workers and/or the public are avoided in all alternatives.	No substantial difference between action alternatives
1 – Human Health and Worker Safety	1b – Drinking Water	No plausible scenarios for public harm due to drinking water contamination are associated with any alternative.	No substantial difference between action alternatives
1 – Human Health and Worker Safety	1c – Worker Safety	Adherence to OSHA guidelines.	No substantial difference between action alternatives; not tracked further in this document.
2 – Treatment Strategy and Effectiveness	2a – Range of Treatment Methods Approved	Analysis of differences in treatment effectiveness based on restrictions to herbicide use.	· The number of herbicides available for use · Percent of infested land base where herbicide may be used
2 – Treatment Strategy and Effectiveness	2b – Long-term Strategy, Reduce Reliance on Herbicides Over Time	Treatment prescriptions in all alternatives include site restoration (passive revegetation, mulching, seeding, planting). Manual and mechanical follow up treatments would be favored, especially when populations are small enough to control without herbicides.	No substantial difference between action alternatives. Restoration strategy is in Appendix F and Chapter 2.5; declining reliance on herbicide over time is addressed in Chapter 3.1.
2 – Treatment Strategy and Effectiveness	2c – Treatment Priority	Invasive plant treatment areas are prioritized.	No substantial difference between action alternatives; see Chapter 2.5 for how priorities were set.
2 – Treatment Strategy and Effectiveness	2d – Adaptive Management/Early Detection-Rapid Response	An adaptive management plan and early detection-rapid response strategy is part of all action alternatives.	No substantial difference between action alternatives, see discussions in Chapter 2.5.

Issue Group	Issue Component	How Issue is Addressed	Factors for Alternative Comparison
Issue Group 3 – Social and Economic	3a – Treatment Costs and Financial Efficiency	Analysis of the total and annual estimated costs of treatment and financial efficiency.	·Total estimated project cost over a 5-year period. ·Annual estimated project cost over a 5-year period ·Average cost of a treatment acre over a 5-year period
Issue Group 3 – Social and Economic	3b – More Jobs Associated with Manual Treatments	Analysis of the estimated number of worker days needed for the project.	· The estimated number of jobs provided by the most ambitious treatment scenario
Issue Group 3 – Social and Economic	3c – Scenic, Recreation, and Wilderness Values	This issue is addressed in all alternatives through the Project Design Features described in Chapter 2, including coordination and notification requirements.	No substantial difference between action alternatives, see Project Design Features in Chapter 2.5.
Issue Group 3 – Social and Economic	3d– Effects on Special Forest Products	This issue is addressed in all alternatives through public education, notification and outreach to special forest product gatherers. Project Design Features described in Chapter 2 include coordination and notification requirements.	No substantial difference between action alternatives; no exposure scenarios are associated with people harvesting or eating special forest products near sprayed areas.
Issue Group 3 – Social and Economic	3e – Effects on American Indian Tribes and Treaty Rights, Civil Rights and Environmental Justice	This issue is addressed through consultation with tribes, outreach to subsistence gatherers, and extensive public notification.	No substantial difference between action alternatives, no disproportionate effects on any minority group; see Chapter 3.6.
Issue Group 4 – Non-Target Plants And Wildlife	4a – Adverse Effects of Herbicide Treatment on Botanical Species Of Local Interest	This issue is addressed through development of Project Design Features intended to avoid potential adverse effects to non-target plants.	·Acres of Broadcast Allowed ·Number of Plant Species of Local Interest Potentially Affected by Broadcast Herbicide Application Methods

Issue Group	Issue Component	How Issue is Addressed	Factors for Alternative Comparison
Issue Group 4 – Non-Target Plants And Wildlife	4b – Potential Adverse Effects Of Invasive Plant Treatment On Terrestrial Wildlife, Species Of Local Interest	This issue is addressed through development of Project Design Features intended to avoid potential adverse effects to terrestrial wildlife, including salamanders and mollusks.	No substantial difference between action alternatives; none of the alternatives are likely to adversely affect any wildlife species of local interest.
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms	5a – Potential Adverse Effects of Invasive Plant Treatment on Soils	This issue is addressed through Project Design Features intended to avoid potential harm to soils.	No substantial difference between action alternatives; none of the alternatives would harm soil productivity.
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms	5b – Potential for Herbicide Delivery to Streams, Lakes, Rivers, Floodplains and Wetlands	This issue is addressed through Project Design Features intended to minimize herbicide delivery to water.	· Character of herbicide use within Aquatic Influence Zones ·Estimated acres of herbicide use within Aquatic Influence Zones · Estimated acreage where herbicide treatment may occur on roadside treatment areas with high potential to deliver herbicides · Estimated proportion of project where broadcast of herbicide may occur on roadside treatment areas with high potential to deliver herbicides

Issue Group	Issue Component	How Issue is Addressed	Factors for Alternative Comparison
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms	5c – Potential for Adverse Effects on Aquatic Organisms from Herbicide	This issue is addressed through Project Design Features intended to avoid herbicide delivery to water and minimize or eliminate risk of concentrations above a threshold of concern to fish and aquatic ecosystems. Treatment situations likely to result in herbicide concentrations of concern to fish are avoided in all alternatives except D: analysis for Alternative D indicates that herbicide concentrations of concern to aquatic organisms are possible under worst-case conditions.	·Potential for herbicides to enter streams in concentrations above the threshold of concern for aquatic organisms and ecosystems.

1.7 Non-Significant Issues

The Council of Environmental Quality requires the USDA Forest Service to identify and eliminate from detailed study the issues that are not significant (40 CFR 1501.7). Issues are eliminated from further analysis when the issue is outside the scope of the EIS; is already decided by law, regulation, Forest Plan, or other higher level decision; is not clearly relevant to the decision to be made; or is conjectural and not supported by credible scientific or factual evidence.

The Forest Supervisor for the Olympic National Forest determined that the following public issues would be eliminated from further analysis:

1.7.1 Preventing, Rather Than Treating Invasive Plants

Some comments expressed that the best approach for addressing invasive plant infestations is to eliminate human disturbance, including: logging, grazing and the related road building, ground disturbance and increased vehicular traffic. These comments suggested that logging and other ground-disturbing projects be suspended until a comprehensive EIS is completed that fully addresses the existing problem and 'root causes.'

Prevention is an important component of invasive plant management addressed in the R6 2005 FEIS, however this project-level EIS focuses on issues specific to invasive plant treatment. Prevention is addressed through the adoption of the standards in the Olympic National Forest Plan from the R6 2005 ROD, additional national and regional manual direction and policy statements, the USDA-Forest Service Guide to Noxious Weed Prevention, and provisions in a variety of environmental documents and contracts. Please see Appendix G for more information.

1.7.2 Funding and Partnerships for Managing Invasive Plants on Private Land

Some people expressed that invasive plant treatments on private lands should be funded or technical assistance provided for private landowners, and that management of noxious weeds can also be improved on both public and private lands by the formation and participation in weed management areas. This issue is outside the scope of this analysis and is therefore not significant to the project analysis.

The Forest Service supports establishing weed management areas in partnership with others. All alternatives would be consistent with such partnerships and the likelihood of success would certainly be increased. However, establishment of weed management areas may be accomplished without consideration in an EIS.

Technical assistance for projects off National Forest is available and is not subject to consideration in an EIS. National Environmental Policy Act (NEPA) documentation may be required when federal funding is used for work on other ownerships. No specific proposals for using Forest Service for work off-National Forest system lands were brought forward during initial project development and scoping, thus, none could be evaluated as a connected action. However, similar work on adjacent lands has occurred in the past and will likely to continue to occur. Where relevant, work on adjacent ownerships is considered as a part of the cumulative effects analysis.

1.7.3 Funding Sources and Commitments

Several commenters mentioned that project effectiveness is directly related to funding. Funding secured for the past several years is not adequate to fully implement any action alternative. While this is an important issue relevant to the ability of the Forest Service to meet the purpose and need, it is outside the scope of this EIS because it cannot be resolved through the NEPA process.

Funding is dependent on many unpredictable factors and some sources may become available once a NEPA decision has been made. Financial efficiency analysis displays estimated costs of treating all known infestations over a five-year period. The average cost of a treatment acre is also disclosed. This information can be used to demonstrate funding that would be needed over time to complete the project, however this NEPA document cannot guarantee that all planned work would be funded.

1.7.4 Linking the Project to Other Initiatives

Some comments suggested linking this invasive plant project Draft EIS to the Fuels Reduction and Healthy Forest Initiatives or other initiatives to provide a more strategic approach to controlling invasive plants than a stand alone document.

One role of the Olympic National Forest Supervisor is to consider the scope of Proposed Actions in the context of other actions that may be connected. In the case of invasive plant management, several approaches may be valid, for instance invasive plant treatments could be addressed through project planning at the watershed scale that integrates invasive plant treatments with other vegetation management proposals. In the past, invasive plant treatments have been connected with projects intended to improve forest health or reduce fuels.

In this case, the Forest Supervisor decided to consider invasive plant management Forest-wide to allow for timely treatment wherever the need arises, however funding may be secured. In some cases, treatments may be linked with other projects, and future NEPA documents will likely tier to analysis herein, so that integrated resource management can be achieved in the best way possible. However, no matter what other actions occur in the project area, the current invasive plant inventory demonstrates the ongoing need for treatment.

Thus, actions other than invasive plant management are not connected to this proposal, so linking this EIS to forest health or fuels reduction projects is outside the scope of this EIS and not a significant issue for the analysis.

Chapter 2. Alternatives, Including the Proposed Action

2.1 Introduction

Chapter 2 describes and compares alternatives considered for invasive plant treatment on the Olympic National Forest in the state of Washington. Chapter 2 focuses on the resource trade-offs associated with differences between the alternatives.

The descriptions of the alternatives in Chapter 2 are derived from a detailed project database founded on invasive plant inventories and refined using anecdotal information. The project area was divided into treatment areas that were classified by the type of site (e.g., roads, administrative sites, meadows) and prioritized considering the threat posed by existing invasive species and the potential for effective treatment. Treatment methods (herbicide and non-herbicide) and strategies were identified based on the location, extent and biology of the existing invasive plant species. Treatment priorities, methods and strategies are tiered to the 2005 R6 Invasive Plant FEIS. A primary focus of the site-specific analysis is development of Project Design Features so that invasive plant treatments comply with the recently adopted treatment and restoration standards.

2.2 Alternative Development Process

This EIS evaluates four alternatives for invasive plant treatment, including the No Action (Alternative A) and the Proposed Action (Alternative B). No Action (Alternative A) is defined as the treatments that would currently be approved under existing NEPA decisions on the Olympic National Forest. The Proposed Action represents our initial proposal for using herbicide, manual and mechanical methods to treat known and predicted infestations of invasive plants.[6] In general, the Proposed Action allows for the use of 10 herbicide ingredients according to environmental standards, in combination with common manual and mechanical methods.

Public and interagency issues centered on the cost, relative effectiveness, and potential adverse effects of using herbicides. Alternatives were developed to respond to public issues while effectively treating invasive plants according to the management direction in the 2005 R6 Invasive Plant ROD. The action alternatives vary in the amount of herbicide use allowed; the methods of application allowed; the likelihood that invasive plants will be controlled and sites restored; the relative monetary costs; and the inherent risks related to herbicide use.

Broadcast herbicide applications have greater inherent risk of adverse effects from herbicide drift and delivery to surface or ground water, but may be more cost-effective than other methods, and in some cases, may be the only reasonable way of effectively treating large, continuous infestations. Thus, the alternatives vary as to the amount of broadcast treatment allowed. The alternatives also vary as to the type and method of herbicide use allowed within the Aquatic Influence Zone.[7]

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[6] Known infestations are those that have been formally surveyed and mapped, along with sites identified anecdotally. "Current inventory" includes known infestations and is subject to change throughout the life of the project.

[7] The Aquatic Influence Zone is an area of special consideration along streams and ditches where herbicides have the potential to enter surface water through leaching, run-off or drift. It is defined for this project as half the distance of a Riparian Reserve.

Some alternatives that would resolve public concerns were dismissed from detailed study because they would not meet the need for action. Examples include: eliminate all herbicide use, and rely entirely on prevention to control invasive plants. These are discussed in Chapter 2.3.

2.3 Invasive Plant Treatment Methods

All of the alternatives (including No Action) employ a variety of invasive plant treatment methods.[8] This section offers a brief description of the different methods proposed for manual/mechanical and herbicide treatments in all alternatives, including No Action. These descriptions are based on Tu, et. al. 2001, edited for local conditions and knowledge.

Manual and Mechanical Methods

Manual techniques include hand pulling, clipping, or digging out invasive plants with non-motorized hand tools. Mechanical methods involve chain saws, mowers, or other mechanized equipment. 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, and in the process, laborers and machines may severely trample vegetation and disturb soil, providing prime conditions for re-invasion by the same or other invasive species. 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.

Weed Pulling - Pulling or uprooting plants 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 are surprisingly powerful and 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.

The advantages of pulling include its small ecological impact, minimal damage to neighboring plants, and low (or no) cost for equipment or supplies. Pulling is extremely labor intensive, however, and is effective only for relatively small areas, even when abundant volunteer labor is available. Hand pulling is easy to plan and implement, and is often the best way to control small infestations, such as when a weed is first detected in an area. Hand pulling may be a good alternative in sites where herbicides or other methods cannot be used.

The key to effective hand pulling is to remove as much of the root as possible while minimizing soil disturbance. For many species, any root fragments left behind have the potential to re-sprout, and pulling is not effective on plants with deep and/or easily broken roots.

Most weed-pulling tools are designed to grip the weed stem and provide the leverage necessary to pull its roots out. Tools vary in their size, weight, and the size of the weed they can extract. The Root Talon is inexpensive and lightweight, but may not be as durable or effective as the all-steel Weed Wrench, which is available in a variety of sizes. Both tools can be cumbersome and

[8] The alternatives vary as to the total and relative amount of treatment approved and some alternatives do not approve some treatment options listed. Appendix B displays likely treatment methods based on the current inventory. These are subject to change given local conditions at the time of implementation.

difficult to carry to remote sites. Both work best on firm ground as opposed to soft, sandy, or muddy substrates.

Clip – "Clip" means to cut or remove seed heads and/or fruiting bodies to prevent germination. This method is labor intensive but effective for small and spotty infestations.

Clip and Pull – "Clip and pull" means 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 Hog, Raking, Trimming, Weed-eating - Mowing and cutting can reduce seed production and restrict weed growth, especially in annuals cut before they flower and set seed. Some species however, re-sprout vigorously 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 resprouting, or as follow up treatments to treat target plants missed by initial herbicide use.

Stabbing - Some plants can be killed by severing or injuring (stabbing) the carbohydrate storage structure at the base of the plant. 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 - 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.

Steaming or Foaming - Pouring boiling hot water onto weeds, or subjecting weeds to hot steam, is a method of weed control that has been practiced for some time. Out of a New Zealand company named Waipuna™ comes this hot foam system for steam-killing vegetation. This system employs hot foam to deliver and trap superheated steam onto foliage to kill weeds. It is an effective treatment for annuals, and with repeated treatments, may be effective for some perennials.

Herbicide Application Methods

The environmental impacts of three types of herbicide application methods are evaluated in this EIS:

Broadcast (includes but not limited to boom spray) **–** Broadcast treatments would be used to treat denser (approximately 70 percent or greater) patches of target vegetation. 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.

Offsite movement due to vaporization or drift and possible treatment of non-target plants can be of concern when using this method. Two alternatives (No Action and Alternative C) do not approve any broadcast treatment.

Not all broadcast methods include a boom; boom-less nozzles are currently in use that can reduce the risk of non-target effects. Backpacks may also be used as a broadcast tool if not directed at individual plants.

Spot spray - Herbicide is sprayed directly onto small patches or individual target plants; non-target plants are avoided. These 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. Drift is far less of a concern because the applicator ensures that spray is directed immediately toward the target plant.

Hand/Selective – Hand/selective methods treat individual target plants, reducing the potential for herbicide to impact soil or non-target organisms. Hand/selective methods include wicking and wiping; foliar application; basal bark treatment; frill, hack, and squirt, stem injection, and/or cut-stump methods.

Wicking and Wiping - Involves using a sponge or wick on a long handle to wipe herbicide onto foliage and stems. Use of a wick eliminates the possibility of spray drift or droplets falling on non-target plants. However, herbicide can drip or dribble from some wicks.

Foliar Application - These methods apply herbicide directly to the leaves and stems of a plant. An adjuvant or surfactant is often needed to enable the herbicide to penetrate the plant cuticle, a thick, waxy layer present on leaves and stems of most plants. There are several types of foliar application tools available.

Basal Bark - This method applies a 6 to 12 inch band of herbicide around the circumference of the trunk of the target plant, approximately one foot above ground. The width of the sprayed band depends on the size of the plant and the species' susceptibility to the herbicide. The herbicide can be applied with a backpack sprayer, hand-held bottle, or a wick.

Frill, Hack and Squirt - The frill method, also called the "hack and squirt" treatment, is 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.

Stem Injection - Herbicides can be injected into herbaceous stems using a needle and syringe. Herbicide pellets can also be injected into the trunk of a tree using a specialized tool. While 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) (Lucero presentation, May 2005).

Cut-stump - This method is often used on woody species that normally re-sprout after being cut. Cut down the tree or shrub, and immediately spray or squirt herbicide 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 therefore, has a low probability of affecting non-target species or contaminating the environment. It also requires only a small amount of herbicide to be effective.

Biological Controls

Table 5 displays the biological control (biocontrol) agents currently released by Clallam, Grays Harbor, Jefferson, and Mason counties on the Olympic Peninsula to treat invasive plants. Releases and redistribution of these biological agents would be expected to occur regardless of alternative selected for this project, including No Action (Alternative A). Canadian Thistle Defoliating Beetle (Cassida rubiginosa) has been reported as distributed within adjacent counties. This biocontrol species has not been approved by the Animal and Plant Health Inspection Service (APHIS) and therefore may not be redistributed on National Forest as per Standard 14.

Table 5. Biological Controls Currently Distributed on the Olympic Peninsula that Comply with Standard 14

Target Species	Biocontrol Agents
Purple Loosestrife	Purple Loosestrife Beetle (*Galerucella calmariensis*), Golden Loosestrife Beetle (*Galerucella pusilla*), Big Purple Loosestrife Weevil (*Hylobius transversovittatus*) and Little Purple Loosestrife Weevil (*Nanophyes marmoratus*)
Tansy Ragwort	Ragwort Flea Beetle (*Longitarsus jacobaea*)
Scotch Broom	Scotch Broom Seed Beetle (*Bruchidius villosus*), Scotch Broom Seed Weevil (*Apion fuscirostre*), or Scotch Broom Twig Miner (*Leucoptera spartifoliella*)
Knapweed	Seed Head Beetle (*Larinus obtusus*)
Canadian Thistle	Canadian Thistle Gall Fly (*Urophora cardui*)
St. John's Wort	Klamath Weed Beetle (*Chrysolina quadrigemina*)
Meadow Knapweed, Spotted Knapweed	Seed Head Gall Fly (*Urophora quadrifasciata*), Banded Gall Fly (*Urophora affinis*), Knapweed Root Moth (*Agapeta zoegana*) and Knapweed Root Weevil *(Cyphocleonus achates)*

Biological control agents undergo a rigorous testing procedure prior to being available for release. Initial testing occurs in quarantine laboratories abroad and in the United States. The agents are tested for their effectiveness in controlling the target organism and for their host specificity. Testing includes potential effects on economic crops, rare plants, and similar species found in North America. An agent can be released only after it has been determined that it is unlikely that the agent will feed or cause injury to any native or agronomic species. It generally takes between ten and fifteen years for an agent to be cleared for release. The analyses for effects of such tools have already been completed under documents (including NEPA decisions) developed by APHIS for approval of entry of such organisms.

The APHIS analysis assumed that biological agents would spread throughout North America, to wherever the target species exists. Like the invasive plants that are targeted, biological agents do not recognize property boundaries. Biological agents are expected to spread onto National Forest system lands regardless of any action the Forest Service may take, including redistribution (agents moved from one location to another).

Similar to prevention, biological agents alone do not eradicate, control or contain invasive plants. However, both prevention and use of biological agents are part of the integrated management program and contribute to the goal of slowing the spread of invasive plants.

2.4 No Action

The No Action Alternative is also known as Alternative A

<u>Alternative A Description</u>

Total Acres to Be Treated: 672

Total Acres Estimated Herbicide Treatment: 86

Estimated Proportion of Herbicide Treatment Acres - Broadcast: 0%

Estimated Proportion of Herbicide Treatment Acres - Spot/Hand: 100%

Under Alternative A, the No Action alternative, invasive plant treatments would be implemented according to existing NEPA decisions, including the Integrated Weed Management Program Environmental Assessment (EA - 1998)/Decision Notice (DN - 1999) and APHIS approved biological controls released on the Olympic Peninsula. In addition, prevention practices would be integrated into all future projects to slow the spread of invasive plants throughout the National Forest.

The existing NEPA decisions allow for an integrated weed management strategy emphasizing prevention and control of invasive plants scattered across the Forest. The 1998 EA/1999Decision Notice approved manual, mechanical and herbicide treatments on 75 sites totaling approximately 672 acres.

Spot or hand herbicide treatments were prescribed on 86 acres, singly or in combination with manual or mechanical treatments. No broadcast treatments were approved. Available herbicides included glyphosate, dicamba and picloram, with only aquatic glyphosate to be used in the vicinity of surface water.

The remaining 586 acres were proposed for manual and mechanical treatment. The 1999 EA included all inventoried invasive plant sites at that time. No early detection/rapid response mechanism for new sites or adaptive management approaches for new methods were considered in the EA.

The No Action alternative would leave more than 80 percent of the currently infested acreage untreated.

Table 6. Alternative A - Acres by Treatment Combination

	Total Acres	Herbicide Only	Herbicide combined with Manual and/or Mechanical Treatment	Manual and Mechanical Only
Acres by treatment combination	672	0	86	586

2.5 The Proposed Action

The Proposed Action is also known as Alternative B.

<u>Alternative B Description</u>

Total Acres to Be Treated: 3,830

Total Acres Estimated Herbicide Treatment: 3,687

Estimated Proportion of Herbicide Treatment Acres - Broadcast: 34%

Estimated Proportion of Herbicide Treatment Acres - Spot/Hand: 66%

The Proposed Action (Alternative B) was developed to respond to the need for action by approving herbicide and non-herbicide treatments to eradicate, contain, control and/or suppress the spread of invasive plants. The Proposed Action would allow treatment of the 672 acres included under No Action using new tools and approaches. It would also approve treatment on approximately 3,200 additional infested acres detected in the November 2004 inventory. The Proposed Action would approve treatments based on common control measures (see table 10). Any of ten herbicides would be used according to Project Design Features and buffers listed in section 2.5.8.

About 85 percent of the infested acres are in roadside treatment areas where broadcast treatment may be the most cost-effective of treatment methods considered in this DEIS (depending on the density and distribution of target species along roadsides; broadcast would not be more cost-effective this in not true for small or scattered target species or where target species density is lower than 70 percent). However, Project Design Features to reduce potential delivery of herbicide to streams would eliminate the option of broadcasting on about 60 percent of the roadside treatment acreage.

2.5.1 Treatment Areas

Treatment areas are geographic assemblages of inventoried and anecdotal invasive plant sites that have been prioritized and prescribed for treatment. There are 102 treatment areas mapped; the majority of the infestations are along roadsides and other disturbed areas. Appendix A provides data tables corresponding to maps depicting the treatment areas.

Table 7. Infested Acres by Treatment Area Description

Treatment Area Description	Estimated Infested Acres
Roadside	3,270
Administrative Sites, Campgrounds, Summer Homes	130
Meadows, Wetlands and Floodplains	80
Trails	135
Forest	215
Total	**3,830**

2.5.2 Treatment Priority and Strategy

Each treatment area was also assigned an overall priority. The urgency, necessity, and intensity of treatment vary depending on priority, as shown in table 8. In general, higher priority treatments would be favored, and are most likely to be accomplished. Assuming current funding levels, lower priority treatments may not be accomplished, or may only be accomplished in connection with higher priority areas.

Priorities on the Olympic National Forest are partially driven by the unique conditions here. Some invasive species that may be tolerated elsewhere may be targeted here, given the high value placed on natural habitats in Wilderness Areas, Research Natural Areas, Botanical Areas, tribal lands and the National Park.

Table 8. Treatment Priority and Strategy

Priority	Associated Treatment Strategy	Local Situations	Acres	PERCENT
Highest	All treatments in areas of with potential for significant ecological impact New infestations of aggressive species when small	Botanical areas, Matheny Creek, Research National Areas, infestations under a forest canopy.	620	16
Second	Eradication of aggressive species Treatment in areas of high traffic and sources of infestation (e.g. parking lots, campgrounds, trailheads, horse camps, gravel pits)	Roadside treatment areas with knotweeds, knapweeds, hawkweeds, butter and eggs, purple loosestrife. Meadows and administrative sites	620	16
Third	Containment/control of existing large infestations of aggressive species with focus on boundaries of infestation.	Roadsides with access to areas of concern, access to Olympic National Park.	1,290	34
Fourth	Containment/control of remaining infestations.	Other roadsides.	1,300	34

Target species within each treatment area were assigned a treatment strategy. These strategies vary depending on the potential negative impacts of a given invasive species and the value or sensitivity of the treatment site (or adjacent lands) and are related to priority shown above. Treatment strategies considered for the Proposed Action include:[9]

- *Eradicate*: Totally eliminate an invasive plant species from a site. This objective generally applies to the hardest to control invasive species (Canada thistle, bull thistle, knapweed and knotweed) and highest-valued sites (e.g. Wilderness and Botanical Areas).
- *Control*: Reduce the size of the infestation over time; some level of infestation may be acceptable. This objective applies to target species such as Scotch broom, English ivy and tansy.
- *Contain*: Prevent the spread of the weed beyond the perimeter of patches or infestation areas mapped from current inventories. This objective applies target species such as reed canary grass and St. John's wort.

Table 9 displays the number of acres proposed for each treatment strategy. Half of the proposed treatment acreage has a strategy of contain, which means that the outer perimeter of the treatment sites are likely to be treated, rather than the whole area.[10] Treatment cost estimates and assumptions vary by strategy (more information in Chapter 3.7).

Table 9. Acres by Treatment Strategy[11]

	Total	Eradicate	Control	Contain
Acres	3,830	420	1,475	1930
Percent of Total	100%	11%	39%	50%

2.5.3 Common Control Measures

Several target species grow within treatment areas on the Olympic National Forest. Table 10 summarizes the target species found in the current inventory and the control measures, including herbicides, commonly used to eradicate, control and/or contain these target species. The common control measures are the starting point for site-specific prescriptions, which would be refined for specific sites according to Project Design Features ((PDFs) Section 2.5.8).

These measures are intended to be refined over time. New invasive plant sites found during the life of the project would be treated with similar control measures. Some of the target species were not detected in the current inventory, but have the potential to be found on the Olympic National Forest. Acreage is shown for target species where inventories indicate more than one acre of coverage.

[9] Two other possible strategies exist: suppress and tolerate. Actions needed to meet these strategies are not the focus of this EIS.
[10] Acreage estimates include the entire infested area, and therefore overestimate the acreage that would actually be treated.
[11] The reason these acreages do not add up to the proportions shown above is that the treatment strategy is identified for each individual infestation, while priority is associated with the entire treatment area.

Appendix B provides additional information about the control measures, including restoration emphasis items and manual disposal considerations. Some control measures listed in table 10 or Appendix B may not be available in some locations due to the PDFs or because they are outside the scope of those analyzed in this EIS (for instance, prescribed burning, broadcast treatment of any herbicide within 100 feet of a live stream, and/or aerial application of herbicide). The Common Control Measures in Appendix B would be applied to site-specific conditions as part of the Implementation Planning process.

Table 10. Common Control Measures by Target Species

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	Acres from current 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 entries per year are required. Mowing is possible, but timing is critical. These treatments may take up to ten years due to long term seed viability.	Clopyralid Picloram Aquatic labeled Glyphosate
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 Aquatic labeled Glyphosate
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. These treatments may take up to ten years due to long-term seed viability.	Upland Forested: Metsulfuron methyl In native grasses: Imazapic (in fall only) Aquatic labeled Glyphosate

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	Acres from current 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 Aquatic labeled 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. These treatments may take up to ten years due to long-term seed viability.	Triclopyr Clopyralid Picloram Aquatic labeled 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, then 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 Aquatic labeled Glyphosate
Reed canarygrass (PHAR3) *Phalaris arundinaceae* *Perennial*	156	Use a combination of herbicides and manual, mechanical, or cultural treatments. Manual treatments or mowing are only practical for small stands when multiple entries 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 Aquatic labeled Glyphosate
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) Aquatic labeled Glyphosate

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	**Acres from current inventory**	**Common Control Measures**	**Documented Effective Herbicides**
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 Aquatic labeled 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.	Aquatic labeled Glyphosate
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 Aquatic labeled 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 Aquatic labeled Glyphosate

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	**Acres from current inventory**	**Common Control Measures**	**Documented Effective Herbicides**
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 Aquatic labeled 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 Aquatic labeled Glyphosate (not found as effective in the literature)
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 Aquatic labeled 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 Aquatic labeled Glyphosate
Creeping buttercup (RARE3) *Ranunculus repens* *Perennial*	6	Hand digging is effective. If chemicals are used, manual treatments could be used for follow- up.	Aquatic labeled 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.	Aquatic labeled 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 Aquatic labeled Glyphosate Clopyralid Picloram/imazapyr (sites without grass cover)

Target Species – Common Names, Scientific Names (shorthand) and Growth Habit	Acres from current inventory	Common Control Measures	Documented Effective Herbicides
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 Aquatic labeled 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) Aquatic labeled Glyphosate
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 Aquatic labeled Glyphosate

2.5.4 Treatment Site Restoration

Treatment site restoration is a component common to all action alternatives. Treatment site restoration may include mulching, seeding, and/or active revegetation, or may be passive in situations where desirable vegetation can naturally replace target invasive species removed. Treatment site restoration is part of the prescription developed during implementation planning. Restoration prescriptions would be influenced by site-scale conditions and broader land management objectives (for more information on restoration prescription process, see Appendix F, Excerpts from the 2003 *Draft Guidelines for Revegetation of Invasive Weed Sites and Other Disturbed Areas on National Forests and Grasslands in the Pacific Northwest).*

The analysis assumption is 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 evident surrounding the inventoried invasive plant populations known across the Olympic National Forest. 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 weed competitors, until native species can become established at the site.

Preferred non-natives 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 mycorrhizae would be added.

Deep-rooted shrubs may also be seeded or planted to more fully utilize resources from the lower soil profile, especially late in the growing season. Shrubs allow for easier establishment of understory species by increasing water availability and reducing understory temperatures and evapo-transpiration. Planting of native shrubs may also occur in cases where rapid revegetation is desired; for example, native shrubs may be planted adjacent to summer homes around Lake Quinault to replace the non-native English laurel dominant there.

Appendix F is excerpted from an unpublished document (2003) *Draft Guidelines for Revegetation of Invasive Weed Sites and Other Disturbed Areas on National Forests and Grasslands in the Pacific Northwest.* This document provides further information on methods and guidelines for revegetation of invasive weed sites and disturbed areas. Steps are outlined for assessing existing and potential site conditions, and for developing long-term revegetation strategies that are effective, affordable, and consistent with the ecological context and land management objectives of the site and surrounding landscape. This document promotes the use of local native plant materials to establish competitive plant cover and meet the long-term objective to restore ecosystem functioning.

2.5.5 Herbicide Selection

Table 11 displays the herbicide ingredients that may be used in the all action alternatives. (See Broadcast treatments that would not exceed typical label rates (see PDF F4 in section 2.5.8 Table 12). Highest label rates would be used infrequently and only where necessary to be effective. For instance, stem injection of knotweed with glyphosate requires the use of highest label rates to effectively kill the plant.

Table 11. Active Herbicides and Highest, Lowest and Typical Application Rates

Active Ingredient (a.i.)	Highest Application Rate Lbs. a.i./acre	Typical Application Rate Lbs. a.i./acre	Lowest Application Rate Lbs. a.i./acre
Chlorsulfuron	0.25	0.056	0.0059
Clopyralid	0.5	0.35	0.1
Glyphosate	7	2	0.5
Imazapic	0.19	0.13	0.031
Imazapyr	1.25	0.45	0.03
Metsulfuron Methyl	0.15	0.03	0.013
Picloram	1.0	0.35	0.1
Sethoxydim	0.38	0.3	0.094
Sulfometuron Methyl	0.38	0.045	0.03
Triclopyr	10	1.0	0.1
Nonylphenol Polyethoxylate Surfactant (NPE)	6.68	1.67	0.167

2.5.6 Early Detection-Rapid Response Approach

Under the Early Detection/Rapid Response approach, new or previously undiscovered infestations would be treated using the range of methods described in this EIS, according to the Project Design Features listed later in this section. This approach is needed because 1) the precise location of individual target plants, including those mapped in the current inventory, is subject to rapid and/or unpredictable change and 2) the NEPA process does not allow for rapid response; infestations may grow and spread into new areas during the time it takes to prepare NEPA documentation. The intent of the Early Detection/Rapid Response approach is to treat new infestations when they are small so that the likelihood of adverse treatment effects is minimized. The approach is based on the premise that the impacts of similar treatments are predictable, even though the precise location or timing of the treatment may be unpredictable.

The Early Detection/Rapid Response approach included in all action alternatives allows the Forest Service to treat anywhere on the Forest that the need exists, based on, but not limited to the current inventory and anticipated rates of spread. The Implementation Planning process detailed in section 2.5.7 is intended to ensure that effects are within the scope of those disclosed in this EIS; new situations that may have different effects would be subject to further NEPA analysis. In addition, further NEPA would be required for the following types of treatments:

- Aerial Herbicide Application
- Herbicides other than the ten listed in table 11.
- Prescribed Burning
- Plowing/Tilling/Disking/Digging With Heavy Equipment
- Grazing Or Other Cultural Treatments
- Flooding/Drowning

The procedure used to develop this approach is as follows:

1. The 2004 invasive plant inventory and database was developed to provide site-specific basis for the Proposed Action. Infested sites were aggregated into treatment areas. See Appendix A data tables that correspond to maps depicting each treatment area.
2. The IDT considered the kinds of site conditions encountered throughout the treatment areas and analyzed the effects of applying a range of treatment prescriptions to these situations.
3. The IDT developed Project Design Features intended to minimize potential for significant adverse effects to such a degree that even though precise treatment locations may be uncertain, the character of the impacts can be predicted, and pose low risk to people and/or the environment.
4. The Implementation Planning process detailed in section 2.5.7 would ensure that treatments of currently undetected invasive plants would have effects within the scope of those disclosed in this EIS because the Project Design Features were developed considering a wide range of conditions that occur throughout the Forest. The Project Design Features serve to eliminate or minimize the likelihood of adverse effects. Uncertainty is addressed through monitoring and adaptive management (see section 2.5.8).

2.5.7 Implementation Planning

This section outlines the process that would be used to ensure that the selected alternative is properly implemented. The methodology follows Integrated Weed Management (IWM) principles (R6 2005 FEIS, 3-3) and satisfies pesticide use planning requirements at FSH 2109.14. It applies to currently known and new sites found during ongoing inventory.

1. 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 EIS.[12]

2. Develop site-specific prescriptions

- Use Integrated Weed Management principles to identify possible effective treatment methods.[13] Considerations include the biology of the target species and surrounding environment. Determine whether effective methods are within the scope of those analyzed in the EIS.[14] Prescribe herbicides as needed based on the biology of the target species and size of the infestations (for instance, manual treatment alone cannot effectively eradicate rhizomatous species). Broadcast application of herbicide would be considered for situations warranted by the density (70-80 percent cover) and/or the distribution of invasive plants, unless limited by PDFs.
- Apply appropriate PDFs from section 2.5.8, and Project Design Criteria (PDC) from ESA Consultation results, based on:
    - The size of the infestation, its treatment history and response to past treatment,
    - Proximity to species of local interest or their habitats
    - Proximity to streams, lakes, wetlands
    - Whether the treatment site is along a road associated with high risk of herbicide delivery
    - Soil conditions
    - Municipal watersheds and/or domestic water intakes
    - Places people gather (recreation areas, special forest product and special use areas).
- 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 would be required to authorize the effective treatment.

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[12] Conditions throughout current treatment areas are assessed in Chapter 3. New treatment areas found during future inventories need to be evaluated for extraordinary site conditions that may trigger additional NEPA requirements.
[13] Table 10 displays a summary of current control measures for various target species. These methods are intended to be refined through monitoring and adaptive management
[14] If preferred methods have effects that are outside the scope of those analyzed in the EIS, additional NEPA would be required.

- Review manual Scotch broom treatments to ensure no effect on heritage resources.
- Complete Form FS-2100-2 (reproduced in Appendix E), 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 Washington State Department of Agriculture (WSDA) for treatments within the Aquatic Influence Zone.
- Confirm restoration plan and ensure acceptable plant or mulch materials are available.
- Identify and perform pre-treatment surveys for species of local interest and/or their habitats.
- Coordinate with adjacent landowners, water users, agencies, and partners.
- Document the public notification plan.

3. Accomplishment and Compliance Monitoring

- Develop a project work plan for herbicide use as per FSH 2109.14.3. This work plan presents organizational and operational details including the precise treatment objectives, the equipment, materials, and supplies needed, 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, Standards 16 and 18, and site-specific PDFs.
- Document and report herbicide use and certified applicator information in the National pesticide use database, via the Forest Service Activity Tracking System (FACTS), and other forms.[15]
- WSDA is the responsible agency for pesticide management. WSDA also holds the Non-Point Discharge permit for use of herbicides to control aquatic and/or emergent noxious weeds in Washington State. Permits would be sought for herbicide treatments within 100 feet of live streams and other water bodies.
- Implement the public notification plan and document accomplishments.

4. Post-treatment Monitoring and Adaptive Management

- Implementation monitoring would occur during implementation to ensure Project Design Features are implemented as planned. Post-treatment reviews would occur on a sample basis to determine whether treatments were effective and whether or not passive/active restoration has occurred as expected.
- Post-treatment monitoring would also be used to detect whether PDFs were appropriately applied.
- 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).

[15] See Appendix E for mandatory and optional reporting forms.

- Re-treatment and active restoration prescriptions would be developed based on post-treatment results. Changes in herbicide or non-herbicide methods 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.
- Effectiveness monitoring would occur in sample sites to ensure non-target vegetation, especially botanical species of local interest, is adequately protected. Non-target vegetation in selected areas would be evaluated before and immediately after treatment, and two to three months later. Treatment buffers would be expanded if damage were found 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.
- Additional monitoring may be included as part of the Olympic National Forest Annual Monitoring Plan or other ongoing programs such as state water quality monitoring.

2.5.8 Project Design Features and Buffers

The following Project Design Features (PDFs) are intended to reduce the potential impacts of invasive plant treatment and provide sideboards for early detection/rapid response and adaptive management.[16] The PDFs are based on site-specific resource conditions within the treatment areas, including (but not limited to) the current invasive plant inventory, the presence of special interest species and their habitats, potential for herbicide delivery to water, and the social environment. Implementation of the PDFs ensures that treatments would have effects within the scope of those disclosed in Chapter 3. All buffer distances are slope distances.

For emphasis, some design features include herbicide label guidance and Forest Plan standards, however, not all Forest Plan standards or label directions are repeated here. However, Forest Plan standards and label directions would be followed, regardless of whether they are listed in the following table.

Project Design Features are summarized in table 12. Tables 13 – 15 show the restricted use areas (buffers) that would apply to individual botanical Species of Local Interest and Aquatic Influence Zones under the Proposed Action.

Herbicides differ in their toxicity and other chemical properties, and consequently also in how they are transported and degraded in air, soil and water. Restrictions on herbicide selection or method are displayed in table 12. Buffers act as a safety zone to keep herbicides of moderate or higher concern for aquatic resources from leaching, running off, or drifting into water. Aquatic labeled herbicides are available for use on emergent vegetation or other areas of likely delivery to water. Some non-aquatic labeled herbicides that pose low risks to aquatic organisms would be favored near streams and other water bodies in accordance with label directions.

[16] In this EIS, the terms project design feature and project Design Features are synonymous.

Table 12. Project Design Features

Reference	Design Feature	Purpose	Source
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), places where people gather, and range allotment conditions. Apply appropriate PDFs (including Project Design Criteria/Terms and Conditions from consultation with regulatory agencies) depending on site conditions.	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 ownerships.	The distance of 150 feet was selected because it incorporates 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 1000 feet was selected to respond to public concern. Herbicide use as proposed for this project would not contaminate drinking water supplies.

Reference	Design Feature	Purpose	Source
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 Olympic National Forest 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***[17]		
D1	No mechanical treatments or motorized equipment would be used in Wilderness areas.	To maintain Wilderness character and meet environmental standards.	Wilderness Act, 1990 Olympic National Forest Plan
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 Olympic National Forest Plan

[17] Invasive plant eradication within Wilderness areas meets the intent of the Wilderness Act and associated land use policies.

Reference	Design Feature	Purpose	Source
E	***Design Features that Apply to All Treatment Methods***		
E1	For portions of the projects implemented below the ordinary high water mark, follow the Washington Department of Fish and Wildlife (WDFW) Guidelines for Timing of In Water Work Periods.	To reduce the likelihood of causing negative impacts to fish and fish habitat.	Memorandum of Understanding between WDFW and USDA Forest Service, January 2005.
E2	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 incorporates the Aquatic Influence Zone for fish bearing streams.
E3	Fueling of gas-powered equipment would not occur within 150 feet of surface waters. Fueling of gas-powered machinery would not occur within 25 feet of any surface waters. Fueling of tanks larger than 5 gallons would not occur within150 feet from any live waters.	To protect riparian and aquatic habitats.	The distance of 150 feet was selected because it incorporates the Aquatic Influence Zone for fish bearing streams.
F	***Herbicide Applications***		
F1	Herbicides would be used in accordance with label instructions, except where more restrictive measures are required as described below. Herbicide applications will 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. Herbicide application methods include wicking, wiping, injection, spot, and	To limit potential adverse effects on people and the environment.	Standard 16, 2005 R6 ROD; Pesticide Use Handbook 2109.14

Reference	Design Feature	Purpose	Source
	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.		
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.	To limit potential adverse effects on people and the environment.	2005 R6 ROD Treatment Standards (see Chapter 1).
F3	POEA and NPE 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 incorporates the Aquatic Influence Zone for fish bearing streams.
F4	Lowest effective label rates would be used. No broadcast applications of herbicide or surfactant will exceed typical label rates. NPE surfactant would not be broadcast at a rate greater than 0.5 lbs. a.i./ac. Favor other classes of surfactants wherever they are expected to be effective. In no case will imazapyr use exceed 0.70 lbs. a.i./ac. (pounds of active ingredient per acre).	To eliminate possible herbicide or surfactant exposures of concern to human health, wildlife, and/or fish.	SERA Risk Assessment for imazapyr demonstrates that no exposures of concern are plausible

Reference	Design Feature	Purpose	Source
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.
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 to non-target vegetation 100 feet or further from broadcast sites.
F7	No herbicide application would occur if precipitation is occurring or is forecasted within 24 hours.	To effectively treat target vegetation and reduce potential for herbicide run off.	This is a typical label measure that allows time for herbicide to adhere to the plant and for the plant to begin uptake of herbicide, which reduces the amount available for runoff.

Reference	Design Feature	Purpose	Source
	G ***Herbicide Transportation and Handling Safety/Spill Prevention and Containment*** 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.	FSH 2109.14, Bonneville Power Administration Biological Assessment, Buckhead Knotweed Project, Willamette NF Biological Assessment

Reference	Design Feature	Purpose	Source
H	***Soils, Water and Aquatic Ecosystems***		
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 will enter surface waters in concentrations of concern.	Buffers are based on label advisories, and SERA risk assessments. Buffers intended to demonstrate compliance with R6 2005 ROD Standards 19 and 20. Many of the buffer distances are based on the Berg's 2004 study of broadcast drift and run off to streams.
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, in wetlands, near aquatic Species of Local Interest or their critical habitat: (1) Manual 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	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.

Reference	Design Feature	Purpose	Source
H3	No use of picloram or Garlon 4, and no broadcast of any herbicide on roadside treatment areas that have a high risk of herbicide delivery (see Appendix D for map and list of these roads).	To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern.	SERA Risk Assessments, R6 3005 FEIS Fisheries Biological Assessment Extra caution is warranted on the Olympic National Forest because of the many aquatic Species of Local Interest in Forest streams.
H4	Aquatic labeled herbicides or herbicides associated with lower risk to aquatic organisms would be applied using spot or hand/select methods within 15 feet of wet roadside ditches.	To ensure herbicide is not delivered to streams in concentrations that exceed levels of concern.	SERA Risk Assessments R6 2005 FEIS and Fisheries Biological Assessment BPA Columbia River Biological Opinion Extra caution is warranted on the Olympic National Forest because of the many aquatic species of local interest in Forest streams.
H5	Vehicles (including all terrain vehicles) used to access invasive plant sites, apply foam, or for broadcast spraying would remain on roadways, trails, parking areas or other 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.	BPA Columbia River Biological Opinion
H6	Avoid use of clopyralid on high-porosity soils (coarser than a loamy sand).	To avoid leaching/ground water contamination.	Label advisory.
H7	Avoid use of chlorsulfuron on soils with high clay content (finer than loam).	To avoid excessive herbicide runoff.	Label advisory.

Reference	Design Feature	Purpose	Source
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.
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.
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.	Based on quantitative estimate of risk from worst-case scenario and uncertainty regarding effects to reptiles and amphibians.
H11	**Wetlands** - Wetlands 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/select treatment methods where effective and practical. No more than 10 contiguous acres or fifty percent individual wetland areas would be treated in any 30-day period.	To reduce exposure to herbicides by providing some untreated areas for some organisms to use.	Based on quantitative estimate of risk from worst-case scenario, uncertainty in effects to some organisms, and label advisories.

Reference	Design Feature	Purpose	Source
H12	Foaming would only be used on invasive plants that are further than 150 feet from streams and other water bodies.	To limit the amount of foam that may be delivered to streams and other water bodies.	No label regulations are associated with this naturally occurring organic compound. The distance of 150 feet was selected because it incorporates the Aquatic Influence Zone for fish bearing streams.
I	***Vascular and Non-Vascular Plant and Fungi Species of Local Interest***		
I1	The buffer distances recommended in I2-I4 may be refined as needed in order to adequately protect perennial fungi, vascular and non-vascular plant Species of Local Interest (SOLI) and other non-target plants	To prevent any repeated effects to SOLI populations, thereby mitigating any long-term effects.	Broadcast buffer sizes are based on Marrs, R.H., 1989, based on tests on vascular plants. Spot and hand/select buffer distances are based on reports from experienced applicators. Uncertainty about effects on non-vascular plants would be addressed through monitoring (see Implementation Planning Section).
I2	Perennial fungi, vascular and non-vascular plant SOLIs within 100 feet of planned broadcast would be covered by protective barrier, or broadcast application would be avoided in these areas (spot or hand herbicide treatment, or non-herbicide methods may be used).	To ensure SOLI are protected and surveys are conducted when appropriate.	Forest Service Manual 2670 Survey and Manage Species Direction.

Reference	Design Feature	Purpose	Source
I3	Perennial fungi, vascular and non-vascular plant SOLIs within 10 feet of planned spot applications would be covered by protective barrier, or spot application would be avoided in these areas (hand herbicide treatment, or non-herbicide methods may be used). Under saturated or wet soil conditions present at the time of treatment, only hand application of herbicide is permitted within 10 ft. of SOLI's.	To ensure SOLI are protected and surveys are conducted when appropriate.	Forest Service Manual 2670 Survey and Manage Species Direction .
I4	Botanical surveys may be necessary to identify vascular and non-vascular plant and perennial fungi SOLIs if suitable habitat is within 100 feet of planned broadcast treatments, 10 feet of planned spot treatments, and/or 5 feet of planned hand herbicide treatments.	To ensure SOLI are protected and surveys are conducted when appropriate.	Forest Service Manual 2670 Survey and Manage Species Direction
J	***Wildlife Species of Local Interest***		
J1	**Bald Eagle**		
J1-a	Treatment of areas within 0.25 mile, or 0.50 mile line-of-sight, of bald eagle nests would be timed to occur outside the nesting season of January 1 to August 31, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). Occupancy of nest sites (i.e. whether it is active or not) will be determined each year prior to treatments.	To minimize disturbance to nesting bald eagles and protect eggs and nestlings	Bald Eagle Management Guidelines for OR-WA (Anonymous); U.S. Fish and Wildlife Service 2003, p. 9

Reference	Design Feature	Purpose	Source
J1-b	Noise-producing activity above ambient levels would not occur between October 31 and March 31 during early morning or late afternoon near known winter roosts and concentrated foraging areas. Disturbance to daytime winter foraging areas would be avoided.	To minimize disturbance and reduce energy demands during stressful winter season	Bald Eagle Management Guidelines for OR-WA (Anonymous); Olympic National Forest Programmatic BO (U.S. Fish and Wildlife Service 2003, p. 9)
J2	**Spotted Owl** - Chainsaw use within 65 yards, and mower or heavy equipment use within 35 yards, of any nest site, activity center, or un-surveyed suitable habitat will be timed to occur outside the nesting season of March 1 to July 15, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). There is no seasonal restriction on the use of roadside broadcast sprayers.	To minimize disturbance to nesting spotted owls and protect eggs and nestlings	Olympic National Forest Programmatic BO (U.S. Fish and Wildlife Service 2003)
J3	**Marbled Murrelet**		
J3-a	Chainsaw or motorized tool use within 45 yards, and mower or heavy equipment use within 35 yards of any known occupied site or un-surveyed suitable habitat will be timed to occur outside April 1 to August 5, unless treatment activity is within ambient levels of noise and human presence (as determined by a local specialist). There is no seasonal restriction on the use of roadside broadcast sprayers.	To minimize disturbance to nesting marbled murrelets and protect eggs and nestlings	Olympic National Forest Programmatic BO (U.S. Fish and Wildlife Service 2003)

Reference	Design Feature	Purpose	Source
J3-b	Outside the dates and distances mentioned above, treatment activity that is likely to generate noise above 92 dB must be scheduled between 2 hours after sunrise and 2 hours before sunset. After August 5, activities generating noise above 92 dB may occur within the disturbance distances listed above, but must still be conducted during the post-sunrise to pre-sunset time window.	To minimize disturbance to marbled murrelets returning to nest tree during the late breeding season.	Olympic National Forest Programmatic BO (U.S. Fish and Wildlife Service 2003)
J4	**Peregrine Falcon**		
J4-a	Seasonal, spatial and temporal restrictions would apply to all known peregrine falcon nest sites for the periods listed below based on the following elevations: • Low elevation sites (1000-2000 ft 01 Jan - 01 July • Medium elevation sites (2001 - 4000 ft) 15 Jan - 31 July • Upper elevation sites (4001+ ft) 01 Feb - 15 Aug	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel unpublished data

Reference	Design Feature	Purpose	Source
J4-b	Seasonal restrictions would be waived if the site is unoccupied or if nesting efforts fail and monitoring indicates no further nesting behavior. Seasonal restrictions would be extended if monitoring indicates late season nesting, asynchronous hatching leading to late fledging, or recycle behavior which indicates that late nesting and fledging will occur. The nest zones associated with those nest sites are described below: (1) Primary: average of 0.5-mile radius from the nest site. Site-specific primary nest zones would be determined and mapped by a local Biologist for each known nest site. (2) Secondary: average of 1.5-mile radius from the nest site. Site-specific secondary nest zones would be determined and mapped for each known nest site. (3) Tertiary: a three-mile radius from the nest site including all zones. The tertiary nest zones are not mapped; they apply to a circular area based on the three-mile radius.	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel unpublished data
J4-c	Protection of nest sites would be provided until at least two weeks after all young have fledged.	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel unpublished data

Reference	Design Feature	Purpose	Source
J4-d	Invasive plant activities within the secondary nest zone requiring the use of machinery would be seasonally restricted. This may include activities such as mulching, chainsaws, vehicles (with or without boom spray equipment) or other mechanically based invasive plant treatment.	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel unpublished data
J4-e	Non-mechanized or low disturbance invasive plant activities (such as spot spray, hand pull, etc.) within the secondary nest zone would be coordinated with the wildlife biologist on a case-by-case basis to determine potential disturbance to nesting falcons and identify mitigating measures, if necessary. Non-mechanized invasive plant activities such as back pack spray, burning, hand-pulling, lopping, and/or re-vegetation planting may be allowed within the secondary nest zone during the seasonal restriction period.	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel unpublished data

Reference	Design Feature	Purpose	Source
J4-f	All foot and vehicle entries into Primary nest zones would be seasonally prohibited except for the following reasons: (1) Biologists performing monitoring in association with the eyrie and coordinated with the District Biologist. (2) Law enforcement specialists performing associated duties with notice to the District Ranger. (3) Access for fire, search/rescue, and medical emergencies under appropriate authority (Forest Service line officer or designee). (4) Trail access, when determined by a biologist to be non-disturbing. (5) Other exceptions on a case-by-case basis as determined by the Deciding Official.	To reduce disturbance to nesting falcons and protect eggs and nestlings. Agitated parents can damage the eggs with thin shells resulting in failed reproduction for that nest.	Pagel unpublished data
J4-g	Picloram and clopyralid would not be used within 1.5 miles of peregrine nest more than once per year.	To reduce exposure to hexachlorobenze, which has been found in peregrine falcon eggs.	Pagel unpublished data
J5	**Van Dyke's, Cope's Giant, and Olympic Torrent Salamanders** - Avoid broadcast spraying of herbicide in talus or rocky outcrops, springs, seeps or stream margins. Utilize aquatic design features for suitable habitat in riparian areas, streams, and rivers. (see PDF – H1, H1a, H6-11)	To reduce likelihood of exposure to contaminated soil and water.	Herbicide characteristics and risk to amphibians in SERA risk assessments, and professional opinion of local biologists

Reference	Design Feature	Purpose	Source
J6	**Sensitive Mollusk Habitat Burrington's and Warty jumping slugs**) - In known sites or high potential suitable habitat outside of roadside treatment locations, avoid manual, mechanical, or herbicide treatments when soil moisture is high (generally late fall to late spring).	To reduce risk of trampling and herbicide exposure	Herbicide characteristics in SERA risk assessments, and professional opinion of local taxa expert.
K	***Public Notification***		
K1	High use areas, including administrative sites, developed campgrounds, visitor centers, and trailheads would be posted in advance of herbicide application or closed. Areas of potential conflict would be prominently marked on the ground or otherwise posted. Postings would indicate the date of treatments, the herbicide used, and when the areas are expected to be clear of herbicide residue.	To ensure that no inadvertent public contact with herbicide occurs.	These are common measures to reduce conflicts.
K2	The public would be notified about upcoming herbicide treatments via the local newspaper. Forest Service and other websites may also be used for public notification.	To ensure that no inadvertent public contact with herbicide occurs.	R6 2005 ROD Standard 23.
L	***Special Forest Products***		
L1	Triclopyr would not be applied to foliage in areas of known special forest products or other wild foods collection.	To eliminate any scenario where people might be exposed to harmful doses of triclopyr.	SERA Risk Assessments, Appendix Q of the R6 2005 FEIS

Reference	Design Feature	Purpose	Source
L2	Special forest product gathering areas may be closed for a period of time to ensure that no inadvertent public contact with herbicide occurs.	To eliminate any scenario where people might be exposed to herbicide.	SERA Risk Assessments, Appendix Q of the R6 2005 FEIS
L3	Popular berry and mushroom picking areas would be posted prominently marked on the ground or otherwise posted.	To eliminate any scenario where people might be exposed to herbicide.	SERA Risk Assessments, Appendix Q of the R6 2005 FEIS
L4	Special forest product gatherers would be notified about herbicide treatment areas when applying for their permits. Flyers indicating treatment areas may be included with the permits, in multi-lingual formats if necessary.	To ensure that no inadvertent public contact with herbicide occurs.	R6 2005 ROD Standard 23
M	***American Indian Tribal and Treaty Rights***		
M1	Consultation with American Indian tribes would occur annually as treatments are scheduled so that tribal members may provide input and/or be notified prior to gathering cultural plants. Individual cultural plants identified by tribes would be buffered as above for botanical species of local interest.	To ensure that no inadvertent public contact with herbicide occurs and that cultural plants are fully protected.	Government to government agreements between American Indian tribes and the Olympic National Forest.

Table 13. Herbicide Use Buffers – Perennial and Wet Intermittent Streams - Proposed Action (Alternative B)

Herbicide	Perennial and Wet Intermittent Stream		
	Broadcast	Spot	Hand/ Select
Aquatic Labeled Herbicides			
Aquatic Glyphosate	50	Water's edge	0
Aquatic Triclopyr-TEA	None Allowed	15	0
Aquatic Imazapyr*	50	Water's edge	0
Low Risk to Aquatic Organisms			
Imazapic	100	15	Bankfull
Clopyralid	100	15	Bankfull
Metsulfuron Methyl	100	15	Bankfull
Moderate Risk to Aquatic Organisms			
Imazapyr	100	50	Bankfull
Sulfometuron Methyl	100	50	Bankfull
Chlorsulfuron	100	50	Bankfull
High Risk to Aquatic Organisms			
Triclopyr-BEE	None Allowed	150	150
Picloram	100	50	50
Sethoxydim	100	50	50
Glyphosate	100	50	50

*Aquatic Imazapyr (Habitat) may not be used until the risk assessment (currently underway) is completed for inert ingredients and additives.

Table 14. Herbicide Use Buffers – Dry Intermittent Streams - Proposed Action (Alternative B)

Herbicide	Dry Intermittent Stream		
	Broadcast	Spot	Hand/ Select
Aquatic Labeled Herbicides			
Aquatic Glyphosate	0	0	0
Aquatic Triclopyr-TEA	None Allowed	0	0
Aquatic Imazapyr*	0	0	0
Low Risk to Aquatic Organisms			
Imazapic	15	0	0
Clopyralid	50	0	0
Metsulfuron Methyl	15	0	0
Moderate Risk to Aquatic Organisms			
Imazapyr	50	15	Bankfull
Sulfometuron Methyl	50	15	Bankfull
Chlorsulfuron	50	15	Bankfull
High Risk to Aquatic Organisms			
Triclopyr-BEE	None Allowed	150	150
Picloram	100	50	50
Sethoxydim	100	50	50
Glyphosate	100	50	50

*Aquatic Imazapyr (Habitat) may not be used until the risk assessment (currently underway) is completed for inert ingredients and additives.

Table 15. Herbicide Use Buffers – Wetlands/High Water Table/Lake/Pond - Proposed Action (Alternative B)

Herbicide	Wetlands/High Water Table/Lake/Pond		
	Broadcast	**Spot**	**Hand/ Select**
Aquatic Labeled Herbicides			
Aquatic Glyphosate	50**	0	0
Aquatic Triclopyr-TEA	None Allowed	15	0
Aquatic Imazapyr*	50**	0	0
Low Aquatic Hazard Rating			
Imazapic	100	15	Water's Edge
Clopyralid	100	15	Water's Edge
Metsulfuron Methyl	100	15	Water's Edge
Moderate Aquatic Hazard Rating			
Imazapyr	100	50	Water's Edge
Sulfometuron Methyl	100	50	Water's Edge
Chlorsulfuron	100	50	Water's Edge
Greater Aquatic Hazard Rating			
Triclopyr-BEE	None Allowed	50	50
Picloram	100	50	50
Sethoxydim	100	50	50
Glyphosate	100	50	50

*Aquatic Imazapyr (Habitat) may not be used until the risk assessment (currently underway) is completed for inert ingredients and additives.
** If wetland, pond or lake is dry, there is no buffer.

Figure 1 displays how herbicide selection and application methods are more limited in Aquatic Influence Zones then elsewhere, according to the buffer distances shown in the previous tables.

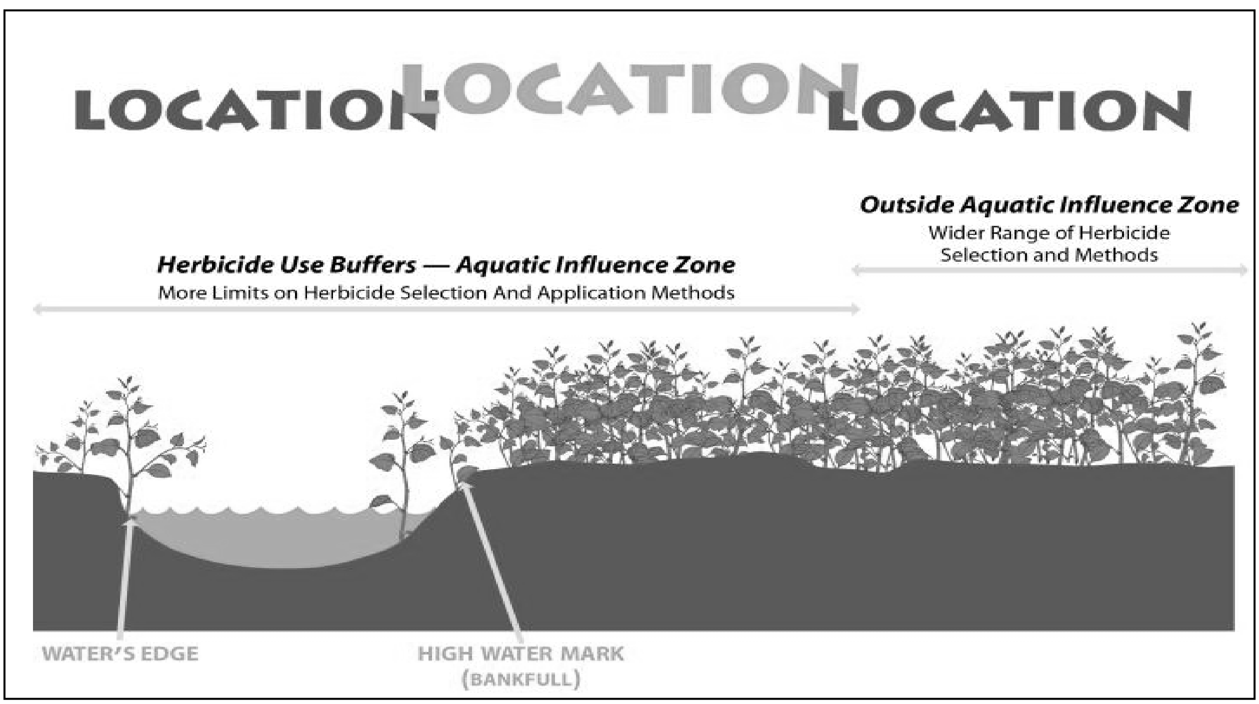

Table 16 displays the protection buffers specific to botanical species of local interest. These buffers are in addition to herbicide use buffers within Aquatic Influence Zones.

Table 16. Protection Buffers for Botanical Species of Local Interest

	Distance from Species of Interest			
	Greater than 100 ft.	**100 ft to 10 ft.**	**5ft to 10 ft.**	**Closer than 5 ft.**
Application Method Allowed	All methods according to PDFs.	1. All treatments, except broadcast spraying, are permitted. 2. Broadcast spraying is permitted when botanical species of concern are shielded with a protective barrier.	1. No broadcast spraying. 2. Spot treatment is permitted when botanical species of concern are shielded with protective barrier, unless soils are wet and/or saturated. application of herbicide and/or non-herbicide treatment would be required in saturated soils. 3. Hand application of herbicide and/or non-herbicide treatment permitted without protective shielding. .	1. No broadcast or spot spraying. 2. Non-herbicide treatments would be favored where effective.

2.5.9 Proposed Action Summary Table

Table 17 displays proposed treatment combinations based on the information gathered for existing infestations

Table 17. Acres by Treatment Combination - Proposed Action (Alternative B)

Total Acres	**Herbicide Only**	**Herbicide combined with Manual and/or Mechanical Treatment**	**Non-Herbicide Only**
3,830	16	3,671	143

2.6 Alternative C - Less Herbicide Use Allowed ________

Alternative Description

Total Acres to Be Treated: 3,410

Total Acres Estimated Herbicide Treatment: 1,035

Estimated Proportion of Herbicide Treatment Acres - Broadcast: 0%

Estimated Proportion of Herbicide Treatment Acres - Spot/Hand: 100%

Alternative C is the Proposed Action, modified to further minimize (or eliminate) risks to soils, water and non-target organisms from the use of herbicides.

2.6.1 Treatment Areas, Priority and Strategy

Alternative C would approve treatment within the same treatment areas as the Proposed Action. However, Alternative C was modeled to treat 3,410 acres, omitting the 420 acres associated with a treatment strategy of "eradicate" in the Proposed Action. Fewer acres would be treated because treatments would tend to be less economically efficient and because eradication of invasive plant species would likely be impractical given the limitation on herbicide use inherent in this alternative.

2.6.2 Common Control Measures and Treatment Site Restoration

Alternative C would draw upon the same common control measures and treatment site restoration approach as the Proposed Action. Target species most effectively treated with herbicides would either not be treated or more time and money would be spent controlling or containing such species.

2.6.3 Implementation Planning and Early Detection-Rapid Response Approach

Alternative C would draw upon the same implementation planning and early detection-rapid response approach as the Proposed Action.

2.6.4 Herbicide Selection

Alternative C would allow for much less herbicide use overall (herbicides would not be used on more than two-thirds of the project area); however the slate of herbicides available would be the same as the Proposed Action.

2.6.5 Project Design Features and Buffers

All of the Project Design Features in the Proposed Action would be adopted. In addition, 1) herbicides would generally not be used within Riparian Reserves or within roadside treatment areas having high risk of herbicide delivery,[18] and 2) broadcast treatments would not be approved anywhere on the National Forest.

[18] Hand/select methods using herbicides of least aquatic concern may be used to treat high priority species such as knotweed especially as a part of ongoing prescriptions developed in partnership with other landowners and agencies. Such treatments would be very limited in extent.

2.6.6 Alternative C Summary Table

Table 18. Total Acres by Treatment Combination – Alternative C

Total Acres	Herbicide Only	Herbicide combined with Manual, Mechanical and/or Cultural Treatment	Non-Herbicide Only
3,410	0	1,035	2,375

2.7 Alternative D – More Broadcast Allowed

Alternative Description

- ***Total Acres to Be Treated: 3,830***
- ***Total Acres Estimated Herbicide Treatment: 3,687***
- ***Estimated Proportion of Herbicide Treatment Acres - Broadcast: 84%***
- ***Estimated Proportion of Herbicide Treatment Acres - Spot/Hand: 16%***

Alternative D is the Proposed Action, modified to increase the cost-effectiveness of using herbicide by allowing more broadcast treatment.

2.7.1 Treatment Areas, Priority and Strategy

Alternative D would approve treatment within the same treatment areas as the Proposed Action. The priorities and strategies would also be the same as the Proposed Action.

2.7.2 Common Control Measures and Treatment Site Restoration

Alternative D would draw upon the same common control measures and treatment site restoration approach as the Proposed Action.

2.7.3 Implementation Planning and Early Detection-Rapid Response Approach

Alternative D would draw upon the same implementation planning and early detection-rapid response approach as the Proposed Action.

2.7.4 Herbicide Selection

Alternative D would allow for the same slate of herbicides as the Proposed Action.

2.7.5 Project Design Features and Buffers

All of the Project Design Features listed for Alternative D would be adopted, exception that Project Design Features specifically related to roadside treatment areas having high potential for herbicide delivery and dry intermittent streams would not be adopted. The buffers associated with perennial and wet intermittent streams, wetlands, lakes, ponds, and wet roadside ditches would be exactly as in the Proposed Action.

However, no buffers would apply to dry intermittent streams (except label restrictions). In addition, broadcast could occur on roadside treatment areas that have a high potential for herbicide delivery. Thus, under Alternative D, broadcast would be approved on a larger proportion of the roadside treatment acreage (84% as compared to 34% for the Proposed Action).

2.7.6 Alternative D Summary Table

Table 19. Total Acres by Treatment Combination – Alternative D

Total Acres	Herbicide Only	Herbicide combined with Manual and/or Mechanical Treatment	Non-Herbicide Only
3,830	16	3,671	143

2.8 Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives may have been outside the scope of this EIS, not meet the Purpose and Need for Action, not reasonably feasible or not viable, duplicative of the alternatives considered in detail, or were determined to cause unnecessary environmental harm. Therefore, the following alternatives were considered, but dismissed from detailed consideration for the reasons summarized in sections 2.8.1-2.8.3.

2.8.1 Do Not Treat Invasive Plants, Focus on Prevention

Some public comments suggested that the Forest should focus on efforts to prevent the spread of invasive plants rather than treat infested sites. Newly adopted goals, objectives and standards in the R6 2005 ROD (and elsewhere) address both the prevention and treatment aspects of integrated weed management. Management direction for preventing the spread of invasive plants applies to all alternatives, including No Action.

The need for this project focuses on treating inventoried and newly detected invasive plant sites. Prevention alone would not meet this need and therefore is outside the scope of this EIS, and was not fully evaluated. No Action is a similar alternative studied in detail.

2.8.2 No Herbicide Use

Additional public comments suggested that herbicide use should be severely minimized or eliminated altogether. The No Action alternative serves this function by allowing fewer than 100 acres of herbicide use (less than 2 percent of the current infested acres), which is very similar to a “no-herbicide” alternative. Alternative C was also developed to address public concerns about herbicide use by severely limiting herbicide use over about two-thirds of the Forest.

Both No Action and Alternative C rely mostly on manual and mechanical treatments. The impacts and effectiveness of such treatments are discussed in Chapter 3. If No Action were selected, future manual and mechanical treatments that have not already been approved would likely be categorically excluded from NEPA documentation.

2.8.3 Follow Herbicide Label Directions – No Additional Design Features

Public comments expressed a concern that Project Design Features proposed by the Forest Service are overly cautious and costly. All action alternatives must comply with new Forest Plan and other relevant invasive plant management direction. An alternative that only follows label directions may meet some, but not all of this management direction. In particular, all action alternatives must prescribe design features to minimize and/or eliminate adverse effects on non-target organisms. Chapter 3 describes how adverse effects may be avoided through application of design features. Alternative D is intended to allow the maximum flexibility in treatment options while still complying with management direction and standards.

2.9 Alternatives Compared

Table 20 displays the components for each alternative including A (No Action) and B (Proposed Action).

Table 20. Alternative Components Compared

Alternative Component	Alternative			
	A	B	C	D
Total Treatment Acres	672	3,830	3,410	3,830
Estimated Percentage of Current Infestation Treated	18%	100%	89%	100%
Acres of Proposed Herbicide Use	86	3,687	1,035	3,687
Estimated Proportion of Herbicide Treatment – Broadcast Application Method	0	34%	0	84%
Estimated Proportion of Herbicide Treatment – Spot/Hand Application Methods	100%	66%	100%	16%
Includes approved existing biological releases	Yes	Yes	Yes	Yes
Includes Early Detection/Rapid Response and Adaptive Management Plan	No	Yes	Yes	Yes
Includes Restoration Plan	No	Yes	Yes	Yes

Table 21 shows how each alternative addresses public issues described in Chapter 1.

Table 21. Alternative Comparison Relative to Issues

Alternative Component	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
1 – Human Health and Worker Safety **1a Exposure to Herbicides**	No significant impact (FONSI).	Project Design Features eliminate plausible harmful exposure scenarios.	Same as B	Same as B
1b – Drinking Water	No significant impact (FONSI).	Project Design Features eliminate plausible harmful exposure scenarios.	Same as B	Same as B
2 - Treatment Strategy and Effectiveness **2a Herbicides Available for Use**	3	10	10	10
2a Proportion of Infested Acres that May be Treated Using Herbicide	2 %	100%	30%	100%
2a Acres of Invasives in 2012 (*assuming unlimited funding***)**	3,503	51	459	51

Alternative Component	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
2b Long Term Strategy, Reduce Reliance on Herbicides Over Time	Long term strategy is not directly addressed in NEPA document	Long-term control strategy applied to individual sites within treatment areas; active and passive restoration would be part of every prescription. Each year of treatment, as target population size is reduced non-herbicide methods would likely become more practical and effective.	Long-term control strategy applied to individual sites within treatment areas; active and passive restoration would be part of every prescription. The strategy of eradicate (applied to about 420 acres or 11% of current infestations) would not be achieved due to limitations on herbicide use over most of the project area.	Same as Alternative B
2c Treatment Priority	Treatment priorities are not directly addressed in NEPA document	Each treatment area has been given a priority, as shown in Chapter 2.5	Each treatment area has been given a priority as shown in Chapter 2.5	Each treatment area has been given a priority as shown in Chapter 2.5
Issue Group 3 – Social and Economic **3a – Total Cost for the Most Ambitious Program over 5 years**	$664,000	$2,183,000	$3,496,000	$2,070,000

Alternative Component	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
Issue Group 3 – Social and Economic **3a – Average Annual Cost for the Most Ambitious Program over 5 years**	$149,000	$490,000	$785,000	$465,000
Issue Group 3 – Social and Economic **3a – Average Cost Per Acre over a 5 year period**	$988	$570	$1025	$540
Issue Group 3 – Social and Economic **3b – Jobs Associated with Treatments (per 6 month year)**	8	18	54	13
3c – Effects on Scenic, Recreation and Wilderness Values	No significant impact (FONSI).	Containing, controlling and/or eradicating invasive plants would improve scenic, recreation and Wilderness values over the long run. Project Design Features limit potential short term adverse impacts.	Containing, controlling and/or eradicating invasive plants would improve scenic, recreation and Wilderness values over the long run. Project Design Features limit potential short term adverse impacts	Containing, controlling and/or eradicating invasive plants would improve scenic, recreation and Wilderness values over the long run. Project Design Features limit potential short term adverse impacts

Alternative Component	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
3d – Special Forest Products and Gatherers	No significant impact (FONSI).	Conflicts between treatments and gathering areas would be minimized. Inadvertent exposures would be minimized through newspaper or individual notification, fliers, and posting signs. No exposure exceeding thresholds of concern for people are plausible.	Conflicts between treatments and gathering areas would be minimized. Inadvertent exposures would be minimized through newspaper or individual notification, fliers, and posting signs. No exposure exceeding thresholds of concern for people are plausible.	Conflicts between treatments and gathering areas would be minimized. Inadvertent exposures would be minimized through newspaper or individual notification, fliers, and posting signs. No exposure exceeding thresholds of concern for people are plausible.
3e – Effects on Tribes, Civil Rights, Environmental Justice	No significant impact (FONSI).	No disproportionate effects on any group of people, ongoing government-to-government consultation with tribes.	No disproportionate effects on any group of people, ongoing government-to-government consultation with tribes.	No disproportionate effects on any group of people, ongoing government-to-government consultation with tribes.
Issue Group 4 – Non-Target Plants And Wildlife **4a – Estimated Proportion of Project with Potential Broadcast Application**	0%	34%	0%	84%

Alternative Component	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
Issue Group 4 – Non-Target Plants And Wildlife **4b – Terrestrial Wildlife**	No significant impact (FONSI).	No adverse effects on wildlife species of local concern, including mollusks and salamanders.	Same as B	Same as B
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms **5a – Effects on Soils**	No significant impact (FONSI).	Project Design Features avoid herbicide concentrations of concern in soils; limitations on herbicide selection depending on site-specific soil conditions.	Project Design Features avoid herbicide concentrations of concern in soils; limitations on herbicide selection depending on site-specific soil conditions.	Project Design Features avoid herbicide concentrations of concern in soils; limitations on herbicide selection depending on site-specific soil conditions.
Issue Group 5 – Effects on Soils, Water and Aquatic Organisms **5b – Character of Herbicide Use Within Aquatic Influence Zones**	Restricted to hand applications of aquatic glyphosate.	Buffers restrict broadcasting near perennial and intermittent streams; treatment of wetland emergent or streamside target vegetation would require low aquatic risk or aquatic labeled herbicides.	Restricted to hand applications of aquatic glyphosate.	Same as B for perennial and wet intermittent streams and wetland emergent or streamside target vegetation. No restrictions beyond label guidance and Forest Plan Standards would apply to dry intermittent streams.
5b – Estimated Acres Herbicide Use Within Aquatic Influence Zones	Fewer than 100 acres	Approximately 620 acres	Same as No Action	Same as Proposed Action

Alternative Component	No Action (Alternative A)	Proposed Action (Alternative B)	Alternative C	Alternative D
5b – Estimated Proportion of Project with Potential Broadcast Application	0%	34%	0%	84%
5b – Estimated acreage where herbicide treatment may occur on roadside treatment areas with high potential to deliver herbicides	0	1,420	0	1,420
5b – Estimated proportion of project where broadcast of herbicide may occur on roadside treatment areas with high potential to deliver herbicides	0	0	0	37%
5c - Potential for herbicides to enter streams in concentrations above the threshold of concern for aquatic organisms and ecosystems.	Very Low	Very Low	Very Low	Low to moderate

Chapter 3. Affected Environment And Environmental Consequences

3.1 Introduction

3.1.1 The Project Area

The project area encompasses the entire 634,000-acre Olympic National Forest (Forest) in the northwest corner of Washington. The vegetation of the Olympic Peninsula is strongly influenced by a maritime climate, as it is surrounded by saltwater on three sides: the Pacific Ocean on the west, the Strait of Juan de Fuca on the north, and the Hood Canal on the east. It has a distinct eastside and westside ecology, due to the Olympic Mountain range in the center. The southern part of the westside is known for its heavy rainfall and thus temperate rainforest, including Sitka spruce, western red cedar, western hemlock, and Douglas-fir

The northern section of the eastside is the driest part of the forest, with a small area of climax Douglas-fir, given the rain shadow effect from the mountains. Glacial and climactic history influenced the evolution of the Olympic flora. As the alpine and continental glaciers advanced, the Peninsula was isolated from other areas. Glacial refugia existed in localized areas where plant species and plant communities survived, resulting in pockets of distinct plant communities.

The Olympic National Forest is comprised of 63 6th-field watersheds (a list of watersheds is displayed in the soil and water section later in this chapter) that cover over 1.8 million acres. Approximately one-third of the acreage within these watersheds lies on National Forest system lands. The Forest surrounds the Olympic National Park, and many of these watersheds originate there.

The Forest has a comparatively large number of streams and high rainfall. Approximately one-third of the project area lies within streamside Riparian Reserves (a land allocation from the Northwest Forest Plan – USDA/USDI 1994a).

3.1.2 Treatment Areas

Invasive plant sites have been inventoried and grouped into 102 treatment areas (see Appendix A). Of these, 16 treatment areas are in special land allocations: 2 treatment areas are within the Buckhorn Wilderness and 14 treatment areas are in designated botanical and/or Research Natural Areas (reference Forest Plan). Each treatment area contains a variety of site conditions that are more or less susceptible to the effects of invasive plants and/or their treatment.

There are approximately 2,180 miles of roads existing on the Forest. About 84 percent (3,270 acres) of the infestations are found within roadside treatment areas. Roadside type treatment areas include disturbed skid trails and landings within adjacent managed timber stands. Approximately 43 percent of the roadside treatment acres (1,420 acres) are estimated to occur along roads identified as high potential for herbicide delivery (Appendix D shows roadside treatment areas in relation to fish bearing streams).

3.1.3 Invasive Plants and Their Impact on Special Places

Approximately 30 invasive plants are inventoried on the Olympic National Forest. Infestations range in size from less than 1 to more than 200 acres within any single treatment area. As Table 22 shows, invasive plants are predominantly located in disturbed areas: along road systems, in timber sale units (e.g., Matwat Timber Sale), at the Lake Quinault summer residences, in administrative sites (e.g., Dennie Ahl seed orchard, Snider Work Center, Quinault Ranger Station), in managed timber stands, and in areas utilized for recreation such as campgrounds, dispersed recreation, etc. (Quinault Loop Trail, OHV Slab camp quarry, Seal Rock Campground, etc,). While most of the infestations are in disturbed areas (many invasive species do not grow well under a forest canopy), invasive species such as herb Robert, ivy and English holly may thrive in forested settings.

Table 22. Estimated Target Species Acres by Treatment Area Description

Treatment Area Description	Estimated Target Species Acres
Roadside	3,270
Administrative Sites, Campgrounds, Summer Homes	130
Meadows, Wetlands and Floodplains	80
Trails	135
Conifer Forest	215
Total Acres	3,830

Roads are conduits for the spread of invasive plants, providing for their transport and dispersal (e.g., seeds and vegetative reproductive parts attached to vehicles) and providing disturbed ground for easy colonization and establishment. Olympic National Forest system roads also serve to introduce invasive species onto the Olympic National Park, where native plant communities and ecological integrity are highly valued.

Roads serve to introduce and establish invasives in areas where they were previously unknown. For example, gorse has been found (and is being treated) on Quinault Indian Nation Lands on Highway 101. These control measures are especially important because gorse has not yet spread to Olympic National Forest system lands.

Timber harvest, road building, and other ground-disturbing activities occur on National Forest system lands and contribute to the spread of invasive plants, as the habitat conditions that facilitate colonization are created. Another common vector of invasive plant spread on the Olympic National Forest comes from the recreation; foot and pack stock traffic have spread invasives along trail systems.

In addition, invasive plants are spread through the movement of water in creeks and across wetlands. Floods move invasive plant seed and materials into adjacent riparian areas.

Intentional and accidental introductions have occurred for centuries, but major introductions have occurred most rapidly over the past century. Introductions of invasive plants for forage (i.e. contaminated livestock feed), ornamental landscaping, road and dune stabilization, and erosion control have occurred throughout National Forest and adjacent lands in the Pacific Northwest. Most invasive plants have been introduced for horticultural use by nurseries, botanical gardens, and individuals (ibid.).

Commercial landscape nurseries in Washington sell, or once sold, exotic species for domestic landscaping that later were found to be invasive (e.g. butterfly bush, pampas grass, purple loosestrife, English ivy). These have been shown to spread to federal lands (ibid.).

On the Olympic National Forest, invasive plants have displaced native vegetation and disrupted the functioning of plant communities in many important areas, including (but not limited to):

- Meadow systems: Mint Meadow, Schmidt Knob, Savannah Restoration Site, Matheny Prairie;
- Buckhorn, Colonel Bob, Mt. Skokomish and the Brothers Wilderness Areas;
- Research Natural Areas: Wet Weather Creek, and Quinault Research Natural Area;
- Botanical Areas: Three Peaks, Matheny Ponds, Bill's Bog, North Fork Matheny Ponds, Matheny Ridge Alaska Yellow Cedar, Cranberry (sphagnum) Bog, Buckhorn, Three O'Clock Ridge, South Fork Calawah, Matheny Prairie, and Tyler Peak Botanical Area.

Without treatment, invasive plants will further displace native plant communities, and spread to new areas. In recent years, acres of invasives have increased at an average rate of 8 to12 percent each year; prevention practices were estimated to reduce that number by half (R6 2005 FEIS Chapter 4.2, page 4-24). Early detection of populations of invasive species is critical before they spread and become larger. As populations increase in number and size, they become more difficult and costly to control.

Appendix A (treatment area information) displays the invasive plant species that have been detected on the Olympic National Forest. The treatment acreage estimates in Appendix A have accounted for expected spread of invasive plants between the time of inventory and the first year of anticipated treatment under this EIS (2007).

3.1.4 Life of the Project and "Most Ambitious Treatment" Analysis Scenarios

This project would be implemented over several years as funding allows, until no more treatments were needed or until conditions otherwise changed sufficiently to warrant this EIS outdated. Site-specific conditions are expected to change within the life of the project, without necessitating further analysis: treated infestations will be reduced in size, untreated infestations will continue to spread, specific non-target plant or animal species of local interest could change, and/or new invasive plants could become established within the project area. The effects analysis considers a range of treatments applied to a range of site conditions to accommodate the uncertainty associated with the project implementation schedule.

Many variables affect invasive plant treatment prescriptions, including: land management objectives and standards related to a particular site; treatment area priority and treatment strategy (see Chapter 2 for more discussion about treatment areas, priorities and strategy); and landscape scale goals. The relative proportion and timing of integrated treatments including herbicides and other methods; the effectiveness of invasive plant management on neighboring lands; and available funding also affect the treatment that would be implemented.

Tables 23, 24 and 25 display the most ambitious annual treatment scenarios by alternative that form the basis for the analysis of economic efficiency, cost-effectiveness and environmental consequences and alternative comparisons. **They are not intended to be binding treatment prescriptions.**

Actual annual treatments will adapt to information gathered through inventory and monitoring and make the most of available funding. Newly discovered infestations could be prioritized over existing sites.

The most ambitious treatment scenario assumes a life of approximately 5 years. It would require a five to tenfold increase in funding compared to previous years (see the financial analysis later in Chapter 3.7). This funding level is not likely to be available; however, the most ambitious treatment scenario provides a consistent assumption for analysis purposes. The assumption of full funding allows the greatest and most intense impacts possible to be evaluated; however, both the positive and negative impacts of the project are likely to be less than predicted for the most ambitious conceivable treatment. However, analysis of the most ambitious conceivable treatment scenario clearly highlights the differences between the costs, effectiveness, and adverse effects from different treatment approaches.

The scenarios show how reliance on herbicides would be decreased over time. Non-herbicide methods are expected to become more effective over time, as populations have been substantially reduced. While not depicted in the charts, manual and mechanical treatments may occur instead, before or during herbicide treatment according to the Common Control Measures (see Chapter 2.5 and Appendix B) adapted to site conditions and experience.

These scenarios also assume that restoration is implemented as planned in the action alternatives. About 65 percent of the treated acres are assumed to require active restoration activity (mulching, seeding, planting) to reach desired conditions. Some restoration activities may actually be implemented before or during herbicide or non-herbicide treatments.

These scenarios are intended to portray the pattern of treatment. It illustrates concepts about restoration as part of the overall prescription, and demonstrates how reliance on herbicide methods would be decreased through the life of the project. The scenarios also emphasize that follow up is an absolute necessity to meet containment, control and/or eradication strategies.

These scenarios are not sensitive to the role of treatment priority and/or strategy (see Chapter 2.5 for more information on these variables, treatment strategy is factored into the Economic Analysis displayed in Chapter 3.7). The scenarios show all acreage treated in Year 1. In reality, the highest priority areas would most likely be treated first; lower priority infestations would continue to spread, increasing acreage where treatment may be needed.

No Action (Alternative A) Most Ambitious Treatment Scenario

As described in Chapter 2, No Action includes treatments that would occur under existing NEPA decisions. An EA completed in 1998 allowed for 672 acres of manual and mechanical treatment, of which 86 acres also included use of herbicides.

Between the years 2000-2001, approximately 2 acres of treatment with herbicide occurred per year, along with about 34 acres of manual/mechanical treatment.[19] The majority of the treatments involved repeated hand pulling of small roadside infestations of high priority species, such as spotted and meadow knapweed. Treatments were generally effective. However, some of the

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[19] Low acreages overall resulted from small budgets in these years (about $20,000 per year) and concerns about the adequacy of NEPA documents supporting herbicide use. Budgets have increased and are expected to continue to grow once this EIS is completed and action is approved. No Action is assumed to have a low effectiveness ranking due to its limited use of herbicide (see Botany and Treatment Effectiveness section below).

manual treatments used for species like scotch broom and tansy ragwort needed repeat treatments annually, and were not very cost effective.

In the year 2002, the budget increased four-fold, to approximately $80,000, due to Forest Service Title II funding to counties for cooperative efforts on invasive plant management of the National Forest and adjacent lands. From the years 2002 through 2005, the four counties on the Olympic Peninsula participated in invasive plant treatments on National Forest system land averaging about 130 acres/year of manual treatment. In 2005, the Forest accomplished herbicide treatments for two Japanese knotweed infestations (2 acres) according to the 1999 EA.

For the purposes of analysis, No Action assumes that all 672 acres are treated in year 1 (86 acres with spot/hand herbicide applications followed by manual and mechanical treatment plus 586 acres of manual and mechanical treatment). Each year, 25 percent fewer acres are assumed to need re-treatment based on the relative estimated effectiveness of each year's work. No specific restoration plan was included, thus no applicable estimate could be made for acres restored. The assumptions built into No Action for the most ambitious treatment scenario would require a two-fold increase in funding (compared to current estimates), thus actual effectiveness may be less than predicted.

Table 23. Most Ambitious Annual Treatment Scenario – Alternative A

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Acres Treated	672	504	378	284	213
Acres Treated with Herbicide	86	65	49	37	28
Acres Treatment With Non-Herbicide	586	439	329	247	185
Acres Active Restoration (mulch, seed, plant)	NA	NA	NA	NA	NA

Alternative B Most Ambitious Treatment Scenario

Under Alternatives B all 3,830 estimated infested acres would be treated in Year 1, which would be assumed to reduce infestation size by 80 percent (see Botany and Effectiveness section later in this Chapter). Each year, 80 percent fewer acres would need to be re-treated, until Year 5, when desired conditions for all known infestations would be assumed to be achieved. For the purposes of analysis, under Alternative B, the project would be concluded within 5 years assuming the most ambitious treatment scenario. In reality, some infestations may still need to be treated after five years if there is a persistent seed bank

As invasive plant populations get significantly smaller, non-herbicide methods would become more cost-effective. Thus, the proportion of non-herbicide compared to herbicide methods would increase over time, as demonstrated by the idealized treatment scenarios shown in the tables 24 and 25.

This most ambitious treatment scenario would require a five-fold increase in funding over a five-year period.

Alternative B has an effectiveness ranking of 80 percent because it allows a relatively wide range of treatment options available at a given site.

Table 24. Most Ambitious Annual Treatment Scenario – Alternative B

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Acres Treated	3,830	765	148	29	0
Acres Treated with Herbicide	3,687	544	62	0	0
Acres Treated With Non-Herbicide	143	221	86	29	0
Percentage of treatments that are non-herbicide	4%	29%	58%	100%	NA
Acres Restored Passive or Active (mulch, seed, plant)	0	958	958	958	958

Alternative C Most Ambitious Treatment Scenario

Under Alternative C, sites having a treatment strategy of "eradicate" would not be treated.[20] This would leave about 3,410 acres to be treated in year 1. The analysis assumes that treatments using herbicides would reduce infestation size by 80 percent annually, similar to Alternatives B and D. Treatments in areas having an herbicide use restriction would reduce infestation size by 25 percent annually, similar to Alternative A.

Table 25. Most Ambitious Annual Treatment Scenario - Alternative C

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Acres Treated	3,410	1979	1133	657	381
Acres Treated with Herbicide	1,035	600	333	193	112
Acres Treated With Non-Herbicide	2,375	1379	800	464	269
Percentage of treatments that are non-herbicide	70%	70%	70%	70%	70%
Acres Restored Passive or Active (mulch, seed, plant)	0	853	853	853	853

[20] This assumption was included to emphasize how eradication of aggressive target species may require herbicides to accomplish, and the restrictions on herbicide use inherent to Alternative C would not allow the Forest Service to fully accomplish this strategy.

Alternative D Most Ambitious Treatment Scenario

The most ambitious treatment scenario associated with Alternative D is exactly the same as the scenario for Alternative B. The differences between these alternatives do not affect the most ambitious scenario or balance between herbicide and non-herbicide treatments through the 5 years that were modeled.

Most Ambitious Treatment Scenario Alternative Comparison

Table 26 displays the acreage that would be treated using herbicide, manual and mechanical methods each year under the most ambitious conceivable program. These scenarios would result in the greatest predicted level of treatment effectiveness and the maximum potential for adverse effects of treatment.

Table 26. Most Ambitious Annual Treatment Scenario - Alternative Comparison

	Treatment Acres (Most Ambitious Conceivable Treatment Scenario)		
Year	**A**	**B and D**	**C**
2007	672	3,830	3,410
2008	504	765	765
2009	378	148	148
2010	284	29	29
2011	213	0	0

Relationship of Analysis Scenarios to Early Detection-Rapid Response

All action alternatives include the ability for Forest Service land managers to approve treatments on currently unknown invasive plant sites assuming Project Design Features would be followed. The premise of early detection-rapid response analysis approach is that treatments of new infestations according to methods and design features defined in this project-level EIS will have similar effects to treatments of existing sites.

Assuming the most ambitious conceivable treatment scenario under each alternative, early detection/rapid response would be expected to be a very small part of the program, because so much of the current inventory would be treated in year 1.

If the most ambitious treatment scenarios were not implemented, over time, early detection-rapid response would tend to become a larger part of the program. The acreage treated in any one year would not likely exceed the most ambitious treatment scenario analyzed because the most ambitious scenario is already five to ten times the current budget, which makes a more ambitious program extremely unlikely.

Even if the acreage treated in one year were to exceed the most ambitious treatment scenario, the effects analysis would still be valid, because the Project Design Features (PDFs) and Implementation Planning process described in Chapter 2 ensure that the plausible adverse effects of treating currently unknown infestations would be within the scope of those disclosed here. Section 3.1.5 provides further reasoning about how PDFs minimize or eliminate herbicide exposure scenarios of concern to people and the environment.

3.1.5 Herbicide Risk Assessments and Layers of Caution

The effects from the use of any herbicide depends on the toxic properties (hazards) of that herbicide, the level of exposure to that herbicide at any given time, and the duration of that exposure. The R6 2005 FEIS used the herbicide risk assessments displayed in table 27 to evaluate the potential for harm to non-target plants, wildlife, human health, soils and aquatic organisms from the herbicides considered for use on the Olympic National Forest.

Risk assessments were done by Syracuse Environmental Research Associates, Inc (SERA) using peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information. Information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate was used to estimate the risk of adverse effects to non-target organisms.

The risk assessments considered worst-case scenarios including accidental exposures and application at maximum label rates. The R6 2005 FEIS added a margin of safety to the SERA Risk Assessments by making the thresholds of concern substantially lower than normally used for such assessments. Although the risk assessments have limitations (see R6 2005 FEIS pages 3-95 through 3-97), they represent the best science available.

Table 27 displays the risk assessments that may be accessed via the Pacific Northwest Region website at http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm.

Table 27. Risk Assessments for Herbicides and Surfactants Considered in this EIS

Herbicide	Date Final	Risk Assessment Reference
Chlorsulfuron	November 21, 2004	SERA TR 04-43-18-01c
Clopyralid	December 5, 2004	SERA TR 04 43-17-03c
Glyphosate	March 1, 2003	SERA TR 02-43-09-04a
Imazapic	December 23, 2004	SERA TR 04-43-17-04b
Imazapyr	December 18, 2004	SERA TR 04-43-17-05b
Metsulfuron methyl	December 9, 2004	SERA TR 03-43-17-01b
Picloram	June 30, 2003	SERA TR 03-43-16-01b
Sethoxydim	October 31, 2001	SERA TR 01-43-01-01c
Sulfometuron methyl	December 14, 2004	SERA TR 03-43-17-02c
Triclopyr	March 15, 2003	SERA TR 02-43-13-03b
NPE and Other Surfactants	May 2003	USDA Forest Service, R-5 (Bakke 2003)

In addition to the analysis of potential hazards to human health from every herbicide active ingredient, Bakke and SERA Risk Assessments evaluated available scientific studies of potential hazards of other substances associated with herbicide applications: impurities, metabolites, inert ingredients, and adjuvants. There is usually less toxicity data available for these substances (compared to the herbicide active ingredient) because they are not subject to the extensive testing that is required for the herbicide active ingredients under FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act).

Information on adjuvants and surfactants is tiered to the R6 2005 FEIS, which incorporated the Analysis of Issues Surrounding the Use of Spray Adjuvants With Herbicides (Bakke, 2003a) and the Human and Ecological Risk Assessment of Nonylphenol Polyethoxylate-based (NPE) Surfactants in Forest Service Herbicide Applications (Bakke, 2003b).

Herbicide Toxicology Terminology

The following terminology is used throughout this chapter to describe relative toxicity of herbicides proposed for use in the alternatives.

Exposure Scenario: The mechanism by which an organism (person, animal, fish) may be exposed to herbicides active ingredients or additives. The application rate and method influences the amount of herbicide to which an organism may be exposed.

Threshold of Concern: A level of exposure below which there is a low potential for adverse effects to an organism. This level was made more conservative in the R6 2005 FEIS to add a margin of safety to the risk assessment process.

Hazard Quotient (HQ): The Hazard Quotient (HQ) is the amount of herbicide or additives to which an organism may be exposed divided by the exposure threshold of concern. An HQ less than or equal to 1 indicates an extremely low level of risk. A HQ below 1 indicates a level below a threshold of concern.

Aquatic Label: Some herbicides are labeled for direct application in water. While no direct application would occur in any alternative for this project, treatment of emergent invasives in standing water or dry stream beds may involve use of such formulations to meet label requirements. Aquatic labeled herbicides are not necessarily less hazardous to aquatic organisms than other herbicides, but have been more extensively tested (however aquatic labeled herbicides are less hazardous to aquatic organisms than their non-aquatic formulations). Aquatic labeled herbicides would not be favored over effective non-aquatic lableled herbicides that pose lower risk to aquatic organisms, assuming compliance with label advisories (more discussion in Chapter 3.5)

Layers of Caution Integrated Into Herbicide Use

Figure 2 displays the layers of caution that are integrated into herbicide use in the Pacific Northwest Region (Region Six). First, label requirements, federal and state laws, and the EPA approval process provide an initial level of caution regarding chemical use. Next, the SERA Risk Assessments disclosed hazards associated with worst-case herbicide conditions (maximum exposure allowed by the label).

The R6 2005 FEIS included an additional margin of safety by reducing the level of herbicide exposure considered to be of concern to fish and wildlife. The R6 2005 ROD adopted standards to minimize or eliminate risks to people and the environment. The Olympic National Forest Site-Specific Invasive Plant Treatment Project is designed to comply with the R6 2005 ROD standards.

Figure 2. Layers of Caution Integrated Into Herbicide Use

Figure 2 also depicts how the site-specific situation on the Olympic National Forest allows for additional layer of caution to be integrated into herbicide use locally:

1. Treatment methods have been limited to those necessary to eradicate, control or contain invasive plants on the Olympic National Forest; higher risk projects such as aerial application and/or broadcast application near wet streams were eliminated from consideration because they are not necessary to meet local invasive plant treatment needs.
2. Project Design Features (Criteria) ensure herbicide exposures (under the Proposed Action) will not exceed conservative levels of concern for people and botanical, wildlife, and aquatic Species of Local Interest. The analysis throughout Chapter 3 demonstrates that herbicide use under the most ambitious conceivable scenario under the Proposed Action is unlikely to result in exposures of concern. This is true for known infestations as well as those found in the future, because the Project Design Features (PDFs) serve to limit the rate, type and method of herbicide application sufficiently to eliminate exposure scenarios that would cause concern, based on the site conditions at the time of treatment. Further analysis would be required if a new infestation would not be treated effectively according to the PDFs (for instance, the herbicides available for use near streams were not effective for a new infestation).
3. The implementation planning and monitoring and adaptive management processes described in Chapter 2 ensure that effective treatments are completed according to PDFs, and undesired effects are indeed minimized.

3.1.6 Basis for Cumulative Effects Analysis

Cumulative effects analysis throughout this chapter considers the additive, synergistic or offsetting effects of other past, present, and foreseeable future actions in combination with the proposed project. Herbicides are widely used for agricultural and industrial forest management, landscaping, and invasive plant management. Herbicide use occurs on Quinault tribal lands, the Olympic National Park, state and county lands, private forestry lands, rangeland, utility corridors, and road rights of way. The Olympic National Forest surrounds the Olympic National Park and shares its watersheds with tribal and other lands. The Forest Service manages about one-third of the lands within 6th -field watersheds containing National Forest (a list of watersheds is displayed in the soil and water section later in this chapter). Actions on neighboring lands can contribute to the containment of invasive plants on National Forests (and visa versa).

The following roads within National Forest treatment areas provide access to/from adjacent non-Forest lands and are likely vectors of invasive plant spread between different ownerships: 2180, 22, 2294, 2340, 2464, 2610, 2902, 2918, 2920, 2922, 2923, 30, 3006, 3006400, 3116. Only the National Forest portion of these roads would be treated in the action alternatives, however, the effectiveness of these treatments would be increased if adjacent lands were also treated.

Treatments on and off National Forest system land s would be coordinated using existing mechanisms such as Weed Management Areas and interagency coordination with the counties and the US Park Service, and government-to-government consultation with American Indian tribes.

No central source exists for compiling invasive plant management information off National Forests within Washington. There is no requirement for landowners or counties to report invasive plant treatment information, thus an accurate accounting of the cumulative acreage of invasive plant treatment for all land ownerships is unavailable. Although many herbicides are registered by the U.S. Environmental Protection Agency for use in agriculture, most are not used in forestry. Forestry uses account for less than one percent of the total herbicides or pesticides used in the United States of America (Norris et al. 1991).

The potential for adverse effects of the use of the proposed herbicides is fairly small (see table 28). While workers, the public, wildlife and/or fish may be exposed to herbicides within and outside the Olympic National Forest, multiple exposures do not necessarily equate to cumulative adverse effects. The herbicides proposed for use are water-soluble, are rapidly eliminated from humans and do not concentrate in fatty tissues and do not significantly bioaccumulate (R6 2005 FEIS). This is true whether an organism is exposed to one or several of the chemicals proposed for use.

The Project Design Features (PDFs) displayed in Chapter 2 constrain the rate and method of herbicide use to such a degree that the likelihood of acute adverse effects occurring is low. Adverse effects from multiple or chronic exposures are also very unlikely. Chronic exposures do not exceed thresholds of concern because the herbicides are excreted from organisms so rapidly that they do not accumulate over time.

Thus, the PDFs limit the mechanisms by which workers, the public, wildlife and fish may be exposed to herbicides. The PDFs were developed considering the risks and properties of the herbicides proposed for use. Herbicide selection and/or method are restricted depending on the toxicity, mobility, and persistence of each chemical applied to a range of site conditions.

The effects of herbicide use are mainly limited to the site of application, and governed by the extent of the target species to be treated. Herbicide would only be applied where needed; non-target vegetation and bare ground would not be treated. Drift from broadcast treatments is unlikely to harm non-target vegetation 100 or more feet away from treated areas. Spot and hand treatments are far less likely to move off site. Herbicide potential to be delivered to streams is also managed through buffers and PDFs. Herbicide persistence is also managed through PDFs to avoid chemical loading in the soil over time at any one site.

The PDFs sufficiently minimize risks to compensate for uncertainty about the impacts of herbicide use on neighboring lands. In watersheds where the majority of acreage is administered by the Forest Service, the likelihood of cumulative effects is low because less than one percent of the total watershed acreage would be treated. As the portion of National Forest system lands decreases, the plausible contribution of Forest Service to the overall chemical load within the watershed also decreases. Either way, herbicide use within the scope of this EIS has little potential for cumulative effects, whether in the context of proposed treatment at any one site or total chemical exposure in any 6th-field watershed.

Early detection-rapid response is part of all action alternatives, and considered in the direct, indirect and cumulative effects analysis. Effects of treatments each year under early detection-rapid response, by definition, would not exceed those predicted for the most ambitious conceivable treatment scenario. This is because the Project Design Features do so much to minimize or eliminate the potential for adverse effects, whether all acreage was treated in a single year, or whether less acreage was treated in a single year and treatments occurred over a longer period of time. Effects of treatments under early detection-rapid response would be sufficiently minimized by the PDFs regardless of when the treatments occurred. If effective treatments of new infestations required methods outside the scope of the project, or if PDFs could not be applied without a significant loss of effectiveness, further analysis would be necessary prior to treatment.

Many people express personal concern about their exposure to agricultural and industrial chemicals and the cumulative effects to human and environmental health from herbicide, pesticide and other chemical use in our society. These concerns are well outside the scope of this project.

Table 28. Herbicide Properties, Risks, and Design Features

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Chlorsulfuron (Telar, Glean, Corsair) Sulfonylurea-Interferes with enzyme acetolactate synthase with 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.	Moderate concern to aquatic organisms.	Do not use on soils that are finer than loam. Buffers ensure that herbicide will not be delivered to water in concentrations that will affect aquatic ecosystems.
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.	Contains hexachloro-benzene (persistent carcinogen) in amounts below a threshold of concern this substance is ubiquitous in the environment. Highly mobile, but does not degrade in water. Low risk to aquatic organisms.	Do not use on soils that are finer than loam. Otherwise, ollow label directions and common control measures. .

Active Ingredient Selected Herbicide Brand Names and Mode of Action	**Properties**	**General Uses/ Known to be Effective on:**	**Risks**	**Design Features to Minimize or Eliminate Risks**
Glyphosate (35 formulations, including RoundUp, Rodeo, Accord XRT, Aquamaster, 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. Trans-locates to roots and rhizomes of perennials. While considered non-selective, susceptibility varies depending on species. Main control for purple loosestrife, herb Robert, English ivy and reed canary grass. Aquatic labeled formulations can be used near water.	Non-selective. Greatest concern to aquatic organisms.	Except for the aquatic formulation, do not use on soils with a high water table. Buffers ensure that herbicide will not be delivered to water in concentrations that will affect aquatic ecosystems
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	More potential to kill non-target vegetation. Low risk to aquatic organisms.	Follow label directions and common control measures.
Imazapyr (Arsenal, Arsenal AC, 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.	More potential to kill non-target vegetation. Moderate concern to aquatic organisms. Human health hazard associated with higher label rates. More mobile.	Do not exceed a rate of 0.70 lb active ingredient (a.i.)/acre with broadcast and spot applications. Except aquatic formulation, do not use on soils with a high water table. Buffers ensure that herbicide will not be delivered to water in concentrations that will affect aquatic ecosystems.

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Metsulfuron methyl (Escort XP) 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). Safest sulfonylurea around non-target grasses.	Use at low rates to control such species as houndstongue, sulfur cinquefoil perennial pepperweed plant.	More potential to kill non-target vegetation. Low risk to aquatic organisms.	Do not use on dry, ashy, or light sandy soils. Otherwise, follow label directions and common control measures.
Picloram (Tordon K, Tordon 22K) 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, toadflaxes, sulfur cinquefoil, and hawkweeds. Provides control of new germinants for two to three growing seasons.	Most mobile, but persistent in soil. Contains hexachloro-benzene (persistent carcinogen) in amounts below a threshold of concern this substance is ubiquitous in the environment. More potential to kill non-target vegetation. Greatest concern to aquatic organisms. Human health hazard associated with higher label rates.	Do not treat any site more than once in a two year period. No use on wet or saturated soils. Do not use on soils with a high water table, soils with high porosity, and shallow, unproductive, or acidic soils. No use on roadside treatment areas with high potential to deliver herbicide to streams (does not apply to Alternative D) Do not use near susceptible non-target vegetation, especially SOLIs. No broadcast at a rate greater than 0.5 lb a.i./acre. Buffers ensure that herbicide will not be delivered to water in concentrations that will affect aquatic ecosystems.

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Sethoxydim (Poast, Poast Plus) 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.	Greatest concern to aquatic organisms.	Do not use on soils with a high water table. Buffers ensure that herbicide will not be delivered to water in concentrations that will affect aquatic ecosystems.
Sulfometuron methyl (Oust, Oust XP) 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 reed canary grass, cheatgrass, and medusahead.	Persistent in soil. Toxic to soil organisms. More potential to kill non-target vegetation. Moderate concern to aquatic organisms. Human health hazard associated with higher label rates.	No more than label rate per acre over a two-year period. Do not use on soils with a high porosity, high clay content, shallow, unproductive, or acidic soils. Do not use on dry, ashy, or light sandy soils. No broadcast at rate greater than 0.12 lb a.i./acre. Do not use on soils with a high water table. Buffers ensure that herbicide will not be delivered to water in concentrations that will affect aquatic ecosystems.

Active Ingredient Selected Herbicide Brand Names and Mode of Action	Properties	General Uses/ Known to be Effective on:	Risks	Design Features to Minimize or Eliminate Risks
Triclopyr (Garlon 3A, Garlon 4, Forestry Garlon 4, Pathfinder II, Remedy, Remedy RTU, Redeem R&P) Synthetic auxin - Mimics natural plant hormones.	A growth regulating selective, systemic herbicide for control of woody and broadleaf perennial invasive plants. Little or no impact on grasses.	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	Greatest concern to aquatic organisms. Exposure may exceed levels of concern for workers and the public.	Use spot and hand/selective treatments only. Except aquatic formulation, do not use on soils with a high water table. Buffers ensure that herbicide will not be delivered to water in concentrations that will affect aquatic ecosystems. Do not apply in areas of known special forest products or other wild foods collection.

Herbicide properties and risks adapted from R6 2005 FEIS. Uses based on Tu et al. (2001).
*Habitat is the name for the aquatic formulation for Imazapyr. It is not currently available for use because inert ingredients in Habitat have not been reviewed as per R6 2005 ROD standard 18. Once this analysis is complete, Habitat may be used according to the buffers shown in Chapter 2, assuming that effects of its use is similar to the other formulations analyzed herein.

3.2 Botany and Treatment Effectiveness

This section focuses on the relative likelihood that the treatment methods approved in each alternative would be effective in reducing threats to non-target vegetation from invasive plants (Issue Group 2). This section also discloses the risks to non-target vegetation, especially Botanical Species of Local Interest, from the treatment of invasive plants (Issue Group 4).

In general, the threats from invasive plants to non-target vegetation are greater than the threats from treatment. As treatment effectiveness increases, the threats to native vegetation decrease. Broadcast herbicide treatments can be the most cost-effective of the methods considered in this EIS, and while this method poses the greatest risk to non-target vegetation, Project Design Features would mitigate the risks. Adequate measures are in place to mitigate the risk of broadcast treatments occurring in proximity to Botanical Species of Local Interest; monitoring is recommended to manage uncertainty related to the potential effect of herbicide drift on certain non-vascular plants.

3.2.1 Affected Environment

Invasive plants have been detected on 3,830 acres of the Olympic National Forest. These sites are predominantly located in disturbed areas: along road systems, in timber sale units (e.g., Matwat Timber Sale), at the Lake Quinalt summer residences, in administrative sites (e.g., Dennie Ahl seed orchard, Snider Work Center, Quinalt Ranger Station), in high public use areas (parking areas, viewpoints), in managed areas such as plantations, and in areas utilized for recreation such as campgrounds, dispersed recreation, etc. (Quinault Loop Trail, OHV Slab camp quarry, Seal Rock Campground, etc,).

Areas where ecosystem functioning and native plant communities are of high value are also affected; these include meadow systems (e.g., Mint Meadow, Schmith Knob, Savannah Restoration Site, Matheny Prairie); sphagnum bogs (e.g., Cranberry Bog); three of five Wilderness areas are known to have invasives (e.g., Buckhorn, Colonel Bob, and the Brothers Wilderness), one, the Mt. Skokomish is likely to have invasives but has never been inventoried. Wonder Mountain Wilderness is the only one that has a low potential for invasive species, but the two Research Natural Areas have invasives, Wet Weather Creek, and Quinalt Research Natural Area; many sites with invasives are adjacent to and threaten populations of rare plants (e.g., *Parnassia palustris* var. *neogaea*, *Erythronium quinaltense*, *Synthyris pinnatifida* var. *lanuginosa*, etc.); and 11 of 12 Botanical Areas have invasives: Three Peaks, Matheny Ponds, Bill's Bog, North Fork Matheny Ponds, Matheny Ridge Alaska Yellow Cedar, Cranberry Bog, Buckhorn, Three O'Clock Ridge, South Fork Calawah, Matheny Prairie, and Tyler Peak Botanical Area. Plant community functioning has been disrupted in these areas and native vegetation has been replaced by invasive plants in some places. Without treatment, these weed sites will further displace native plant communities, and spread to new areas. Invasives have been estimated to spread at a rate of 8 to12 percent each year. Prevention practices may reduce that number by half (2005 R6 FEIS Chapter 4.2, page 4-24).

Roads are conduits for the spread of invasive plants, providing for their transport and dispersal (e.g., seeds and vegetative reproductive parts attached to vehicles) and providing disturbed ground for easy colonization and establishment. Olympic National Forest system roads also serve to introduce invasive species onto the Olympic National Park, where native plant communities and ecological integrity are highly valued, as well as to the Quinault Indian Nation land, where they are aggressively treating Japanese knotweed and gorse to protect riparian areas.

Roads serve to introduce and establish invasives in areas where they were previously unknown. For example, currently gorse is unknown on the Olympic National Forest, although it is a species on their watch list. Gorse is moving in from the Quinalt Indian Nation on Highway 101, which goes to Olympic National Forest system lands. This EIS would allow for treatment of these sites.

Timber harvest, livestock grazing, road building, and other ground-disturbing activities occur on National Forest system lands, and contribute to the spread of invasive plants as the habitat conditions that facilitate colonization are created. Early detection of populations of invasive species is critical before they become larger and spread. The best action against invasive plants is prevention through early intervention; otherwise, populations increase in number and size, becoming more difficult and costly to control later.

The 634,000-acre Olympic National Forest is in the northwest corner of Washington, and surrounds the Olympic National Park. The vegetation of the Olympic Peninsula is strongly influenced by a maritime climate, as it is surrounded by saltwater on three sides: the Pacific Ocean on the west, the Strait of Juan de Fuca on the north, and the Hood Canal on the east. It has distinct eastside and westside ecology, due to the Olympic Mountains in the center.

The southern part of the westside is known for its high rainfall and temperate rainforest, with Sitka spruce, western red cedar, western hemlock, and Douglas-fir. The northern section of the eastside is the driest part of the forest, with a small area of climax Douglas-fir, given the rain shadow effect from the mountains. Glacial and climactic history influenced the evolution of the Olympic flora. As the alpine and continental glaciers advanced, the Peninsula was isolated from other areas. Glacial refugia existed in localized areas where plant species and plant communities survived, resulting in pockets of distinct plant communities. Table 29 displays target species that may be associated with wetter habitats.[21]

Table 29. Target Species in Wetter Habitats

Target Species	Potential Wet Habitat
Knapweeds	Adjacent to and standing in water (streams, rivers, ponds etc.).
Hawkweeds	Moist meadows.
Tansies	On streambanks.
Scotch Broom	Adjacent to and in meadows, streams, and riparian margins.
English Ivy	Can grow over rocks and adjacent to water, but not in water.
Reed Canarygrass	Wetland emergent species, likes to be flooded – in wet ground, streams, marshes, canals, irrigation ditches, etc.
Canada and Bull Thistle	In meadows and along creeks, streams, and in aspen stands adjacent to creeks.
Herb Robert	Adjacent to water, creek, streambanks.
Purple Loosestrife	Streambanks, canals, ditches, and in shallow ponds.
Blackberry	Often a monoculture along streams and rivers, etc.
Oxeye Daisy	Adjacent to and in meadows, and stream, and river edges.
Yellow Nutsedge	Moist or wet areas.

[21] Most of these species have been detected along roadsides and other disturbed areas that may be outside of mapped Riparian Reserves.

Invasive Plants and Native Plant Species of Local Interest

Botanical Species of Local Interest (SOLI's) within 100 feet of treatment areas are displayed in table 30. [22] Table 30 displays:

a) Regional Forester Sensitive or Proposed Sensitive Species (Forest Service Manual 2670); and

c) Survey and Manage Mitigation Measure Species.[23]

No botanical species listed under the Endangered Species Act grow within 100 feet of any treatment area. Invasive plants currently or may someday threaten 20 different botanical SOLI's at 90 sites (3 species of fungi, 9 species of lichens and bryophytes, and 8 vascular plant species). Three botanical SOLI's at 13 sites are seriously threatened by encroachment of invasive plants.

Table 30. Botanical Species of Local Interest, Olympic National Forest

Botanical Species	Habitat	Number of SOLI sites near invasive plant treatment areas	Level of Threat from Invasive Plants
Lichens and Bryophytes			
Diplophyllum plicatum **Survey and Manage Species**	Liverwort	1 (of 13 populations recorded in Washington)	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Hypogymnia duplicata **Survey and Manage Species**	Lichen, epiphytic on mountain hemlock, western hemlock, Pacific silver fir, Douglas-fir and subalpine fir in old-growth forests	11 (of 13 populations recorded in Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat if fewer host trees are recruited.
Iwatsukiella leucotricha **Sensitive and Survey and Manage Species**	Moss; wet areas along the coastal region, on bark of conifers and alders on ridges with fog penetration	5 (of 11 populations recorded In Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat, especially if fewer host trees (silver fir) are recruited.

[22] Databases and records from the Olympic National Forest, Washington State Natural Heritage Program, Oregon Natural Heritage Program, and ISMS (Interagency Species Management System) database were used to overlay SOLI's with the invasive plant inventory. Local botanists/ecologists Joan Zriegltrum, Deborah McConnell, and Pat Grover assisted in determining proximity of target species to SOLI's. All of the botanical SOLI's within 100 feet of treatment areas are Regional Forester Sensitive Species except *E. quinau*ltense, which is proposed to be added to the sensitive list.

[23] "Survey and Manage" is a mitigation measure in the Northwest Forest Plan adopted as part of the Olympic National Forest Plan.

Botanical Species	Habitat	Number of SOLI sites near invasive plant treatment areas	Level of Threat from Invasive Plants
Nephroma bellum **Sensitive and Survey and Manage Species**	Lichen; in moist forest with strong coastal influence; often on riparian hardwoods	2 (of 22 populations recorded in Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat if fewer host trees are recruited.
Platismatia lacunosa **Sensitive and Survey and Manage Species**	Lichen; on boles and branches of hardwoods and conifers in moist riparian forests and cool upland sites	7 (of 18 populations recorded in Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat if fewer host trees are recruited.
Pseudocyphellaria rainierensis **Sensitive and Survey and Manage Species**	Epiphytic lichen; moist old growth forest	4 (of 56 populations recorded in Washington)	No direct threats from invasives have been observed; future threats include loss of/competition for habitat if fewer host trees are recruited.
Racomitrium aquaticum **Survey and Manage Species**	Moss, forms mats on shaded, moist rocks and cliffs along shady streams or in forests, often in splash zones, but never in aquatic habitat	3 (of 13 populations recorded in Washington)	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Schistostega pennata **Sensitive and Survey and Manage Species**	Moss; in dark places: upturned rootwads, rock crevices, adjacent to standing water	3 (of 50 populations recorded in Washington)	No direct threats have been observed, and future threats are not expected. This species has a highly selective habitat, one whose niche would not easily be occupied by invasive species.

Botanical Species	Habitat	Number of SOLI sites near invasive plant treatment areas	Level of Threat from Invasive Plants
Tetraphis geniculata **Sensitive and Survey and Manage Species**	Moss; old growth downed stumps and large logs in moist areas	20 (of 40 populations recorded in Washington)	No direct threats have been observed, and future threats are not expected. This species has a highly selective habitat, one whose niche would not easily be occupied by invasive species.
Fungi			
Albatrellus avellaneus **Survey and Manage Species**	Terrestrial, mycorrhizal polypore restricted to Sitka Spruce	3 (of 13 populations recorded in Washington)	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Bondarzewia mesenterica **Survey and Manage Species**	A terrestrial, parasitic polypore found solitary or in clumps, associated with conifers	2 (of 13 populations recorded in Washington)	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Ramaria lorithamnus **Survey and Manage Species**	Terrestrial, mycorrhizal fungus associated with late successional Douglas fir and western Hemlock forests in the Pacific Northwest	1 (of 13 populations recorded in Washington)	No direct threats from invasives have been observed; future (within ten years) threats include loss of/competition for habitat.
Vascular Plants			
Carex anthoxanthea **Sensitive Species**	Sedge; Grassy, boggy places	1 (of 1 site recorded in Washington State)	Reed canary grass grows in the vicinity. Within five years, reed canary grass may be directly competing with this *Carex* population.

Botanical Species	Habitat	Number of SOLI sites near invasive plant treatment areas	Level of Threat from Invasive Plants
Carex obtusata **Sensitive Species**	Sedge; Dry, open ridges, scree meadows, talus slopes, often in late snowmelt pockets from 5800' to 6800'	3 (of approximately 10 sites recorded in Washington)	Invasive plant surveys are not complete at these locations. It is unlikely Canada thistle and common dandelion are competing with *Carex obtusata*, as rocky, scree ridgeline is not conducive habitat for these invasives.
Carex pauciflora **Sensitive Species**	Sedge; Sphagnum bogs to 3000'	1 (of approximately 20 recorded sites in Washington)	No direct threat to *Carex pauciflora*, but within 5 years Canada thistle or herb Robert may out-compete the *Carex* for space and resources.
Erythronium quinaultense **Proposed Sensitive Species**	Herbaceous; In openings and rock ledges in coniferous forests at an elevation of 1640 to 2953 ft. (500 to 900 m). Populations have been found from 960-2600 ft.	9 (of 12 populations recorded on the Olympic peninsula, on the Olympic National Forest)	There are 8 sites where invasives are impacting *Erythronium quinaultense* habitat, competing for space and resources.
Galium kamtschaticum **Sensitive and Survey and Manage Species**	Herbaceous; Northerly aspects from 1930' to 2900', in the silver fir or mountain hemlock plant associations, in wet canopy gaps.	2 (8 sites on the Olympic peninsula all of which are on the Olympic National Forest)	No direct threats from invasives. Within 5 years, there is potential for competition for space and resources between invasives and *Galium kamtschaticum*.

Botanical Species	Habitat	Number of SOLI sites near invasive plant treatment areas	Level of Threat from Invasive Plants
Parnassia palustris var. neogaea **Sensitive Species**	Herbaceous; Wet meadows, wet rock faces, seeps and along streams and pond edges	5 (19 sites recorded on the Olympic National Forest)	At 4 sites, invasives are impacting *Parnassia palustris* var. *neogaea* habitat. Currently, there are no direct impacts to individuals, but within five years there is potential.
Pellaea breweri **Sensitive Species**	Fern; Rocky crevices, rock outcrops, ledges and talus slopes	1 (of 10 sites recorded in Washington)	Surveys are not complete. It is unlikely invasive species are competing with *Pellaea breweri*, as rocky, scree ridgeline is not conducive habitat for invasives in this treatment area.
Synthyris pinnatifida var. lanuginosa **Sensitive Species**	Herbaceous; On scree and talus slopes and other rocky areas in the alpine zone	6 (of less than 20 sites known from the Olympic Peninsula)	There is 1 site where invasives are impacting *Synthyris pinnatifida var. lanuginosa* habitat. Within five years, there is potential impact to individuals.

3.2.2 Treatment Effectiveness

Treatment effectiveness increases with the number of treatment options available and percentage of the infested land base that may be treated using herbicides. All alternatives, including No Action, approve a wide range of non-herbicide methods, including biological, manual and mechanical treatments. The variation between alternatives is mostly related to the use of herbicides. For the purposes of this analysis, all herbicide application methods (broadcast, hand, spot) are considered equally effective.[24] Funding constraints and conditions on neighboring lands may also influence treatment effectiveness; these variables are constant across alternatives.

Invasive plant spread is not continuous or even across the landscape. Invasive plants can “jump” across far distances. For example, a vehicle carrying seeds or propagules, can deposit these “hitchhikers” to another county where that invasive might be otherwise unknown. Hikers are likely to deposit invasive plant seeds along the trail into dispersed recreation sites within the Wilderness. The hazard related to

[24]Herbicide application methods may influence cost-effectiveness, for instance, spot and hand treatments tend to cost more per acre than broadcast treatments. This is discussed further in the economic analysis in Chapter 3.7.

invasion of uninfested areas and high value areas like Wilderness may be much greater than the hazard related to invasive plant spread elsewhere.

Several of the infested sites on the Olympic National Forest also threaten plant species of local interest. Another indicator of effectiveness is the number of SOLI species that are at risk of extirpation if invasive plants are not effectively treated.

Effectiveness of Common Control Measures

Biological Agents

Several biological agents have been approved for release on the Olympic National Forest (Jennifer Andreas, e-mail communication, January 2006). The analyses for effects of such tools have already been completed under documents developed by Agricultural Plant Health and Insect Service (APHIS) for approval of entry of such organisms.

Biological control is self-perpetuating, selective, energy self-sufficient, economical, and well suited to integration in an overall invasive plant management program. Introducing predators, parasites, or pathogens from a plants country of origin does not eradicate, but controls any given invasive plant (R6 2005 FEIS, 2-35 to 2-37).

Biological controls have varied results, for some invasive plants they provide substantial control, for others little effect (Cecile Shohet, personal observations, December 2005). Tansy ragwort (Senecio jacobaea), St. John's wort (*Hypericum perforatum*), Canada thistle (*Circium arvense*), and bull thistle (*Circium vulgare*) have been contained using biocontrols in the western United States (Andrea Ruchty, personal communication, 2006).

The time frame for controlling invasives using biocontrols is very long, and would occur regardless of alternative. The effects of biological agents are described in Appendix J of the R6 2005 FEIS, and direct, indirect and cumulative effects are negligible (e.g. unlikely to result in adverse effects to aquatic species (page J-24), no direct effects on wildlife (page J-19), few examples of non-target effects (page J-16)).

Manual and Mechanical Treatments

Manual and mechanical treatment methods are approved in all alternatives. These treatments are preferred where effective (consistent with treatment strategies), particularly where impacts (disturbance, compaction) from use of motorized equipment can be minimized. The effectiveness of manual and mechanical treatments increases if herbicides are also available for use. However, if herbicide use is not allowed, stand alone manual and mechanical treatments are less effective, and may actually increase rather than decrease population numbers.

For instance, manual and mechanical treatments can increase populations of meadow knapweed, Canada thistle and Japanese knotweed as pieces of rhizome/root/stem break off and develop into a plant the following spring. Also, in the process of digging/pulling, the disturbance created by the treatment creates the ideal habitat conditions for invasive seeds to germinate and flourish. For these species, in order for manual/mechanical to be effective, meticulous follow-up is necessary several times in a growing season for at least five years, to prevent seeds from being produced and dispersed, and to kill any germinants. In contrast, annuals may be effectively pulled out of the ground by hand (manual treatment) because of their one-year life cycle.

Herbicide Treatments

Greater numbers of herbicide options tend to result in greater potential effectiveness; lower numbers of options tend to result in lower potential effectiveness (R6 2005 FEIS, 4-15 to 4-16, and 4-36). Each invasive species has its own physiology, and its own habitat requirements. Herbicide effectiveness varies substantially depending on the invasive species, treatment timing, restoration plans, and environmental factors. Chapter 2 includes a chart showing the measures considered most effective for the invasive species known on the Olympic National Forest.

A range of herbicide and non-herbicide options is necessary to effectively treat invasive plants (R6 FEIS 4-15). For instance, the herbicide glyphosate does not work effectively for all species of invasives. Glyphosate can be used against woody vegetation, but other herbicides such as triclopyr are more effective (Robin Dobson, personal communication, November 2006). Glyphosate also has more restrictions for effective use; for instance, glyphosate must be applied in the fall after the berries have dropped to effectively treat blackberry, whereas triclopyr is effective applied at any time of year (ibid.).

In addition, nationwide a number of invasives have been found to develop a tolerance to glyphosate, and its effectiveness has been markedly reduced. Dr. Tim Miller, the Washington State Extension Weed Scientist in Mt. Vernon, Washington, reports tolerance to glyphosate in locations close to the Olympic National Forest.

The percentage of the land-base that would be treated varies between alternatives. The more acres left untreated, the greater the likelihood that invasives will spread and compete with native plant communities. Over time, infestations that are left untreated will continue to spread. Thus, another indicator of effectiveness is the acreage of invasive plant infestations projected five years from now.

Effectiveness of Alternative A - No Action

Under Alternative A, the No Action Alternative, some treatments that have been approved under previous NEPA decisions would continue. Invasive plant prevention standards were adopted (R6 2005 ROD) that are expected to reduce the rate of spread of invasive plants across the Pacific Northwest Region from 8 to 12 percent down to 4 to 6 percent. In addition, biological releases (see above) have been approved and would continue to be partially effective under No Action.

On the Olympic National Forest, treatments have been approved for 672 acres. Of these, 86 acres are prescribed for herbicide use (about 2.2 percent of the 3,830 acres estimated to be currently infested). Herbicide use is restricted to spot and/or hand applications of glyphosate, dicamba, and picloram, and in proximity to water, only the herbicide glyphosate can be used. On the Olympic National Forest, the effectiveness of the No Action Alternative is low (assumed to be 25%, which means that one-quarter of an invasive plant infestation would be controlled in any year of treatment) because the comparative acreage allowed for herbicide use is low, and the herbicide selection is limited.

Given estimates of target species average rate of spread and the effectiveness predicted for the most ambitious treatment scenario analyzed for No Action, net infestation would be reduced by about 327 acres by the year 2012. This estimate assumes a $200,000 per year budget and use of the tools currently available under No Action. No Action has a low effectiveness because of the limited use of herbicide. Fewer than half the acreage currently considered high priority would effectively be treated under the most ambitious conceivable No Action treatment scenario. No Action is unlikely to effectively treat invasive plants because so little of the current infestations would be treated.

The rate of invasive plant spread would be reduced via the implementation of prevention practices. The R6 2005 FEIS estimated that invasive plant spread would be reduced from about 10 percent per year to 5, assuming the consistent application of prevention practices. Each year, untreated invasive plants are assumed to spread by this rate.

Invasive plant treatments that occur on parcels neighboring the National Forest system lands would contribute to project effectiveness. Invasive plants flow between land ownerships and administrative units. Treatments must occur across land ownerships to optimize the effectiveness of this alternative.

Table 31. Estimated Invasive Plant Acres, No Action, 2007-2012

Year	Acres Invaded	Acres Treated	25% Effectiveness	Acres Remaining	5% Spread
2007	3,830	672	168	3,662	3,700
2008	3,700	504	126	3,574	3,612
2009	3,612	378	94.5	3,518	3,554
2010	3,554	284	71	3,483	3,520
2011	3,520	213	53.25	3,467	3,503
2012	3,503	Last Year of Projection			

Table 32. Summary of Effectiveness Indicators, No Action

	Percentage of Invasive Plants Treated With Herbicide	Number of Herbicide Options	Acres of Invasive Plants 2012
Alternative A (No Action)	2%	3	3,503

Under No Action, the values at risk from invasive plants would continue to be great. Three Species of Local Interest would continue to be threatened by invasive plants. Infestations would continue to impact Wilderness Area, Botanical Area and Research National Area values. Meadow and riparian habitats would continue to be at risk. Roads would continue to act as vectors of invasive plant spread between National Forest and other lands.

Effectiveness of Alternative B – Proposed Action and Alternative D

Alternatives B and D respond similarly to this issue so they are discussed together in this section. Alternative D has the potential to be more cost-effective than the Proposed Action (see Economic Efficiency Analysis) but assuming unlimited funding, both alternatives allow a sufficient range of options to be used in most, if not all, situations.

Under both of these alternatives, all currently infested acres would be treated with integrated prescriptions that combine manual and mechanical invasive plant control methods with the use of herbicides. Each year of treatment is assumed to reduce population size by 80%, given the range of tools that would be available.

The following beneficial effects would be expected from treatment:

- Invasive plant establishment and spread would be reduced along roads, trails and other disturbed areas.
- Native plant communities and ecosystem functions would recover in meadows and forested areas.
- Many invasive populations would never gain a foothold to Wilderness, Botanical Special Interest Areas, or Research Natural Areas.
- Recreation and administrative sites would become less of a vector for invasive spread.

- Invasive plants would no longer pose threats to invasive plant species of local concern.

Assuming current funding estimates, the highest priority invasives (about one-fifth of the current infestations) could be fully eradicated or controlled by 2012. The rate of invasive plant spread would be reduced via the implementation of prevention practices, however containing or controlling remaining infested sites would take at least 30 years, based on the assumption that each year of treatment, about 80 percent of invasive plant infested acreage would be controlled if the tools included in these alternatives were available.

Table 33. Estimated Invasive Plant Acres, Alternatives B and D, 2007-2012

Year	Acres Invaded	Acres Treated	80% Effectiveness	Acres Remaining	5% Spread
2007	3,830	3,830	3064	766	774
2008	774	765	612	162	164
2009	164	148	118.4	46	46
2010	73	29	23.2	50	50
2011	50	0	0	50	51
2012	51	Last Year of Projection			

Table 34. Summary of Effectiveness Indicators, Alternatives B and D

	Percentage of Current Land Base Where Herbicides May Be Used	Number of Herbicide Options	Acres of Invasive Plants 2012
Alternatives B (Proposed Action) and D)	100%	10	51

Effectiveness of Alternative C

Given an unlimited budget, Alternative C would still not be as effective as Alternatives B and D. It treats fewer acres with herbicide, and infestations that are difficult to eradicate would likely not be effectively treated given Alternative C's restrictions on the use of herbicides. Examples of target species that are difficult to control without herbicides include Japanese and giant knotweed; purple loosestrife; orange hawkweed; and meadow and brownray knapweed. Alternative C would have less potential to effectively treat these species, especially if they are growing along road ditches and near streams where herbicides would not be used.

Alternative C is less effective than other action alternatives because of its limitations on herbicide use; Alternative C is assumed to reduce target populations by about 42 percent per year. In contrast, under No Action, target populations reduced by 25% per year and the other action alternatives are assumed to reduce target populations by 80% per year.

Waterways would continue to transport invasives downstream, and invasive dominance would increase along lakes, ponds, creeks, etc. Roads would continue to act as corridors, transporting invasive seeds and propagules to new locations. *Parnassia palustris* var. *neogaea* is a water-loving species that are directly threatened by invasive species. Habitat loss to *Parnassia*has already occurred from invasive plants and continued spread could lead to mortality. Thus, since these areas are off limits to herbicide use under Alternative C, these two SOLI species would be at continued risk from infestations.

While currently undetected sites could be treated under Alternative C, these future treatments would be less effective because herbicide use restrictions would be applied. Restoration objectives would continue to apply to treated sites and would reduce the potential for re-infestation over time.

As with the other alternatives, the rate of invasive plant spread would be reduced via the implementation of prevention practices. Assuming current funding estimates, less than 17 percent of the inventoried sites would be controlled by 2012. Containing or controlling remaining infested sites would take longer than 35 years. Full eradication of any invasive species would be unlikely.

Invasive plant treatments that occur on parcels neighboring the National Forest system lands contribute to project effectiveness. Invasive plants flow between land ownerships and administrative units. Treatments must occur across land ownerships to optimize the effectiveness of this alternative.

Table 35. Estimated Acres of Invasive Plants, Alternative C, 2007-2012

Year	Acres Invaded	Acres Treated	42% Effectiveness	Acres Remaining	5% Spread
2007	3,830	3,410	2728	1,102	1,114
2008	1,114	681	544.8	569	575
2009	575	136	108.8	466	471
2010	471	27	21.6	449	454
2011	454	0	0	454	459
2012	459	Last Year of Projection			

Table 36. Summary of Effectiveness Indicators, Alternative C

	Percentage of Current Land Base Where Herbicides May Be Used	Number of Herbicide Options	Acres of Invasive Plants 2012
Alternative C	30%	10	459

Alternative Comparison – Effectiveness Indicators

Table 37. Comparison of Alternatives, Effectiveness Indicators

	Percentage of Current Land Base Where Herbicides May Be Used	Number of Herbicide Options	Annual Effectiveness (Amount Population Decreased Each Year of Treatment)	Acres of Invasive Plants 2012
Alternative A (No Action)	2%	3	25%	3,503
Alternative B (Proposed Action)	100%	10	80%	51
Alternative C	30%	10	42%	459
Alternative D	100%	10	80%	51

Effectiveness of Early Detection-Rapid Response

The most ambitious treatment scenario analyzed would effectively treat all known invasive acreage. The adoption of an Early Detection-Rapid Response protocol would allow for quick treatment of newly found invasive populations, thereby not allowing them to further spread, and reducing impacts on botanical resources in the future. Restoration of treated sites would decrease the likelihood for re-infestation. The IDT predicts that if all infestations were effectively treated immediately, within approximately 6 years target populations would be suppressed, contained, controlled, or eradicated to the extent desired, and treated sites would be restored. Sites will likely have to be revisited in a given year to reach the interior of dense invasives such as knotweed, to accommodate invasive plant reproductive cycles that occur through the year, or to ensure treatment of individual plants that may have been skipped during the initial entry.

Invasive plant treatments that occur on parcels neighboring the National Forest system lands contribute to project effectiveness. Invasive plants flow between land ownerships and administrative units. Treatments must occur across land ownerships to optimize the effectiveness of these alternatives. Alternatives B and D allow a range of treatment options sufficient to effectively treat invasive plants that may threaten resources off National Forest system lands.

Invasive plant spread would be reduced in all alternatives via the implementation of prevention practices. The R6 2005 FEIS estimated that invasive plant spread would be reduced from about 10 percent per year to 5, assuming the consistent application of prevention practices. Each year, untreated invasive plants in all alternatives are expected to spread at this rate.

3.2.3 Environmental Consequences of Invasive Plant Treatments on Non-target Plants

Introduction

All invasive plant treatments are designed to kill or slow the growth of target plants, and some damage to non-target plant species is likely in all alternatives, despite careful planning and implementation. The effects of non-herbicide methods, including the manual and mechanical methods in the scope of the action alternatives, are addressed in Appendix J of the R6 2005 FEIS. While some common vegetation may be impacted by manual and mechanical methods, such effects are unlikely to be significant, because an operator would immediately make adjustments if adverse effects were to occur. Most of the concern about adverse effects of treatment are related to herbicide use, partially because of the potential for drift, leaching or runoff to affect non-target vegetation and/or because adverse non-target effects may not be immediately noticeable.

Herbicides have the potential to shift species composition and reduce diversity of native plant communities, as less herbicide-tolerant species are replaced by more herbicide-tolerant species. The type of herbicide and the application method may also affect plant pollinators. A reduction or shift in pollinator species could also lead to changes in plant species composition or diversity (R6 2005 FEIS Chapter 4.27). For example, the repeated use of triclopyr, a broadleaf selective herbicide, might shift the species composition resulting in a reduction of woody vegetation and an increase in the herbaceous and grass component.

Herbicides can move off-site in water, soil, and wind, thereby affecting non-target vegetation. This can result from spray drift (broadcast and spot), runoff, leaching, or through groundwater movement. Herbicides can vary dramatically in their potential for movement. For example, picloram is highly soluble in water, is mobile under both laboratory and field conditions, is resistant to degradation, and has a high potential to leach to groundwater in most soils. While glyphosate strongly binds to soil particles, which prevents it from excessive leaching or from being taken up from the soil by non-target plants, has a low potential for leaching into groundwater systems, and degrades quickly (R6 2005 FEIS Chapter 4, 4-29, 4-32).

Translocation of herbicide between rhizomatous same-species individuals, or from plant-fungi, rootlet-mycorrhizal interactions can also result in herbicide movement. The result may include mortality, reduced productivity e.g., physiological, structural, and abnormal growth (R6 2005 FEIS Chapter 4.27). Effects, such as mortality, brown spots, and chlorotic coloration, may not be immediate, and may become apparent months later. Other non-visible effects e.g., physiologic, may never be noticeable (Marrs, R.H., 1989).

The risk of adverse effects is dependent on the type of herbicide used and the application method chosen. Herbicides have different characteristics, degrees of selectivity, and modes of action. Potency of the herbicide and persistence also are a factor, as is duration of the treatment.

For example, glyphosate is a general, non-selective herbicide, which may kill or damage species from all plant families. In contrast, clopyralid has little effect on the mustard family and grasses. Other herbicides are more selective and thus have less potential to adversely affect non-target plants.

Glyphosate, which is generally non-selective, has no adverse effect on horsetail (non-flowering plant) and some species of algae (Cathy Lucero, personal communication, August, 2005). Picloram is a persistent herbicide that can remain active for several growing seasons post application. Clopyralid mimics auxins, a plant growth hormone and stimulates abnormal growth. Metsulfuron methyl works by inhibiting the activity of an enzyme called acetolactate synthase, an enzyme necessary for plant growth. If a non-vascular species does not use the above mechanisms, the herbicide may not have any impact at any distance (depending on the surfactant used as well).

The risk to non-target vegetation also varies with the herbicide application method. Spot and hand application methods substantially reduce the potential for loss of non-target vegetation because there is little potential for drift. Drift is most associated with broadcast treatments and can be mitigated to some extent by the applicator. Droplet size is key to drift as larger droplets are heavier and therefore less affected by wind and evaporation. Figure 3 demonstrates the relationship between droplet size and buffer distance. As droplet size increases (VMB microns), the distance herbicide may travel in concentrations sufficient to harm plants decreases.

The diagram shows that a 100-foot broadcast buffer is likely to prevent glyphosate from harming plant species further away (Personal Communications with Thistle, 2005). Factors affecting droplet size are nozzle type, orifice size and spray angle, as well as spray pressure, and the physical properties of the spray mixture. Wind speed restrictions also significantly contribute to a reduction in drift (Spray Drift Task Force, 2001). By simply changing the type of nozzle (diameter of pore size) used during broadcast treatments, the drift potential of herbicide can be effectively and significantly decreased as the droplet size forced out the nozzle is increased in size (Dr. Harold Thistle, personal communication, April 2006).

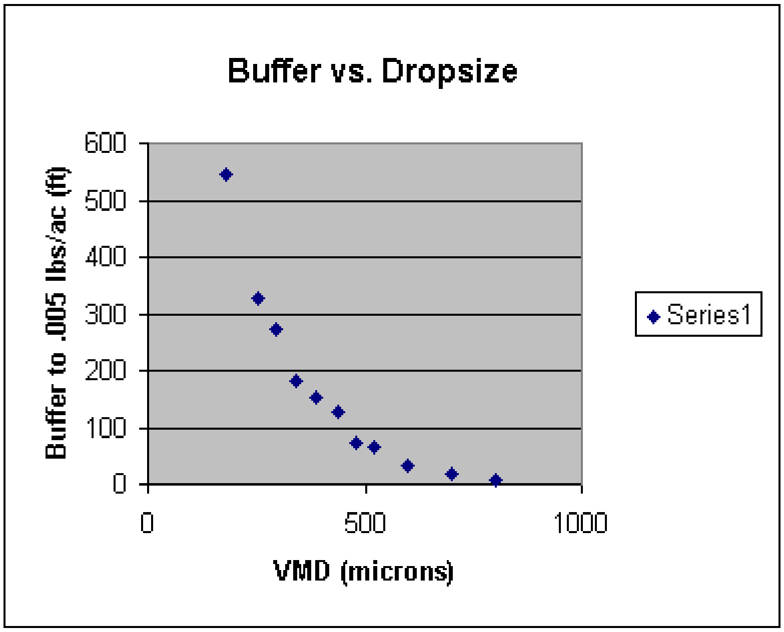

Figure 3. Droplet Size and Drift Distance

Marrs, R.H., in the 1989 publication, "Assessment of the Effects of Herbicide Spray Drift on a Range of Plant Species of Conservation Interest," examined the distances drift affected non-target vascular plants using broadcast treatment methods similar to those considered in this EIS. Their observations are consistent with drift-deposition models in which the fallout of herbicide droplets has been measured. The maximum safe distance at which no lethal effects were found was 20 feet, but for most herbicides the distance was 7 feet. Generally, damage symptoms were found at greater distances than lethal effects, but in most cases there was rapid recovery by the end of the growing season. No effects were seen to vascular non-target vegetation further than 66 feet from the broadcast treatment zone. Little information is available for how drift distances may effect non-vascular non-target vegetation. The distance spray drift will travel can vary substantially based on wind speed, topography, temperature, the herbicide applied, and the vegetation present.

Spray drift is largely a function of droplet particle size. The largest particles, being the heaviest, will fall to the ground quickly upon exiting the sprayer. Medium size particles can be carried beyond the sprayer swath (the fan shape spray under a nozzle), but virtually all of the particles fall within a short distance of the release point. The smallest, and therefore the lightest particles have the potential to travel the farthest, for this reason if the droplet size forced out the nozzle can be limited to larger particle sizes, the potential for herbicide to drift beyond the targeted vegetation can be controlled. The physics of sprayers dictates that there will always be a small percentage of the spray droplets that are small enough to be carried in wind currents to varying distances beyond the point of release. Since these smallest droplets are a minor proportion of the total spray volume, their toxicological significance beyond the project area boundary rapidly declines as they are diluted in increasing volumes of air. Vegetation on the ground, including the target invasive species themselves, act as a substantial barrier to herbicide droplet drift as well.

Spray nozzle diameter, pressure, the amount of water applied with the herbicide, and herbicide release height are important controllable determinants of drift potential by virtue of their effect on the spectrum of droplet sizes emitted from the nozzles. Meteorological conditions such as wind speed and direction, air mass stability, temperature and humidity and herbicide volatility also affect drift.

Commercial drift reduction agents are available that are designed to reduce drift beyond the capabilities of the determinants previously described. These products create larger and more cohesive droplets that are less apt to break into smaller particles as they fall through the air. They reduce the percentage of smaller, lighter particles that are the size most apt to drift

The Common Control Measures (see Chapter 2.5 and Appendix B for details) include information about effective herbicides and those to avoid in situations near susceptible non-target vegetation.

Special Forest Products

The most popular forest products gathered on the Olympic National Forest are berries, beargrass, salal, mushrooms and medicinal plants. Two of these species are target invasive plants (e.g. St. John's wort, Himalayan blackberries). The Olympic National Forest is currently authorized to use herbicide treatments on 86 acres with no adverse effects on special forest products noted. Non-target special forest products would be protected by the Project Design Features in all action alternatives, and increases in herbicide use conceivable in all alternatives would not likely result in adverse effects to non-target special forest products. However, forest products such as berries that are also invasive species would be killed under the most ambitious treatment scenarios.

Effects from Herbicides to Botanical SOLI's by Alternative

Direct and Indirect Effects of No Action

Under No Action, spot and hand herbicide treatment is approved on about 86 acres and manual/mechanical treatment on an additional 586 acres. Treatments under the No Action alternative have very low potential to adversely impact fungi and vascular and non-vascular plant species of local interest because:

- The total acreage where herbicide could be used is very low; few treatment acres would occur in any one watershed or area of botanical concern.
- Drift associated with spot application methods is relatively easy to manage and hand application methods do not result in any potential drift.

Under No Action, herbicide use is limited to three herbicides, picloram, dicamba, and glyphosate. This limits the range of herbicides available compared to the action alternatives. Picloram poses specific risks to non-target vegetation because it can be persistent in the soil for several years, is highly soluble in water, is resistant to degradation processes, has a high potential to leach to groundwater in most soils, and is mobile under both laboratory and field conditions. Picloram can also move readily to non-target native plants through root translocation or runoff (R6 2005 FEIS 4-29). Like picloram, dicamba is a selective herbicide that can affect broadleaf and woody species, but in general does not affect grasses (may affect some annual grasses). Runoff from dicamba is one of its greatest risks to non-target vegetation, but the effects are highly site specific, and therefore difficult to quantify. Vaporized or volatilized dicamba can affect non-target vegetation, but the level of effect is not understood, and requires more study (R6 2005 FEIS).

Table 38. Effects to Non-target Vegetation from No Action

	Number of Possible Broadcast Acres	Number of SOLI Species at Direct Risk from Treatment		
		Fungi	Bryophytes (Moss)	Vascular Plants
No Action	0	0	0	0

Direct and Indirect Effects of Alternatives B (Proposed Action) and D

Alternatives B and D allow use of several new herbicides (chlorsulfuron, metsulfuron methyl, sulfometuron methyl, imazapic, and imazapyr) that are associated with hazards to non-target vegetation (R6 2005 FEIS, 4-27 to 4-33. The range of herbicides available partially mitigates the risk to non-target vegetation by allowing several options; all infestations known within treatment areas may be effectively treated with low risk to non-target vegetation given careful implementation of Common Control Measures and PDFs.

Broadcast applications pose the greatest potential for harm to non-target vegetation due to drift. Under the most ambitious treatment scenario analyzed, Alternative B is estimated to use broadcast application methods about 34% of the time (1320 acres); Alternative D is estimated to use broadcast application methods about 86% (3,110 acres) of the time.

Project Design Features listed in Chapter 2 would adequately protect non-target vegetation, including fungi, vascular and non-vascular plant SOLI. Table 39 displays Protection Widths for Botanical SOLI.

Fungi Species of Local Interest

In general, herbicides are not expected to affect the fruiting bodies of fungi (personal communication, David Pilz, Faculty Research Assistant, Forest Mycologist, Oregon State University, September 2005). Fungi can absorb toxic minerals and other toxic compounds, accumulating the herbicide. Fungal SOLI's are either parasitic or mycorrhizal, both with an extensive underground hyphal network that potentially can translocate substances (herbicides) to the fruiting body. The effect of individual herbicides to these hyphal networks is largely unknown; so, effects to present and future populations of fungi are unknown as well. A long term monitoring study would be required to determine effect because population variability in fungi is common from year to year. Results of studies of herbicide effects to mycorrhizae are varied, running the gamut of effect: stimulation of mycorrhizal growth, no effect, and inhibition (Estok, D. et al, 1989; Busse, M.D. et. al, 2001). This variability is due to variation in the type of herbicide, the concentration utilized, the fungal species, and environmental factors.

In addition, fungi hyphal networks can extend for long distances, and it is uncertain how to adequately buffer for these organisms. Broadcast treatments of herbicide might effect hyphae several hundred feet or more from the SOLI site, or not have any effect at all. The duration of the effect is also unclear, and would be variable depending on the type and concentration of the herbicide utilized, as well as on environmental factors (microbial activity, organic content, soil type, etc.) While the impact herbicides may have on underground hyphal networks is uncertain, monitoring of known fungi sites of interest would identify observable impacts.

Studies have pointed to both beneficial and inhibitory effects due to variation in the type of herbicide, the concentration, the species of fungi and environmental factors. However, adverse effect on the three fungal SOLI's, *Albatrellus avellaneus, Bondarzewia mesenterica,* and *Ramaria lorithamnus,* are unlikely as currently there are no locations where broadcast treatments would be within 100 feet of the above ground portion (fruiting body) of these fungi. Effects to fungi would be difficult to ascertain visually, so while monitoring is recommended to note changes in fungi populations after treatment, such monitoring may not be conclusive.

Lichen and Bryophyte Species of Local Interest

Bryophyte and lichens are potentially more prone to injury from broadcast drift than other species due to their unique physiology. They lack a tissue layer (cuticle) that regulates substances entering cells from the air and atmosphere (the cuticle in vascular plants is analogous to human skin). Newmaster et al. (1999) raised concern that drift from glyphosate could affect the long-term sustainability of populations of lichens and bryophytes.

Project Design Features are expected to eliminate impacts to lichens and bryophytes from spot and hand application of herbicide. These measures are also expected to eliminate impacts from drift associated with broadcast application, although there is some uncertainty. Adverse effects (mortality, browning, chlorotic coloration, etc.) would likely be visible immediately to several months after treatment. Invisible physiologic effects are also possible, including reduced reproductive capacity, where seed-set is reduced or the organism becomes infertile.

The 100-foot buffer Project Design Feature for broadcast treatment is based on a study done under similar conditions but for vascular plant species (Marrs et. al., 1989). This buffer incorporates an additional 35 feet to mitigate for the uncertainty about effects on non-vascular species. Monitoring and adaptive management (see Chapter 2.5) would ensure that buffer widths are appropriate.

Vascular Plant Species of Local Interest

Botanical design features were developed to minimize/eliminate effects to vascular plant species from hand, spot, and broadcast application of herbicides and are based on scientific literature and resource management experience. Proximity between invasives and SOLI species is one factor that determines the potential for effect from herbicide application. Translocation may occur between roots of adjacent plants, even with hand application of herbicide.

The robustness or size of the SOLI also plays a role. The likelihood is greater that small, delicate plants may be impacted when adjacent invasives are treated. Sufficient distance exists between invasive species and botanical SOLI's to avoid significant risks, even when considering the five rhizomatous botanical SOLI's: *Carex anthoxanthea, Carex obtusata, Carex pauciflora, Galium kamtschaticum,* and *Pellea breweri.*

Table 39. Effects on Botanical SOLI's from Treatment in Alternatives B and D

	Estimated Proportion of Project Area Where Broadcast Would be Allowed	Number of SOLI Species at Direct Risk from Treatment		
		Fungi	Bryophytes (Moss)	Vascular Plants
Proposed Action (Alternative B)	34%	0	0	0
Alternative D	84%	0	0	0

Direct and Indirect Effects of Alternative C

Alternative C also allows use of several new herbicides (chlorsulfuron, metsulfuron methyl, sulfometuron methyl, imazapic, and imazapyr) that are associated with hazards to non-target vegetation (R6 2005 FEIS, 4-27 to 4-33). Under Alternative C, there would be no broadcast application of herbicide anywhere on the Olympic National Forest so the likelihood of extensive non-target impacts is very low.

Fungi Species of Local Interest

Alternative C eliminates the broadcast treatment option, therefore eliminating most of the potential for effects to fungi. Drift from spot application of herbicide is expected to have no effect to the fungi SOLI, *Phaeocollybia fallax*, because there is sufficient distance to the invasive and drift from spot application is largely controllable by the applicator.

Lichen and Bryophyte Species of Local Interest

Alternative C eliminates the broadcast treatment option, therefore eliminating most of the potential for effects to fungi. Drift from spot application of herbicide is expected to have no effect to the three fungi SOLIs, *Albatrellus avellaneus, Bondarzewia mesenterica*,and *Ramaria lorithamnus*, because there is sufficient distance to the invasive and drift from spot application is largely controllable by the applicator.

Vascular Plant Species of Local Interest

Botanical PDFs were developed to minimize/eliminate effects to vascular plant species from spot and broadcast application of herbicides. Under Alternative C, there would be no broadcast treatments allowable. Proposed treatments of the following Olympic National Forest vascular SOLI's: *Carex anthoxanthea*, *Carex pauciflora, Erythronium quinaultense, Galium kamtschaticum,* and *Parnassia palustris* var. *Neogaea*, under Alternative C would not result in any further direct, or indirect negative effects from treatment to these species, as they are found in riparian habitats and would not be treated under Alternative C.

Carex obtusata, *Pellaea breweri,* and *Synthyris pinnatifida* var. *lanuginosa* are not riparian associated and under Alternative C, invasives in proximity to these species could be treated with herbicide. Of the three, none are in close proximity to invasives and spot/hand treatment would have no effect.

Table 40. Alternative C Botanical SOLI's at Risk From Treatment

	Estimated Proportion of Project Area Where Broadcast Would be Allowed	Number of SOLI's at Risk from Treatment		
		Fungi	Bryophytes (Moss)	Vascular Plants
Alternative C	0	0	0	0

Biological Evaluation

The discussions herein and in Appendix C provide the Biological Evaluation that is required for Regional Forester's Sensitive Species and habitats within the project area. None of the sensitive botanical species are likely to be directly harmed by the project. The PDFs, buffers and monitoring strategy eliminate the likelihood of adverse impacts to these species or habitats. However, since all alternatives allow use of herbicide, damage to individual SOLIs remains a possibility. As stated previously, effects on non-vascular plants are fungi are particularly uncertain. Therefore, all alternatives are associated with a finding of "May Impact, Not Likely to Lead to Federal Listing" for all sensitive botanical species.

Cumulative Effects of Herbicide Use on Non-target Plants and Fungi

The Affected Environment describes the limited range of some botanical SOLI's. While past activities may have contributed to the limited extent of botanical SOLI's within the analysis area, the pre-disturbance condition is not known. Therefore, the baseline for comparison of effects to botanical SOLI's is the current inventory. None of the alternatives would significantly contribute to population losses of Species of Local Interest compared to the current inventory.

No Action does not pose any additional risk to botanical SOLI's from treatment above baseline conditions. The 1998 EA/DN found that the currently approved treatments under No Action would have no significant impact on non-target vegetation.

While some adverse effects on non-target vegetation are possible from treatments considered in the action alternatives, they are unlikely to be significant because the extent and threats posed by treatment are generally very small compared to the known range of botanical species, including SOLI's. Project Design Features mitigate known risks and the monitoring and adaptive management plan would ensure uncertain risks are also mitigated.

Invasive plant treatments within the range of botanical SOLI's on lands outside National Forest are possible; the amount of treatment or specific risks from such treatments are unknown. Project Design Features in all alternatives minimize or eliminate risks to non-target vegetation. No immediate conflicts between treatments and SOLI's exist and monitoring and adaptive management would resolve uncertainties over time.

Summary of Effects of Herbicide Use on Non-target Plants and Fungi

Table 38 displays the comparison of alternatives in terms of relative risks associated with herbicide use. Herbicide use in all alternatives would comply with environmental standards, policies and laws. No loss of viability of any botanical SOLI's would likely occur.

Table 41. Summary of Effects on Botanical SOLI's

Alternative	Estimated Proportion of Project Area Where Broadcast Would be Allowed	Number Of SOLI's At Risk from Invasive Plant Treatment
A **No Action**	0	0
B **Proposed Action**	34%	0
C	0	0
D	84%	0

3.3 Terrestrial Wildlife

3.3.1 Introduction

The potential effect of invasive plant treatment on wildlife is a primary public issue (Issue Group 4). The Olympic National Forest provides diverse habitats, ranging from subalpine forest to wet meadows, and from late successional temperate rainforest of Douglas-fir, hemlock and cedar to mixed conifer plantations, for a diverse array of wildlife species, including amphibians and reptiles. Olympic National Forest system lands are located within the Pacific Flyway, which is a major migratory route for thousands of birds. Many species that are not permanent residents on the Forest may be found here during migration.

Olympic National Forest system lands provide important habitat for three federally listed threatened species and two species that are federal candidates, discussed below. No federally listed endangered species occur on the Forest.

Invasive plant species have become established on Olympic National Forest system lands and continue to spread, causing a loss of wildlife habitat and posing a risk of injury to wildlife. Methods used to control invasive plants have the potential to have adverse effects to individual animals as well as wildlife habitat. The following wildlife analysis focuses on potential effects of treatment on terrestrial Species of Local Interest, including Survey and Management species; Listed and Proposed Threatened and Endangered Species, Regional Forester Sensitive Species and Management Indicator Species (MIS). Effects on MIS species indicate welfare of other species using the same habitat (Thomas 1979). Birds of Conservation Concern are also discussed.

3.3.2 Affected Environment

Invasive Plants and Wildlife Habitat

Some wildlife species utilize invasive plants for food or cover. For example, it has been reported that elk, deer and rodents eat rosettes and seed heads of spotted knapweed. However, the few uses that an invasive plant may provide do not outweigh the adverse impacts to an entire ecosystem (Zavaleta, 2000). More detailed information on the effects of invasive plants to wildlife is reported in the R6 2005 FEIS.

Invasive plants have adversely impacted habitat for native wildlife (Washington Dept. of Fish and Wildlife, 2003). Any species of wildlife that depends upon native understory vegetation for food, shelter, or breeding, is or can be adversely affected by invasive plants. In the case of common burdock (A*rctium minus),* the prickly burs can trap bats and hummingbirds and cause direct mortality to individuals (Raloff, 1998; and documented in photos by Clay Grove, USFS, and Rosa Wilson, NPS). Himalayan blackberry has created a physical barrier and blocked salmonid migration upstream in one tributary on the Columbia River Gorge National Scenic Area (Fiedler, C., personal observation, 2005).

Habitats that become dominated by invasive plants are often not used, or used much less, by native and rare wildlife species. Washington Department of Fish and Wildlife (2003) identified invasive plants, such as yellow starthistle and knapweed, as threats to upland game bird habitat. Species restricted to very specific habitats, for example pond-dwelling amphibians, are more susceptible to adverse effects of invasive plants.

Of the federally listed species that occur on Olympic National Forest system lands, none are known to be adversely affected by invasive plants within the project area. Bald eagle mortality in other parts of the U.S. has been linked to a toxin produced by a *cyanobacterium* that grows on the invasive aquatic plant, *Hydrilla verticillata* (Wilde, 2004).

Some invasive species could adversely affect bald eagle foraging areas by creating dense patches of tall vegetation in and around streams or rivers that could hinder access to salmon. This speculation is based on observations of some invasive species that grow along rivers and streams in the Region.

In summary, invasive plants are known or suspected of causing the following effects to wildlife:

- Embedded seeds in animal body parts (e.g. foxtails), or entrapment (e.g. common burdock) leading to injury or death.
- Scratches leading to infection.
- Alteration of habitat structure leading to habitat loss or increased chance of predation.
- Change to effective population through nutritional deficiencies or direct physical mortality.
- Poisoning due to direct or indirect ingestion of toxic compounds found on or in invasive plants.
- Altered food web, perhaps due to altered nutrient cycling.
- Source-sink population demography, with more demographic sinks than sources.
- Lack of proper forage quantity or nutritional value at critical life periods.

Threatened, Endangered, Sensitive, and Management Indicator Species

Federally Listed Species

Several species listed as “threatened” under the Endangered Species Act of 1973 (as amended) (ESA), are found on Olympic National Forest system lands. In addition, the U.S. Fish and Wildlife Service (FWS) maintains a list of “candidate” species. Candidate species are those taxa that the FWS has on file sufficient information on biological vulnerability and threats to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions (U.S. Fish and Wildlife Service 1996). Listed and candidate species found on Olympic National Forest system lands are included in Table 42.

Table 42. Federally Listed Species on Olympic National Forest

Common Name	Scientific Name	Status	Critical Habitat
Mammals			
Pacific fisher	*Martes pennanti*	Candidate	None
Mazama pocket gopher	*Thomomys mazama melanops*	Candidate	None
Birds			
Northern Bald eagle	*Haliaeetus leucocephalus*	Threatened	None
Northern spotted owl	*Strix occidentalis caurina*	Threatened	Designated
Marbled murrelet	*Brachyramphus marmoratus*	Threatened	Designated

The two candidate species found on Olympic National Forest system lands are also included in the Regional Forester's Sensitive Species List and are discussed in the section titled "Forest Service Sensitive Species."

Brief general descriptions of the species' life history, threats, conservation measures, and their occurrence are in Appendix C. More detailed accounts can also be found in the Biological Assessment prepared for the Regional Invasive Plant Program (USDA Forest Service 2005), which is incorporated by reference.

Forest Service Sensitive Species

Terrestrial wildlife species found on Olympic National Forest system lands that are included in the Region's "Special Status/Sensitive Species Program" are listed in Table 43. The "Special Status/Sensitive Species Program" and the Regional Forester's Sensitive Species List are proactive approaches for meeting the Agencies obligations under the Endangered Species Act and the National Forest Management Act (NFMA), and National Policy direction as stated in the 2670 section of the Forest Service Manual and the U.S. Department of Agriculture Regulation 9500-4. The primary objectives of the Sensitive Species program are to ensure species viability throughout their geographic ranges and to preclude trends toward endangerment that would result in a need for federal listing. Species identified by the FWS as "candidates" for listing under the ESA, and meeting the Forest Service criteria for protection, are included on the Regional Forester's Sensitive Species Lists.

Table 43. Regional Forester Sensitive Terrestrial Wildlife Species

Common Name	Scientific Name	Occurrence on National Forest System Lands*
Mammals		
Townsend's big-eared bat	*Corynorhinus townsendii*	Documented
Pacific fisher	*Martes pennanti*	Extirpated, historically Documented
Mazama pocket gopher	*Thomomys mazama melanops*	Suspected
Birds		
Common loon	*Gavia immer*	Documented
American peregrine falcon	*Falco peregrinus anatum*	Documented
Amphibians		
VanDyke's salamander	*Plethodon vandykei*	Documented
Cope's giant salamander	*Dicamptodon copei*	Documented
Olympic torrent salamander	*Rhyacotriton olympicus*	Documented
Terrestrial Invertebrates (also Northwest Forest Plan Survey and Manage Species)		
Puget Oregonian	*Cryptomastix devia*	Documented
Burrington's jumping slug	*Hemphillia burringtoni*	Documented
Warty jumping slug+	*Hemphillia glandulosa*	Documented
Malone's jumping slug	*Hemphillia malonei*	Suspected
Blue-gray taildropper	*Prophysaon coeruleum*	Suspected
Hoko vertigo	*Vertigo n. sp.*	Suspected

*__Documented/Suspected__: Documented means that an organism that has been verified to occur in or reside on an administrative unit. Suspected means that an organism that is thought to occur, or that may have suitable habitat, on Forest Service land or a particular administrative unit, but presence or occupation has not been verified.
+ The warty jumping slug was removed from the Survey and Manage list for Olympic National Forest in the 2001 annual species review.

The Pacific fisher and the California wolverine do not currently occur on Olympic National Forest system lands. The wolverine occurrence is a mistake in the 2004 Regional Forester's Sensitive Animal List which will be corrected in the next version (Piper, 2005, personal communications). The Pacific fisher is extirpated from the entire state of Washington (WDFW, 2005). The Pacific fisher and California wolverine will not be discussed further in this analysis.

Brief general descriptions of the species' life history and their occurrence on the Olympic National Forest are in Appendix C.

Survey and Manage Species

"Survey and Manage" species were identified in the 1994 Northwest Forest Plan. In 2001 (2001 ROD) and again in 2004 (2004 ROD), the agencies sought to make changes in this mitigation measure. The 2004 ROD was litigated and on January 9, 2006, Judge Pechman signed an Order that reinstated the 2001 ROD. Thus, the Survey and Management Mitigation Measure currently applies to all species that were included in the program in 2001. Species that were added to the Regional Forester's Sensitive Species Program in 2004 remain in both programs and are discussed above, with further information in Appendix C.

For the Olympic National Forest, mollusks were the only fauna included in the Survey and Manage program in the 2001 ROD. All Survey and Manage mollusks were added to the Sensitive Species Program, except for evening fieldslug (*Deroceras hesperium*) and are therefore listed above.

Evening fieldslug

This slug has been reported to be associated with wet meadows in forested habitat in a variety of low vegetations, litter, and debris; rocks may also be used (Pillsbury 1944). Little is known about this species or its habitat, but it is thought to be most associated with perennial wetlands, springs, seeps in riparian areas (Duncan et al. 2003). It is one of the least known slugs in the western U.S. (Duncan 2005). Most of the 19 documented sites for this species occur on the eastern slope of the Oregon Cascades (Duncan 2005). No known sites are reported in Washington. From 1998-2002, the Olympic National Forest conducted extensive surveys for this species, as well as other mollusks, across the forest in a range of habitat conditions. Because the evening fieldslug has not been documented on the Olympic National Forest, no effects are conceivable and this species will not be discussed further in this document.

Management Indicator Species

Management Indicator Species (MIS) are selected species whose welfare is believed to be an indicator of the welfare of other species using the same habitat or a species whose condition can be used to assess the impacts of management actions on a particular area (Thomas 1979). Table 44 includes those species that were identified as MIS for the Olympic National Forest (USDA 1990). Aquatic MIS are discussed in the aquatic species specialist's report.

Table 44. Management Indicator Species

Common name	Scientific Name
Bald eagle	*Haliaeetus leucocephalus*
Northern Spotted owl	*Strix occidentalis caurina*
Pileated woodpecker	*Dryocopus pileatus*
"Primary cavity excavators"	see below
Columbian black-tailed deer	*Odocoileus hemionus columbianus*
Roosevelt elk	*Cervus canadensis roosevelti*
Pine marten	*Martes americana*

Species identified as MIS for the Olympic National Forest, with the exception of the Roosevelt elk and Columbia black-tailed deer, represent a suite of species that are dependent on mature and old-growth forest habitat. The black-tailed deer and elk represent wildlife associations that require a mix of vegetative age classes.

MIS are discussed below. The bald eagle is sensitive to management in riparian areas. The northern spotted owl represents wildlife species associated with mature and older coniferous forests. The bald eagle and northern spotted owl are discussed under the section titled "Federally Listed Species."

Pileated woodpecker

The pileated woodpecker represents species that inhabit mature coniferous forest habitats. The pileated woodpecker is the largest woodpecker species in the western United States and nests in cavities of large trees or snags.

It is a denizen of mature forests, relying on dead and decaying trees for foraging and nesting. Pileated woodpeckers can act as a keystone habitat modifier by excavating large numbers of cavities that are depended upon by several other species, and by influencing ecosystem processes such as decay and nutrient cycling (Aubry and Raley 2002). Pileated woodpeckers will return to areas after timber harvesting (Ehrlich 1988), however, past management in the Pacific Northwest has lead to relatively few snags and down logs, especially of large diameters, remaining in many watersheds. Previous timber harvest, as opposed to wildfire events, has had the greatest effect on the availability of large diameter standing dead trees in the Olympic National Forest.

Primary Cavity Excavators

A large number of species rely on cavities in trees for shelter and nesting. Olympic National Forest system lands has designated a group of species for this Management Indicator category.

This group of species represents snag-dependent cavity nesters. It includes animals dependent on dead or dying trees for nest sites. "Primary cavity excavators" comprise a broad group of species associated with standing dead trees or snags and down logs, and that excavate their own nests. Species included in this MIS group are listed in Table 45.

Table 45. Primary Excavator Species

Primary Excavators	Occurrence on Olympic National Forest
Lewis' woodpecker	transient
Red-breasted sapsucker	common
red-napped sapsucker	transient
downy woodpecker	very common
hairy woodpecker	very common
three-toed woodpecker	very rare
black-backed woodpecker	transient
northern flicker	very common
pileated woodpecker	common
black-capped chickadee	common
mountain chickadee	very rare
chestnut-backed chickadee	very common
red-breasted nuthatch	very common
white-breasted nuthatch	transient
northern flying squirrel	common

Brief general descriptions of the cavity excavator's life history and their occurrence are in Appendix C

Roosevelt Elk and Columbian Black-tailed Deer

These two species are known throughout the Olympic National Forest and Peninsula. There are several established herds of Roosevelt elk that reside on the Forest as year-round residents, as well as many that are migratory, for example, moving into the Olympic National Park during the summer. Deer occur throughout the forest, and both species use a combination of habitats comprised of cover and forage areas that are not too fragmented by road systems. Taber and Raedeke (1980) reported that winter mortality, legal harvest, and poaching were the primary causes of elk mortality. Poaching is the second leading cause of mortality to elk in Washington State and is prevalent on the Olympic Peninsula (WDFW 2004). As one might expect, a high density of roads, common throughout much of the Peninsula, would have a negative impact on elk with increased disturbance from legal hunting and poaching (CEMG 1999).

On the Olympic Peninsula, winter range is typically defined as land below 1500 feet in elevation (USDA 1995). The Olympic Land and Resource Management Plan (USDA 1990) provides interim direction that in those areas managed for winter survival, habitat should be managed to provide 10-15% of the area in openings (natural and created) and the remainder in thermal and hiding cover, 20% of which should be optimal cover (the Land and Resource Management Plan also recommends managing roads to reduce wildlife disturbance). Preferred forage areas are in natural openings or managed stands that have been harvested no later than 30 years ago.

Pine Marten

The pine marten represent species that inhabit mature coniferous forest habitats. Pine martens occur in forests containing snags and down logs, which provide suitable denning sites. The American marten (*Martes americana*), also known as the "pine marten," is most closely associated with heavily forested east and north-facing slopes that contain numerous windfalls (Maser 1998). They tend to avoid areas that lack overhead protection and the young are born in nests within hollow trees, stumps, or logs. According to a Washington Department of Fish & Wildlife study (Sheets 1993), which combined trapper interviews with remote camera surveys in various locations on the Peninsula, it was concluded that marten may only be found within the Olympic National Park, and in surrounding low elevation wilderness areas and un-fragmented mature timber on the Olympic National Forest adjacent to the park. National Forest land, in general, has perhaps become too fragmented to support a population.

Past management has lead to relatively few snags and down logs, especially of large diameters. Historic fire and intensive forest stand management within the national forest has lead to relatively few large snags and down logs, resulting in lower densities relative to historic levels. Much of the area is less than 60 years old and is interspersed with small patches of old growth.

The Olympic National Park has conducted surveys for pine marten in recent years using smoked track plates and remote camera stations. No pine marten have been detected within the park during these surveys. Given these survey results, it is unlikely that they would occur on the Olympic National Forest, but they could be present in more remote wilderness areas, or in contiguous mature forest, where forest has not been fragmented.

Birds of Conservation Concern

Olympic National Forest system lands are included in Bird Conservation Region Five (Northern Pacific Forests). Within this region, Olympic National Forest system lands may provide significant habitat, based on range maps in NatureServe Explorer (NatureServe 2005, Ridgely et al. 2003) and forest survey information) for five species listed by the United States Department of Interior Fish and Wildlife Service (FWS) as "Birds of Conservation Concern.. These species include black swift (Cypseloides niger), rufous hummingbird (Selasphorus rufus), and olive-sided flycatcher (Contopus cooperi). Peregrine falcons (Falco peregrinus) are included in Bird Conservation Region Five and occur on the Olympic Peninsula, but they are not known to nest on Olympic National Forest system lands, based on recent surveys. Brief descriptions of these species' life history are found in Appendix C.

Landbirds

In 1999, Partners in Flight released a conservation strategy for landbirds in coniferous forests of western Oregon and Washington (Altman 1999). The strategy identifies a select group of focal species and their associated habitat attributes that can be used to identify desired forest landscapes. All of the focal species identified (Altman 1999, Table 3, p. 20) are found on the Olympic National Forest. The strategy is intended to help facilitate land management planning for healthy populations of native landbirds. The document focuses on landscape-scale forest management, with emphasis on habitat structure. The conservation options recommended in the strategy are not relevant to invasive plant treatments because the treatments proposed in this DEIS do not involve modifying forest habitat structure or any other modifications to native habitat.

Amphibian Decline

Many species of amphibians in many parts of the world have experienced alarming population declines in the past two decades. International task forces have been formed and scientists have researched causes. A number of studies have documented declines, even in relatively undisturbed habitats (Drost and Fellers 1996, Lips 1998), while other studies have found some populations to be stable (Pechmann et al. 1991). However, detecting actual population declines in amphibian populations is difficult due to the extreme annual variation in populations caused by environmental factors, such as drought (Pechmann et al. 1991, Reed and Blaustein 1995).

Potential causes of amphibian declines investigated include ultraviolet radiation (Starnes et al. 2000, Adams et al. 2001), pesticides (Bridges and Semlitsch 2000), global warming (Blaustein et al. 2001, Crump 2005) habitat loss, non-native predators (e.g. Drost and Fellers 1996, Knapp and Matthews 2000), and disease (Muths et al. 2003, Berger et al. 1998, Berger et al. 1999), among others. Results of studies are variable and some populations are in decline while others are not. There is no "smoking gun" and all the causes are implicated to some degree (Halliday 2005).

3.3.3 Environmental Consequences

Introduction

Effects of invasive plant treatment methods to wildlife were evaluated and discussed in detail in the R6 2005 FEIS and its Appendix P, the corresponding Biological Assessment (USDA Forest Service 2005c), project files, and SERA risk assessments (2001, 2003, 2004). These documents indicate that disturbance from manual and mechanical treatment pose greater risks to terrestrial wildlife species of local interest than herbicide use.

For spotted owls and marbled murrelets, loud and sudden noises above background or ambient levels (those above 92 dB) can cause disturbance that might flush a bird off the nest or abort a feeding attempt. Vehicles used to spray roadside vegetation with herbicides do not make noise above 92 dB, based on recent field measurements, so no "injury" or "harassment" from noise will occur. Other mechanical devises proposed for use on invasive plants include brushing machines, mowers, chainsaws, and string trimmers. These tools have the potential to create noise above background levels that may disturb owls or murrelets if used close to nests during the early nesting season. Bald eagles could be disturbed by these same tools, as well as human presence, but eagles are quite variable in their responses to activity and noise in the vicinity of their nests or roosts.

Small species that lack rapid mobility (e.g. mollusks and salamanders) are vulnerable to crushing or injury from people or equipment. Invasive plant treatments will not alter native habitat structure or composition for MIS, or bird species included in Birds of Conservation Concern or the Partners in Flight strategy for landbirds (Altman 1999).

Risk from herbicide exposure was determined using data and methods outlined in the SERA risk assessments. Tables 8 and 9 in the Biological Assessment (USDA Forest Service 2005c, pp. 138-140) list the toxicity indices used as the thresholds for potential adverse effects to mammals and birds (respectively) from each herbicide. A quantitative estimate of dose using a "worst case" scenario was compared to these toxicity indices. There is insufficient data on species-specific responses to herbicides for free-ranging wildlife, so wildlife species were placed into groups based on taxa type (e.g. bird, mammal), body size, and diet (e.g. insect eater, fish eater, herbivore).

Under "worst case" scenarios, mammals and birds that eat insects or grass may be harmed by some herbicides and surfactants. Amphibians also appear to be at higher risk of adverse effects due to their permeable skin and aquatic or semi-aquatic life history.

The SERA and Bakke risk assessments and the R6 2005 FEIS indicated that for typical application rates, triclopyr and NPE surfactants produced doses that exceeded toxicity indices for birds and mammals. NPE surfactant exceeded the toxicity index for direct spray of a small mammal, large mammal and large bird that consumed contaminated vegetation (acute), and small mammal and small bird that consume contaminated insects.

The "worst case" exposure scenarios do not account for factors such as timing and method of application, animal behavior and feeding strategies, seasonal presence or absence within a treatment area, and/or implementation of Project Design Features. Therefore, risk is overestimated when compared to actual applications proposed in this EIS.

Nonetheless, caution in the design and implementation of the project is warranted. In many cases, insufficient data is available to allow quantitative risk assessment. For instance, data was insufficient to assess risk of chronic exposures for a large grass-eating bird from NPE exposure, or insect-eating birds and mammals for several herbicides. Data was also lacking on potential adverse effects of herbicides to mollusks and amphibians. Some data suggested that amphibians may be as sensitive to herbicides as fish (Berrill et al. 1994; Berrill et al. 1997; Perkins et al. 2000).

The limited spatial extent of infestations, which are limited primarily to disturbed roadsides (see Section 2.5), and the limits placed on herbicide applications will reduce exposure of wildlife to herbicides. Standards 19 and 20 adopted in the R6 2005 ROD require that adverse effects to wildlife species of local interest from invasive plant treatments be minimized or eliminated through project design and implementation. In addition, Standard 16 restricts broadcast use of triclopyr, which eliminates plausible exposure scenarios. All action alternatives must be designed to comply with these standards.

To account for uncertainty, the Project Design Features, for example, eliminate broadcast herbicide treatments near perennial streams; minimize disturbance to certain habitats during certain times of the year; and limit the amount or proportion of certain habitats that may be treated in a 30-day period. These Forest Plan Standards and Project Design Features ensure that no alternative adversely affects federally listed species; results in a trend toward listing of any sensitive species; nor adversely impacts the habitat of Management Indicator Species, landbirds, or Birds of Conservation Concern.

Direct and Indirect Effects on Federally Listed Species: Bald Eagles, Spotted Owls, Marbled Murrelets

The Project Design Features listed for bald eagles, spotted owls, and marbled murrelets apply to all action alternatives. For bald eagles and marbled murrelets, which feed upon fish, adverse effects from herbicide or NPE surfactant exposure are not plausible because murrelet prey is not found on National Forest System land, and even if they fed on contaminated fish for a lifetime, the estimated dose for herbicide or NPE does not exceed a threshold of concern for potential effects (i.e. the toxicity index). For spotted owls, no herbicide or NPE dose from feeding on prey that had been directly sprayed exceeded the toxicity index for typical application rates. In addition, exposure of spotted owl prey to herbicide, and the consumption of contaminated prey by spotted owls are not plausible because of the life history and habitat of the prey. The owl's arboreal and nocturnal prey, which does not feed upon invasive plants, has almost no opportunity to become exposed to herbicide or NPE surfactants.

Exposure scenarios used to analyze potential effects from herbicides are discussed in the 2005 R6 FEIS (Appendix P, p. 15-17). The potential effect to birds from herbicide is listed in the Table 4-9 of the 2005 R6 FEIS. A summary of Direct and Indirect Effects to Terrestrial Wildlife Species of Local Interest follows:

Bald Eagle

Disturbance

Potential effects of invasive plant treatment methods on bald eagles are associated with disturbance that may occur during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people and vehicles. Human and vehicle presence can disturb bald eagles during the breeding season, causing the birds to leave nests, or stay away from the nest long enough to have detrimental effects to eggs or young (U.S. Fish and Wildlife Service, 1986). Effects from mechanical methods (e.g. tractors, bulldozers, chainsaws, or string trimmers) may be more likely to occur, and occur at greater distances from the project site, because machinery creates louder noise.

The critical period in Oregon and Washington when human activities could disturb occupied nests extends from January 1 to August 31 (Anthony and Isaacs, 1989, U.S. Fish and Wildlife Service, 1981). Bald eagles are sensitive to human disturbance during this time, particularly within sight distance of nest sites. Invasive plant treatments will avoid conducting projects that create noise or disturbance above ambient levels in proximity to an occupied nest during the nesting season, as required by PDF J1-a. This same PDF has been included in many Biological Opinions throughout the region and has been found to be effective at minimizing effects to bald eagles because it minimizes or eliminates the source of disturbance near nests.

Invasive plant treatments will not result in the removal of bald eagle nest or roost trees, or suitable habitat, because invasive plants do not provide habitat. Projects could occur within suitable habitat.

Eleven bald eagle nests occur within 0.25 mile of proposed treatment areas. Because disturbance is a plausible occurrence, all action alternatives may affect bald eagle. However, the project design features included in all alternatives would minimize the likelihood that disturbance to nesting eagles would actually occur. Therefore, all alternatives "may affect, but are not likely to adversely affect" the bald eagle from disturbance.

Wintering bald eagles are not as restricted to one location and are not as sensitive to disturbance as nesting eagles. Disturbance near winter roost sites is not likely to occur in any alternative because invasive plant treatments generally do not occur during the winter.

Effects of Herbicides

Herbicides and surfactants applied according to PDFs, pose no risk to bald eagles. Bald eagles are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial application is proposed. No ground applications of herbicide would reach the upper canopies of mature trees where bald eagles nest.

The potential for the herbicides to adversely affect bald eagles was determined using quantitative estimates of exposure from worst-case scenarios. The dose estimates for fish-eating birds were calculated using herbicide or NPE concentrations in fish that have been contaminated by an accidental spill of 200 gallons into a small pond. Assumptions used include no dissipation of herbicide, bioconcentration is equilibrium with water, contaminant level in whole fish is used, and upper estimate assumes 15 percent of body weight eaten/day. For chronic exposures, we used a scenario where the bird consumes fish from water contaminated by an accidental spill over a lifetime. All estimated doses used in effects analysis were the upper levels reported in the Forest Service/SERA risk assessments.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals, which may not accurately represent potential effects to free-ranging wildlife.

The results of these exposure scenarios indicate that no herbicide or NPE surfactant poses any plausible risk to birds from eating contaminated fish. All expected doses to fish-eating birds for all herbicides and NPE are well below any known No Observable Adverse Effect Level (NOAEL - see R6 2005 FEIS, Appendix B). The weight of evidence suggests that adverse effects to bald eagles from NPE or the herbicides included in the action alternatives are not plausible.

Northern Spotted Owl

Disturbance

Invasive plant treatments may disturb spotted owls during the nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people, vehicles and equipment. The potential for visual disturbance to cause harassment of spotted owls is low. Noise-generating activities above ambient could potentially cause enough disturbance to result in harassment of northern spotted owls during the breeding season. Noise or visual stimuli may interrupt or preclude essential nesting and feeding behaviors, cause flushing from the nest or missed feedings of young (U.S. Fish and Wildlife Service, 2003).

Projects that generate noise or activity above ambient levels and occur within the 35 yards (for heavy equipment), or 65 yards (for chainsaws or motorized tools), from an active spotted owl nest may cause these harassment effects (U.S. Fish and Wildlife Service, 2003). Some equipment used to treat invasive plants could create noise above ambient levels, depending upon site-specific conditions. Engines used to pump herbicide and other liquids through nozzles for roadside spraying operations, normally in the back of a pick up truck, may generate noise levels that could disturb spotted owls. Because noise levels of this type of equipment were not known, two diesel pump engines used for roadside spraying were evaluated for noise level. Two separate readings of different pump engines using different decibel meters produced readings of 72-75 decibels within 10 yards, dropping to 64-67 decibels at 35 yards (observations in the project file). The threshold for noticeable noise is 70 decibels and the threshold for disturbance causing “injury” or “harassment” is 92 decibels (U.S. Fish and Wildlife Service 2003). Vehicles used to spray roadside vegetation with herbicides do not make noise above 92 dB, based on the measurements taken, so no effect to the northern spotted owl from noise disturbance will occur. Within 10 yards of a nest or un-surveyed suitable habitat, roadside spraying could create a brief noise of notice to spotted owls (e.g. slightly above 70 dB), but not loud enough to create disturbance (U.S. Fish and Wildlife Service 2003, project file data). County Weed Coordinators also reported that the noise of diesel pump engines measured for this analysis was greater than the noise of gasoline-powered pump engines used by some operators (D Sherwin, pers. comm. 2005, D. Durfey, pers. comm. 2005). The gasoline-powered pump engines will be quieter than the diesel pump engines that we measured.

On Olympic National Forest system lands, five known spotted owl activity centers are located within 65 yards of treatment areas where brushing or mowing is currently prescribed. There is also an abundance of unsurveyed suitable habitat on the Olympic National Forest where spotted owls could nest. Mowing and brushing uses machinery that can create louder noise, so treatment areas with these methods was considered a potential disturbance effect for owls.

Treatment areas that may use brushing or mowing include 3,442 acres of suitable habitat for spotted owls and/or marbled murrelets. The mandatory PDF for spotted owls (PDF J-2) requires that these methods, or others that generate sufficient noise (greater than 92 dB), to be conducted farther away than 35 yards for heavy equipment or motorized hand tools, and 65 yards for chainsaws, or outside the breeding season. This PDF has been included in several Biological Opinions throughout the region and has been found to be effective at minimizing effects to spotted owls because it minimizes or eliminates the source of disturbance near nests or suitable habitat.

Therefore, noise from mechanical and manual methods to control invasive plants, including equipment used to spray roadside vegetation, “may affect, but is not likely to adversely affect” spotted owls.

Effects of Herbicides

Exposure scenarios used to analyze potential effects from herbicides are discussed in 2005 R6 FEIS, Appendix B, p. 461. None of the herbicides proposed for use in this EIS nor NPE surfactants, applied at typical application rates, pose a risk to northern spotted owls.

Spotted owls are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial applications are proposed. No ground applications of herbicide would reach the upper canopies of mature trees where the owls nest and forage.

Spotted owls within Douglas-fir/Hemlock forests prey on red tree voles and flying squirrels, which are nocturnal and chiefly arboreal. Voles feed on the needles of Douglas-fir trees and the flying squirrels feed primarily on fungi and lichen. It is not plausible for the arboreal owls or their prey to be exposed to herbicides used within their activity centers in this forest type. However, a worst-case exposure scenario for the spotted owl was conducted using consumption of prey that had been directly sprayed, and assuming 100 percent absorption of the herbicide.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals which may not accurately represent potential effects to free-ranging wildlife.

At typical application rates, the estimated doses from the exposure scenarios are all less than the reported NOAELs (no-observable adverse effect level) for all herbicides and NPE. Therefore, there is no basis for asserting or predicting that adverse effects to spotted owls from NPE or the herbicides considered in this EIS are plausible.

Critical Habitat

Invasive plant treatments do not remove or modify any of the primary constituent elements that define critical habitat. The action alternatives will have “no effect” to critical habitat for the northern spotted owl.

Marbled Murrelet

Disturbance

Invasive plant treatments are associated with disturbance that may occur during the marbled murrelet nesting season. Direct effects from invasive plant treatment include disturbance caused by noise, people, equipment and vehicles. However, the potential for visual disturbance to cause harassment of marbled murrelet is low.

Noise-generating activities above 92 dB could potentially cause enough disturbance to result in harassment during the breeding season (U.S. Fish and Wildlife Service 2003). Vehicles used to spray roadside vegetation with herbicides do not make noise above 92 dB, based on the measurements taken, so no effect to the marbled murrelet from noise disturbance will occur. Within 10 yards of a nest or un-surveyed suitable habitat, roadside spraying could create a brief noise of notice to marbled murrelets (e.g. slightly above 70 dB), but not loud enough to create disturbance resulting in “harassment” or “injury” (U.S. Fish and Wildlife Service 2003, project file data). (see section on spotted owl above).

Mowing and brushing uses machinery that can create louder noise, so treatment areas with these methods may disturb murrelets. Treatment areas that may use brushing or mowing include 3,442 acres of suitable habitat for spotted owls and/or marbled murrelets. Mandatory PDFs for marbled murrelets require that these methods, or others that generate sufficient noise, be conducted farther away than 35 yards for heavy equipment or motorized hand tools, and 45 yards for chainsaws, or outside the breeding season. This will minimize any potential disturbance. There are 20 known or historic marbled murrelet sites within 65 yards of treatment areas that are currently prescribed for brushing or mowing. This PDF has been included in several Biological Opinions throughout the region and has been found to be effective at minimizing effects to marbled murrelets because it minimizes or eliminates the source of disturbance near nests or suitable habitat.

Therefore, noise from mechanical and manual methods to control invasive plants, including equipment used to spray roadside vegetation, “may affect, but is not likely to adversely affect” marbled murrelets.

Effects of Herbicide

Exposure scenarios used to analyze potential effects from herbicides are discussed in USDA Forest Service 2005b, Appendix B. None of the herbicides proposed for use in this EIS nor NPE surfactants, applied at typical application rates, pose a risk to marbled murrelets.

Marbled murrelets are not likely to be directly sprayed, or encounter vegetation that has been directly sprayed, because no aerial applications are proposed. No ground applications of herbicide would reach the upper canopies of mature trees where murrelets nest.

Murrelets feed on marine fish, which will not be exposed to herbicides or NPE from control of invasive plants on lands administered by the Forest Service. It is not plausible for their primary prey to be exposed to herbicides or NPE considered in this analysis. However, some murrelets in some locations have been reported to feed upon some freshwater fish (Carter and Sealy 1986). Therefore, in order to investigate a worst-case scenario for exposure, a scenario involving the consumption of contaminated fish was analyzed. The potential for the herbicides included in the action alternatives to adversely affect marbled murrelets was determined using quantitative estimates of exposure from worst-case scenarios. The dose estimates for fish-eating birds were calculated using herbicide or NPE concentrations in fish that have been contaminated by an accidental spill of 200 gallons into a small pond.

Assumptions used include no dissipation of herbicide, bioconcentration is equilibrium with water, contaminant level in whole fish is used, and upper estimate assumes 15 percent of body weight eaten/day. For chronic exposures, we used a scenario where the bird consumes fish from water contaminated by an accidental spill over a lifetime. All estimated doses used in effects analysis were the upper levels reported in the Forest Service/SERA risk assessments.

The following interpretations of the exposure scenario results are made with the reservation that toxicity data was generated from laboratory animals that may not accurately represent potential effects to free-ranging wildlife. The results of the exposure scenarios indicate that no herbicide or NPE surfactant poses any plausible risk to birds from eating contaminated fish. All expected doses to fish-eating birds for all herbicides and NPE are well below any known NOAEL (see R6 2005 ROD, Appendix B). Even if they fed, for a lifetime, upon fresh-water fish that had been contaminated by an accidental spill of herbicide or NPE, they would not receive a dose that exceeds any known NOAEL. Therefore, marbled murrelets would not be adversely affected by herbicide use in any alternative.

Critical Habitat

Invasive plant treatments do not remove or modify any of the primary constituent elements that define critical habitat. The action alternatives will have no effect to critical habitat for the marbled murrelet.

Summary of Effects Determinations – Federally Listed Species

Table 46. Effects Determinations on Federally Listed Species (All Action Alternatives)

Species	Status	Effects Determinations
Northern Bald eagle	Threatened	May Affect, Not Likely to Adversely Affect
Northern spotted owl	Threatened	May Affect, Not Likely to Adversely Affect
Marbled murrelet	Threatened	May Affect, Not Likely to Adversely Affect

Direct and Indirect Effects on Regional Forester Sensitive Species

Under all alternatives, two primary effects on sensitive wildlife species are plausible: 1) disturbance and trampling from machinery or people treating invasive plants; and 2) risk from herbicide contact, particularly to species for which data is not sufficient to allow quantitative estimates of risk.

Sensitive species' habitat would be protected in all alternatives because invasive plant treatments do not remove suitable habitat for any species, and the majority of the treatments will occur along highly disturbed roadsides which do not provide suitable habitat in most cases. Some species on the Olympic National Forest may have suitable habitat along roads, although in small amounts relative to the amount of suitable habitat that is not within a road corridor.

Townsend's big eared bat

This bat is known to have roosts on bridges within or near treatment areas. Traffic along the roads and the bridges used for roosting was well-established when the bats colonized the bridges. Roadside treatments typically consist of a boom or nozzle spray attached to a pick-up truck, or a person with a backpack sprayer conducting spot sprays of plants. Both treatment methods only take a couple minutes to conduct, do not generate noise much beyond the background noise of the road and bridge use, and do not occur in close proximity to the bats themselves. Therefore, the likelihood of disturbing roosting bats during treatment of roadside invasive plants is remote. Invasive plant treatments in the treatment areas near bridges known to be utilized by Townsend's big-eared bats are not likely to adversely impact Townsend's big-eared bats.

The bats forage over large areas catching insects (primarily moths) in flight or by gleaning from vegetation. The small amount of acreage proposed for treatment, scattered in small patches, make it unlikely that the bats would forage within treatment areas and on insects that have been inadvertently sprayed by herbicides and NPE surfactant. If contaminated insects were ingested, only NPE surfactants resulted in a dose that exceeds the toxicity index. In order to receive this dose, the bat would have to consume nothing but contaminated insects for an entire nights feeding. Given the bats foraging habits, it is unlikely that bats would be exposed to this level of NPE. In addition, because the bats roost in crevices well above ground level during the day, it is not plausible that they could be directly exposed to spray of herbicides or NPE.

Data is lacking on risk from chronic exposure to contaminated insects. The likelihood of a chronic exposure to contaminated insects is remote, given the small acreages treated and the relatively large areas in which bats forage. The bats are not likely to forage exclusively within treated areas over a 90-day period (the chronic exposure) so there does not appear to be a plausible risk from chronic exposure. Therefore, "no impact" to Townsend's big-eared bats will occur for all action alternatives.

Mazama (Olympic) Pocket Gopher

Mazama (Olympic) pocket gopher is not known to occur on the Olympic National Forest, but there may be suitable habitat within the higher elevations in Buckhorn Wilderness. Treatment areas 9H-01 and 9H-Three O'Clock Botanical Area are adjacent to the wilderness, but occur at the lower elevations than inhabited by Mazama pocket gophers. Since there are no proposed treatment areas within suitable habitat, no alternatives would impact the Mazama pocket gopher.

Common Loon

The loon has been documented on Lake Quinault and Wynoochee Lake within Olympic National Forest system lands. They are winter visitors and are not known as breeding residents. Proposed invasive plant treatment sites (9P-32, 9P-32a, and 9H-27) are located within Forest Service campgrounds that are adjacent to Lake Quinault and Wynoochee Lake. Invasive plant treatments are planned to be a combination of herbicide and manual techniques and would occur during spring and summer. No dose of herbicide or NPE exceeded toxicity indices even in a "worst case" scenario. Since the treatments would occur when loons are not likely to be present, and herbicide effects are not plausible, there will be "no impact" to common loons from proposed treatments, regardless of alternative chosen.

American Peregrine Falcon

No current nest sites for peregrine falcon occur within 1.5 miles of any proposed treatment area, the mandatory PDF will avoid disturbance, and no herbicide or NPE dose exceeded the toxicity indices for fish-eating birds even in a "worst case" scenario, so there would be "no impact" to peregrine falcons regardless of alternative chosen.

Cope's giant, Olympic Torrent and Van Dyke's Salamander

The Copes' giant and Olympic torrent salamanders are highly aquatic and found in streams. There are 12 known sites for Cope's giant salamander documented on the Olympic National Forest, but none occur within treatment areas. There are 27 known sites for the Olympic torrent salamander on National Forest system lands, 2 of which are in treatment areas. Van Dyke's salamander is associated with moist areas, including streams, seeps, and springs and is active when soil moisture is high and temperatures are cool. There are 22 known sites for Van Dyke's salamander on the Olympic National Forest, 1 of which is within a treatment area.

Suitable habitat for all three of these salamanders exists on the forest; much of it has not been surveyed. Suitable habitat has not been mapped but can be considered to be most closely associated with riparian areas. For purposes of this analysis, the Aquatic Influence Zone (the inner half of Riparian Reserves) is used as an indicator of suitable salamander habitat that has not been surveyed. This will greatly overestimate the actual suitable habitat for these rare salamanders, which have quite specific habitat associations. There are an estimated 626 acres within the Aquatic Influence Zone that may be infested with invasive plants (see Section 3.4.2, Table 48). This compares to an estimated 109,841 total acres of Aquatic Influence Zone on the Olympic National Forest. So, of the unsurveyed suitable salamander habitat on the Olympic National Forest, 0.5 percent is infested acres that may be treated and 99.5 percent are not likely to have invasive plant treatments.

Mechanical treatments near streams and springs can create ground disturbance that could introduce silt into salamander habitat, potentially clogging the gills of the salamanders and resulting in mortality. Little is known about the effects of herbicides other than the potential for herbicides to cause mortality or result in malformations of amphibian larvae. Effects of herbicides to amphibians are discussed in the R6 2005 FEIS (Appendix P, pp. 28-31).

The aquatic and salamander Project Design Features (H1, H1a, H6-11, J5) that limit broadcast application of herbicides and apply to all alternatives would minimize exposure of salamanders to the herbicides most likely to have adverse effects. Limiting broadcast application of herbicides within potential salamander habitat reduces the likelihood and amount of herbicide that could contaminate water, soil or rocks used by salamanders. Broadcast spray buffers apply wherever and whenever water is present, which is where and when salamanders are most likely to occur. In addition, there is little overlap between the habitat for these salamanders and locations of infestations to be treated, as suggested by the Aquatic Influence Zone acres described above. Most invasive plants occur in more open, drier, and previously disturbed sites. Because there is minimal overlap between actual treatment sites and salamander habitat, and project design feature minimize exposure to herbicides, this project may adversely impact individuals, but is not likely to lead to a trend toward federal listing of these salamanders.

Puget Oregonian, Hoko Vertigo, Malone Jumping Slug, and Blue-Gray Taildropper

These four mollusks are not located within any treatment areas, and likely do not occur on Olympic National Forest system lands, so there would be "no impact" to these mollusk species from any alternative.

Burrington's and Warty Jumping Slug

Both these mollusks are associated with a variety of moist forest and they retreat into down wood, leaf litter and moist areas during the dry summer months (May or June through September). There are 10 known sites for Burrington's jumping slug on the Olympic National Forest, 8 of which are within treatment areas that may have herbicide use. The warty jumping slug is locally common and abundant with 605 known sites on the Olympic National Forest; 478 (or 79 percent) of which are within treatment areas that may have herbicide use. The majority of the proposed treatment areas are along disturbed roadsides that do not provide suitable habitat for these mollusks. Roadsides conditions are more dry and harsh than is suitable for mollusks. While many known site locations coincide with treatment areas, the actual invasive plant treatments would occur in microhabitats that are not suitable for mollusks (Joan Ziegltrum, personal communication, 2006). Mollusk habitat and populations occur off the roads in adjacent suitable habitat.

No invasive plant treatments will remove habitat for jumping slugs nor will treatments cause large-scale microclimate changes within their suitable habitat. Habitat components for jumping slugs, such as down logs, will remain in place on treatment sites.

In all action alternatives, PDF J-6 requires that treatments avoid known sites or high potential habitat when soil moisture is high and these slugs are most likely to be at or near the surface. This will minimize their exposure to herbicides and reduce the risk of mortality by trampling. Most mechanical and herbicide treatments would occur along disturbed roadsides, which are often drier conditions and not suitable mollusk habitat (Joan Ziegltrum, personal communication, 2006). Although the Project Design Features minimize risk to these species from manual, mechanical, and herbicide treatments, all action alternatives may adversely impact some individuals, but would not likely to lead to a trend toward federal listing.

Table 47. Impact Determinations for Sensitive Wildlife Species

Wildlife Common Name	Impact Determination
Townsend's Big-Eared Bat	No Impact
Mazama Pocket Gopher	No Impact
Common Loon	No Impact
American Peregrine Falcon	No Impact
Vandyke's Salamander	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Cope's Giant Salamander	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Olympic Torrent Salamander	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Puget Oregonian	No Impact
Burrington's Jumping Slug	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Warty Jumping Slug	May Impact Individuals, But Would Not Likely To Lead To A Trend Toward Federal Listing.
Malone's Jumping Slug	No Impact
Blue-Gray Taildropper	No Impact
Hoko Vertigo	No Impact

Direct and Indirect Effects on Survey and Manage Species

As discussed previously, the Burrington's jumping slug is the only wildlife species currently included in the Survey and Manage list that is likely to occur on the Olympic National Forest. Other species are listed for Survey and Manage, but have not been detected on the Olympic National Forest in any previous or ongoing survey. Further discussion on these species is in Appendix C. Effects to the Burrington's jumping slug are discussed above under Direct and Indirect Effects to Regional Forester Sensitive Species.

Surveys for Burrington's jumping slug are unlikely to be needed for this project, particularly within roadside treatment areas. The 2001 Survey and Manage ROD (USDA and USDI 2001, p. 22) states, "The line officer should seek specialists' recommendations to help determine the need for a survey based on site-specific information. In making such determination, the line officer should consider the probability of the species being present on the project site, as well as the probability that the project would cause a significant negative effect on the species habitat or the persistence of the species at the site." The expert opinion of the Forest Ecologist is that pre-project surveys for Burrington's jumping slug are not required for roadside treatment areas, regardless of alternative, because 1) these areas are not considered suitable habitat (Ziegltrum, personal communication, 2006 - see Burrington jumping slug discussion above) and 2) roadside treatment would not negatively impact adjacent suitable habitat or species persistence. While individual mollusks may be found on roadsides, they would not be there if not for the adjacent [unaffected] natural habitat (2003 USDA/USDI Survey Protocol for Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan, v.3.0, 70page). In addition, invasive plant treatments can be considered routine road maintenance similar to cleaning ditches removing encroaching vegetation, which are not considered habitat-disturbing activities in the 2001 ROD (p. 22).

The need for pre-project surveys in other types of treatment sites would be evaluated during the annual implementation planning process (see Section 2.5, Implementation Planning).

Direct and Indirect Effects on Management Indicator Species

The invasive plant treatments proposed in all alternatives focus on treating the target non-native plants and avoid or minimize effects to non-target native vegetation. No treatments will remove native trees or alter native habitat structure. Proposed treatments will improve cover of native plants within treatment areas and could contribute to improved habitat conditions for deer and elk in some select sites. Habitat for pileated woodpecker, primary cavity excavators, and pine marten is not substantially affected by invasive plants, nor would it be affected by invasive plant treatments.

Pileated woodpecker and Primary Excavators

Invasive plant treatments under any alternative would not affect the pileated woodpecker, nor the primary cavity excavator group. These birds nest in cavities in dead limbs and forage on trees and shrubs. Black-capped chickadee, Lewis' woodpecker, and flicker may encounter contaminated insects due to their foraging habits.

The 2005 R6 FEIS (Appenix P) assessed risk of herbicides to insectivorous birds. The exposure scenarios for insectivorous birds indicate that only NPE doses would exceed a threshold of concern in acute exposures at typical application rates. In order to receive this dose, the birds would have to feed exclusively on contaminated insects for an entire day's feeding. The above-mentioned species forage in relatively large areas, sometimes several acres or more, and forage on a variety of plants and locations (e.g. tree limbs and boles, understory shrubs, bare ground, and bird feeders). Proposed broadcast application of herbicides is proposed only along roadsides. Other application methods treat individual plants and are unlikely to contaminate significant amounts of forage insects or seed. The patchy nature of proposed invasive plant treatments would make it unlikely for a single bird to feed exclusively on insects from treated patches, even in roadsides treated with broadcast applications. However, adverse effects on some individual birds cannot be ruled out, due to lack of data on occurrence and foraging area within treatment areas.

Data on chronic exposure of birds to contaminated insects is lacking. Very conservative assumptions regarding herbicide residue on insects would indicate that several herbicides could exceed a threshold of concern in a chronic exposure scenario. However, chronic exposure thresholds of concern were established by daily doses for 90 days or more in laboratory studies. It seems highly unlikely that wild birds would feed exclusively on insects from treated patches of invasive plants along a roadside for the length of time needed to acquire a chronic dose of concern.

The northern flicker regularly forages for ants on the ground and ants can be active during herbicide applications. However, even if a flicker ate contaminated ants, it would have to eat nothing but contaminated ants for an entire day's feeding to be exposed to enough NPE-based surfactant to be a concern. Given that the vast majority of proposed treatments are along roadsides, and that flickers would move among various foraging sites throughout the day, this scenario is not plausible. Given varied diet, foraging strategies, and movement of black-capped chickadees and Lewis' woodpecker, actual doses exceeding level of concern are unlikely.

Northern flying squirrel is arboreal but feeds on underground fungi. It could encounter some contaminated soil or vegetation but it is unlikely to feed exclusively within treated patches of ground. Even if it fed exclusively on contaminated vegetation for an entire day, or on 20% contaminated vegetation over 90 days, it would not receive a dose that exceeded any toxicity indices for any herbicide proposed or NPE. Direct spray is not feasible due to the squirrel's arboreal and nocturnal behavior. An herbicide dose of concern is not plausible. No action alternative would alter habitat for these species. No adverse effects are plausible to populations.

Roosevelt elk and Black-tailed deer

Invasive plant treatments will not reduce available habitat for deer or elk, but could contribute to improved habitat quality in the long term (see Rice et al. 1997, for example).

The grazing and browsing habits of elk and deer make it possible for them to consume vegetation that has been sprayed with herbicide. Quantitative estimates of risk using “worst-case” scenarios found that none of the herbicides considered for use, at typical application rates, would result in a dose that exceeds the toxicity indices in either acute or chronic scenarios. The dose for NPE surfactant exceeds the toxicity index only in an acute scenario. The deer or elk would have to consume an entire day’s diet of contaminated grass in order to receive this dose. Deer and elk do not forage extensively on the invasive plants found on the Olympic National Forest, they are not likely to forage exclusively on the patches of invasive plants that have been treated with herbicide, and the treated sites comprise a very small proportion of the available foraging area for these species. Backpack spot sprays and roadside broadcast applications would only contaminate very small amounts of forage, if any, because forage species are not the target of the applications. The “worst case” exposure scenario for NPE is not plausible for the treatments proposed in any of the alternatives. Therefore, no plausible adverse effects to deer or elk would result regardless of alternative chosen.

Pine Marten

On the Olympic National Forest, pine martens are most likely to occur in remote wilderness areas or contiguous old-growth forest. Most treatment areas are on roadsides and are unlikely to disturb pine martens, do not alter suitable habitat, and are unlikely to expose their prey. Even if pine martens consumed for an entire day nothing but prey that had been directly sprayed, they would not receive a dose that exceeded the toxicity indices for any herbicides or NPE (USDA Forest Service 2005, Appendix B). No plausible effects would result from any alternative.

Direct and Indirect Effects to Landbirds

Invasive plant treatments proposed on the Olympic National Forest will not remove habitat of the focal species for coniferous forests. No trees will be removed and forest structure will not be altered by proposed treatments. Only species that forage or nest near the ground are likely to be exposed to disturbance from treatments or herbicides. Of the coniferous forest focal species identified in Altman (1999), the following species are most likely to forage or nest near the ground: varied thrush, Wilson’s warbler, winter wren, black-throated gray warbler, Hutton’s vireo, olive-sided flycatcher, western bluebird, orange-crowned warbler, rufous hummingbird (Source: Altman 1999, Marshall et al. 2003). Because these species are not reported to nest in invasive plant species targeted for treatment, manual and mechanical treatments are not likely to disturb nests of these species.

As discussed above for Primary Cavity Excavators, analysis in the 2005 R6 FEIS (Appendix P) indicated that only NPE poses a risk to insectivorous birds at typical application rates for acute exposures. Exposures resulting in a dose of concern do not appear plausible for the proposed treatments, as detailed above for Primary Cavity Excavators, although risk to some individual birds cannot be ruled out. In conclusion, invasive plant treatments will not alter habitat for focal species in the Partner’s In Flight land bird conservation strategy. Manual and mechanical treatments are not likely to disturb nests of focal species. Some individuals of focal species could be exposed to herbicides by foraging on contaminated insects, but the likelihood of any dose of concern is remote.

Direct and Indirect Effects to Birds of Conservation Concern

For all species included in the Birds of Conservation Concern, invasive plant treatments proposed on the Olympic National Forest will not remove or degrade their habitat. Removal of invasive plants will likely contribute to the integrity of habitat areas, although no specific habitat elements for these species are currently being affected by invasive plants on the Olympic National Forest.

The black swift and olive-sided flycatchers are insectivorous birds. They do not nest in close proximity to the ground and are not sensitive to the short-term disturbance that most invasive plant treatments would create. The exposure scenarios for insectivorous birds indicate that only NPE doses would exceed a threshold of concern in acute exposures at typical application rates (see 2005 R6 FEIS, Appendix P). In order to receive this dose, the birds would have to feed exclusively on contaminated insects for an entire day's feeding. Black swifts feed primarily on flying aquatic insects like mayflies, stoneflies, and caddis flies, catching them high in the air. These insects are unlikely to be directly sprayed because broadcast spray of herbicide is limited or prohibited in their habitats. Therefore, any exposure of concern for black swift is unlikely. Olive-sided flycatchers also catch their flying insect prey high in the air, launching from a high perch in a snag or tree. Proposed broadcast spraying is along infested roadsides and the infestations occur in patches rather than long solid infestations. The patchy nature of proposed invasive plant treatments would make it unlikely for a single flycatcher to feed exclusively on insects from treated patches. While some of their insect prey may become contaminated by broadcast spraying, it seems unlikely that they would forage exclusively on contaminated insects. Chronic doses are even more unlikely, as described above in the effects to Landbirds. Therefore, negative effects to olive-sided flycatchers are unlikely.

The rufous hummingbird inhabits open areas and meadows, catching insects and sipping nectar. A small amount of exposure to herbicides or NPE could amount to a dose of concern because of the very small body size of the rufous hummingbird. These hummingbirds could forage in open areas where invasive plants have been treated and possibly glean contaminated insects. It is unlikely that they would forage exclusively within a patch of invasive plants. These hummingbirds are not known to heavily utilize invasive plants for a nectar source and they prefer tubular flowers where the nectar is deep inside the corolla. Native forage plants would not be treated so the nectar is unlikely to be contaminated with herbicide. Rufous hummingbirds breed from Alaska south to Oregon. The patchy nature of the invasive plant infestations and the multi-state breeding range for this bird indicate that while adverse effects to some individual birds cannot be ruled out, there is not likely to be any population-level effect to the species from proposed invasive plant treatments on the Olympic NF.

Herbicide Use and Amphibian Decline

Information on the effect of pesticides on amphibian populations is limited, and the studies that are available often focus on the most toxic compounds like insecticides (e.g. Taylor et al. 1999, Bridges and Semlitsch 2000, Boone and Semlitsch 2001, Relyea and Mills 2001). Some herbicides are known to have adverse effects on amphibians (e.g. Hayes 2002, Wojtaszek 2005). To date, atrazine is the only herbicide that has been implicated in overall amphibian declines (Hayes 2002). The pesticides investigated (e.g. carbaryl, PCB's, atrazine) all have much higher propensity to accumulate in the fatty tissues than the herbicides proposed in this document. For example, Atrazine has a Kow of 481 while the highest Kow for any herbicide proposed is 45.1 for sethoxydim, and all the other herbicides have Kow ranging from 2.1 to much less than 1. There is a substantial data gap regarding effects of the herbicides included in this analysis and the potential for effects to amphibian populations, but current date on these herbicides does not suggest a risk to amphibian populations because they do not accumulate in animal tissues and are less persistent, less mobile, and less widely used than pesticides that have been implicated in amphibian declines.

Project Design Features have been proposed that respond to uncertainty about effects to amphibians from herbicide exposure. These Project Design Features (e.g. PDFs H1, H1a, H6-11, and J5) include buffers that prohibit broadcast spraying, specify selective application methods, and limit the herbicides that can be used within certain distances of amphibian habitat.

Cumulative Effects Analysis for All Alternatives

The Project Design Features common to all action alternatives are likely to effectively reduce risk of adverse effects to terrestrial wildlife because they minimize or eliminate disturbance and herbicide exposure scenarios of concern. The types of treatments that are proposed, implemented according to Project Design Features, have a low likelihood of contributing to cumulative effects from other projects on and off the Olympic National Forest. Invasive plant treatments are likely to have an overall beneficial impact to wildlife to the extent that invasive plants are replaced with native vegetation. All of the environmental standards, policies and laws related to wildlife would be met in all alternatives.

3.4 Soils and Water

3.4.1 Introduction

The effect of invasive plant treatment on soils and water is a primary public issue (Issue Group 5). Federal and state laws, policies and regulations control the use of herbicides on National Forest system lands, including the Clean Water Act and the Federal Water Pollution Control Act. Section 208 of the 1972 amendments to the Federal Water Pollution Control Act (Public Law 92-500) specifically mandated identification and control of non-point source pollution. Clean Water Act Section 303(d) directed the State of Washington to list Water Quality Limited Waterbodies (listed streams) and develop Total Daily Maximum Loads to control the non-point source pollutant causing loss of beneficial uses.

To date the Olympic National Forest has completed a TMDL for the Upper Humptulips Watershed (includes both the West Fork Humptulips and East Fork Humptulips Watersheds). The Forest and Washington Department of Ecology have discussed development of a Forest wide TMDL but have not yet set dates to initiate development of this plan.

The Olympic National Forest Plan (USDA, 1990, amended by the 1994 Northwest Forest Plan ROD and by the R6 2005 ROD for invasive plants) provides direction to protect and manage resources. The Forest Plan Goal for soils is to “Protect, conserve, and enhance the long-term productivity of forest soils for the multiple uses of the Forest”. Forest Plan Goals for water resources are to “provide water quality needs for municipal and domestic supply, and to protect rivers, streams, shorelines, lakes, wetlands, flood plains, and other riparian areas during implementation of management activities”.

Forest Management Objectives for soil, riparian areas and water resources include IV-12 and IV-18:

- The primary goal for water quality is to provide high quality water by minimizing soil erosion and the introduction of chemicals and bacteria.
- All riparian areas are to be managed to protect and maintain their unique values as they relate to wildlife, fish habitat and water quality.

This project would comply with all Washington State water quality standards and requirements for detailed in Water Quality Standards for the State of Washington, Chapter 173-201A WAC. 1997 & 2003 and Forest Chemicals Chapter 222-38 WAC.

Waters on the Olympic National Forest are considered AA (extraordinary) under State of Washington 173-201A120 list. Beneficial uses for these waters include:

- Water Supply (Domestic, Industrial, Agricultural)
- Stock Watering
- Commerce and Navigation
- Wildlife habitat
- Recreation
- Salmonid, clam, oyster, mussel, crustacean and other shellfish migration, rearing, spawning, and harvesting.

3.4.2 Affected Environment

Aquatic Conservation Strategy

The Aquatic Conservation Strategy (ACS) is an integral part of the 1994 Northwest Forest Plan. The ACS was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems within public lands. The ACS is intended to meet several objectives toward meeting the goal of healthy ecosystems and watersheds. Aquatic Conservation Strategy Objectives are applied over time at watershed and broader scales.

Table 48 displays the relative distribution of the invasive plants at the 6th field watershed. In many of these watersheds there are fewer than ten acres of invasive plant sites.

Table 48. Sixth Field Watersheds on Olympic National Forest

Sixth Field Watershed Name	National Forest Acres	Percent Watershed National Forest	Riparian Reserve Acres on National Forest	Infested Acres	Percent National Forest Acres Infested	Infested Acres in Riparian Reserves
Big Creek/Upper Quinault River	8479	24	2786	0.5	0.0	0.07
Bockman Creek	3679	22	1682	1.9	0.1	0.57
Calawah River	2065	21	1103	0.3	0.0	0.08
Canyon Creek/Pats Creek	8230	41	2334	91.4	1.1	24.98
Cook Creek	8082	27	2001	28.3	0.3	7.71
Cresent Lake/Lyre River	1964	5	488	2.3	0.1	0.19
Deep Creek	5483	44	1950	82.4	1.5	29.16
East Fork Humptulips River	19508	66	7795	184.2	0.9	67.48
East Twin River	4095	33	1381	2.8	0.1	0.79
Fulton Creek/Waketickeh Creek	7332	43	2569	39.6	0.5	7.78
Headwaters Sol Duc River	9539	28	2693	66.1	0.7	13.77
Hoko River	344	1	74	0.0	0.0	0
Jefferson Creek	12866	92	4596	108.5	0.8	45.39
Jimmy-Come-Lately Creek	9010	73	2443	5.1	0.1	1.54

Sixth Field Watershed Name	National Forest Acres	Percent Watershed National Forest	Riparian Reserve Acres on National Forest	Infested Acres	Percent National Forest Acres Infested	Infested Acres in Riparian Reserves
Lilliwaup Creek	2546	8	839	42.4	1.7	8.2
Little Quilcene River	9989	44	2660	28.8	0.3	6.28
Lower Big Quilcene River	8061	61	2825	2.8	0.0	1
Lower Bogachiel River	5724	12	2953	0.2	0.0	0.08
Lower Dosewallips River	21553	60	6002	17.6	0.1	5.66
Lower Duckabush River	14295	70	3855	49.7	0.3	15.43
Lower Elwha River	5719	31	853	1.5	0.0	0.11
Lower Gray Wolf River	12400	79	3321	3.9	0.0	0.79
Lower North Fork Skokomish River	2698	17	866	27.5	1.0	4.71
Lower Sol Duc River	2996	11	1797	0.1	0.0	0.04
Lower South Fork Skokomish River	16145	57	6731	69.6	0.4	24.67
Mainstem Hamma Hamma River	28207	71	8990	110.9	0.4	37.72
Matheny Creek	20338	84	7383	79.6	0.4	22.84
McDonald Creek/Siebert Creek	2588	7	725	0.6	0.0	0.11
Middle Clearwater River	250	1	107	0.1	0.0	0.01
Middle Dungeness River	14693	100	4252	9.9	0.1	1.86
Middle Fork Satsop River	13023	34	5271	89.4	0.7	26.15
Middle Hoh River	413	1	254	12.6	3.1	3.27
Middle North Fork Skokomish River	13206	48	4045	81.5	0.6	19.9
Middle Queets River	3258	15	1118	4.3	0.1	1.22
Middle Quinault River	6208	13	1691	42.9	0.7	9.2
Middle Sol Duc River	14047	47	5325	128.1	0.9	48.22
Middle Wynoochee River	13426	32	5578	39.0	0.3	7.14
North Fork Calawah River	19267	63	10038	237.9	1.2	69.98
Pysht River	4876	14	2128	1.2	0.0	0.39
Quinault Lake	13684	56	4185	274.9	2.0	89.49
Raft River	0	0	0	0.0	0.0	0
Salmon River	5789	28	2559	13.1	0.2	3.52
Sams River	16170	82	4685	8.0	0.0	1.07
Sequim Bay Tributaries	89	1	4	0.0	0.0	0
Snow Creek/Salmon River	7724	31	2298	27.7	0.4	7.78
South Fork Calawah River	27463	59	15066	436.9	1.6	211.16
Spencer Creek/Marple Creek	4616	46	1125	8.7	0.2	1.96
Stevens Creek	1644	6	647	9.8	0.6	3.59

Sixth Field Watershed Name	National Forest Acres	Percent Watershed National Forest	Riparian Reserve Acres on National Forest	Infested Acres	Percent National Forest Acres Infested	Infested Acres in Riparian Reserves
Tshletshy Creek	188	1	70	0.0	0.0	0
Upper Big Quilcene River	30333	96	7921	33.2	0.1	5.31
Upper Bogachiel River	10	0	0	0.1	0.6	0
Upper Duckabush River	1253	4	364	0.0	0.0	0
Upper Dungeness River	20296	65	4670	119.3	0.6	13.54
Upper North Fork Skokomish River	5096	16	1244	0.9	0.0	0.1
Upper Sol Duc River	15625	68	5142	246.1	1.6	47.26
Upper South Fork Skokomish River	36733	95	13035	121.4	0.3	39.49
Upper West Fork Satsop River	20135	52	8360	213.9	1.1	94.53
Upper Wishkah River	1412	6	588	0.5	0.0	0.03
Upper Wynoochee River	24677	94	8898	125.7	0.5	31.27
West Fork Humptulips River	33826	72	13207	265.4	0.8	96.8
West Twin River	4934	61	1578	222.3	4.5	88.9
total	630610	35%	219,758	3,380	0.6%	1,251

Table 48 also displays the proportion of infested acres within Riparian Reserves. Approximately 33 percent of the lands within treatment areas are allocated to Riparian Reserves. About half these acres (626) are within the Aquatic Influence Zone, defined as half the width of a Riparian Reserve.

The Aquatic Conservation Strategy established a system of Key Watersheds to protect areas of high water quality and habitat for wild fish populations. Key Watersheds are intended to serve as refugia for at risk stocks of native and anadromous fish. Activities to protect and restore aquatic habitat in Key Watersheds are higher priority than similar activities in other watersheds. The key watersheds on the Olympic National Forest are listed in table 49. About 70 percent of the invasive plant sites are within Key Watersheds.

Table 49. Key Watersheds

Watershed	Number	Acres	Number of Inventoried Invasive Plant Sites in the Watershed
Big Quilcene River	W-204	39546	6
Canyon River Corridor	W-109	1662	1
Cook Creek	W-113	10145	2
Dosewallips River	W-105	69165	3
Duckabush River	W-106	14856	1
Dungeness River	W-103	96752	14
Elwha River	W-102	7847	3
Lake Cushman/N.Fk. Skokomish River	W-107	24604	5
McCalla Creek	W-112	4807	4
Satsop River Corridor	W-110	2688	3
Skokomish River	W-108	23795	8
Soleduck River	W-201	10892	20
Wynoochee River	W-111	13297	8
Total		**320,056**	**78**

Watershed analysis has been conducted between 1994 and 2005 for South Fork Skokomish River, Sitkum and South Fork Calawah River, North Fork Calawah River, Matheny Creek, Boulder and Cooks Creeks, Big Quilcene River, Hamma Hamma River and Hood Canal tributaries, East and West Forks Humptulips River, Quinault River, Snow and Salmon Creeks, Upper Wynochee River, Salmon River, Sams River, Dosewallips River, Soleduck River, Deep Creek and East and West Twin Rivers, Dungeness River and finally, the West Fork Satsop River. Appropriate treatment is urged in Watershed Analysis documents that address noxious weeds or other non-native invasives.

Geology and Soils

The geology of the Olympic National Forest is complex. The bedrock is a combination of volcanic and sedimentary rocks, deformed by tectonism and heavily eroded by glaciation and runoff, leaving deep glacial deposits in the larger valleys. Uplift is ongoing and many steeper slopes are unstable and prone to mass movements. Many of the volcanic and sedimentary rocks are highly deformed and fractured. Where these fractures are exposed they can have high permeability, which may serve to transfer herbicide from soils to groundwater.

Soils are formed from four broad categories of parent materials. These are: (1) recent alluvium; (2) glacial deposits; (3) hard sedimentary and meta-sedimentary rocks; and (4) hard volcanic and metavolcanic rocks.

There are 183 different soil types within areas containing invasive plants. Of particular concern for the Olympic National Forest are the soils listed as hydric (poorly drained, have a high groundwater table or are frequently ponded or flooded). Potential hydric soils were identified from the Olympic SRI soils layer on floodplains and low stream terrace sites, glacial deposits and small wet depressions with a high seasonal water table. Approximately 684 acres of hydric soils are within treatment areas, with about 110 acres estimated as being infested.

Invasive plants can affect soils in many ways. They can cause changes in soil properties such as pH, nutrient cycling and changes in composition or activity of soil microbes. For example, spotted knapweed has been implicated in reducing available potassium and nitrogen (Harvey and Nowierski, 1989). A reduction in soil nutrient levels makes it difficult for native plants to compete with the invasive plants, and probably also affects the soil biotic community. The long-term effects of these changes are not known. A reduction in soil nutrient levels makes it difficult for native plants to compete with the invasive plants, and probably also affects the soil biotic community.

These effects can impact water quality by increased sedimentation of streams and by lowering recharge rates for groundwater. Plants and mycorrhizal fungi are strongly dependent on each other, and species of fungi are associated with specific plants. Presence of non-native plants also leads to changes in the mycorrhizal fungus community (ibid). These changes could increase the difficulty of reestablishing native vegetation after the invasive plants are removed.

Riparian Condition and Water Quality

Streams are complex and dynamic systems that reflect the balance between stream flow, sediment input and substrate/bank composition. Riparian condition and water quality are the two elements potentially affected by invasive plant treatments.

Approximately 23,377 miles of streams flow on the Olympic National Forest. Approximately 30 percent are perennial and 70 percent are intermittent. The Washington State 303(d) list of water quality limited streams lists six streams on the Forest. The South Fork Calawah River, Soleduck River, Sitkum River, Deep Creek and Upper Cool Creek are listed for temperature and Bear Creek is listed for dissolved oxygen. None of the water quality limited streams on the Forest are listed for sediment or chemical contaminants.

Riparian vegetation stabilizes stream banks, and acts as a filter to prevent the run-off of soil into streams. Riparian vegetation also provides large and small wood to streams, adding to habitat complexity and providing cover and food sourced for aquatic organisms. Aquatic ecosystems have evolved with certain vegetation types; invasive plants do not necessarily provide similar habitat.

Approximately 12.5 acres of Japanese knotweed and 0.2 acres of giant knotweed are estimated within treatment areas. Japanese knotweed has poor bank holding capacity, which leads to more bank erosion and sedimentation of streams in high winter flows. Knotweed spreads rapidly in flood prone areas such as the Pacific Northwest. Knotweeds tolerate a wide variety of substrates from cobbles to fine soils (Tu and Sol, 2004).

While knotweed has only been recognized as a major problem for the last five years in the Pacific Northwest, it is documented as a major invasive plant in the British Ilse and many other areas in the U.S. For example, in the eastern United States Japanese knotweed has been found along the banks of the Ohio and Allegheny Rivers and in islands of these rivers where it occupies hundreds of acres of wetlands, stream banks and hillsides (http://www.invasive.org).

While knotweed may provide shade, native streamside hardwoods and conifers are much taller, so knotweed dominated areas may be associated with higher water temperatures than areas with native forest communities.

Approximately 156 acres of reed canary grass are mapped along streams and wetlands on the Forest. Reed canarygrass is extremely aggressive and often forms persistent, monocultures in wetlands and riparian areas. Infestations threaten the diversity of these areas, since the plant chokes out native plants and grows too densely to provide adequate cover for small mammals and waterfowl. The grass can also lead to increased siltation along drainage ditches and streams. Once established, reed canarygrass is difficult to control because it spreads rapidly by rhizomes http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua011.html).

Purple loosestrife is another aggressive invasive species that occupies streambanks, canals and shallow ponds has been found in small areas on the forest.

On the Olympic without treatment, all of these riparian species are expected to continue to spread. Where they spread banks could become less stable, leading to changes in suspended sediment and substrate character and embeddedness. Potentially this could lead to effects on pool frequency and quality.

Invasive plants can adversely affect the functioning of riparian areas. If invasive plants replace riparian conifers and hardwood trees, large woody material inputs could be reduced, affecting stream stability, morphology and fish habitat. Himalayan blackberry and knotweed can act as a sediment trap and fish barrier. For instance, blackberries are presently catching sediment and acting as a fish barrier on a stream near the Columbia River Gorge (Dobson, personal communication).

Lakes, Wetlands and Floodplains

Lakes, wetlands and floodplain areas are often popular for recreation, and so are at risk from invasive plants brought in by visitors. They are also at risk from invasive plants such as knotweeds that colonize areas downstream of the original infestation along streams. Wetlands can be inundated with water year-round, and others are wet only seasonally. The areas that are wet only seasonally can be infested with upland invasive species, as well as invasive plants specifically adapted to wetlands. Three acres of wetlands and two acres of floodplains are identified as infested with invasives.

The Forest includes extensive acreage of soils only seasonally inundated with water. These soils were discussed in the soils section above and would be given the same level of protection as wetlands. These soils and wetland soils are all considered hydric soils. There are approximately 110 acres of these soils identified as infested with invasive plants.

The wetland treatment area type identified in the Olympic National Forest weed inventory database is the Cranberry Bog Botanical Area, located in the Canyon Creek/Pats Creek sub-watershed. This treatment area was established primarily to treat reed canary grass (although Scotch Broom is also found at this site). The floodplain treatment area type is located in the Middle Hoh River sub-watershed and consists of knotweed sites along the Hoh River.

Lake Quinault has many summer homes, and with these homes are a large number of invasive species intentionally or unintentionally planted by summer visitors. These include patches of Japanese knotweed, herb Robert, English ivy and English holly, estimated to cover approximately 96 acres. The Japanese knotweed grows below the high water mark in some places and many of the other infestations are close to the lake. About 26 acres of invasive plants are currently mapped within 100 feet of the lake.

Municipal Watersheds and Domestic Water Supplies

There are nine municipal watersheds on the Olympic Forest that range in size from 293 acres to 108,785 acres (two watersheds for the City of Port Townsend have been combined in table 50). An estimated 210 acres are currently infested within municipal watersheds. These invasives are found primarily along roads and in plantations and other disturbed areas. The Lake Sutherland Water District water intake is potentially within 1000 feet downstream of a treatment area. All other municipal watershed intakes are at least 1000 feet downstream from proposed treatment areas.

To be classified as a municipal watershed, a water source must meet one of the following criteria: 1) at least 25 individuals are served at least 60 days per year, or 2) at least 15 service connections are provided.

The 1990 Olympic National Forest Plan states that the primary goal for municipal watershed management is to provide high quality water by minimizing soil erosion and the introduction of chemicals or bacteria. A Forest Plan standard for municipal watersheds states:

> "Herbicides and pesticides should not be used. Chemicals should be used as a last resort, and only when site-specific analysis indicates water quality will not be adversely affected."

The Olympic National Forest has not used herbicides in municipal watersheds since this standard was adopted in the Forest Plan in 1990. Since that time, the invasive plant problem has grown, and new chemical methods of treatment have become available. An analysis has been conducted which indicates water quality would not be adversely affected by the projects proposed in this EIS.

In addition to the municipal watersheds, there are approximately 113 appropriated Washington State Surface Water Rights for on and off-forest water withdrawals. There are 30 special use permits for surface water intakes on National Forest System lands for individual homes. Validation of the water rights is underway on the Forest. The use is used for fish propagation, irrigation and other municipal or domestic uses (ibid).

Approximately 50 forest campgrounds, work sites and guard stations use surface or ground water sources on the Olympic National Forest; a map showing locations of both the municipal watersheds and the forest water sources is in the project record. Validation of the water rights is underway on the Forest. There are minimal infestations of invasive plants in most municipal watersheds with the exception of the watersheds supplying Sequim and Port Townsend (Table 50).

Municipal watersheds are governed by agreements (on file at Olympic National Forest). Two of the agreements specifically mention herbicides:

City of Port Townsend - "Until such time as the Cooperative Watershed Protection Program is fully implemented, the Forest Service shall not use any pesticides or herbicides within the watershed without the city's concurrence."

City of Aberdeen - "The use of herbicides are not contemplated in this open water source watershed. However, in the event herbicides are needed to control a catastrophic outbreak of insects, the City and the public will become involved in the decision-making process."

Herbicide use within these watersheds would need to be coordinated with the city watershed managers. Less than one acre is currently known to be infested in the City of Aberdeen watershed.

Table 50. Acres of Invasive Plants in Municipal Watersheds

Municipal Watershed	Acres of Infestation Proposed for Treatment	Water Source
Black Diamond Water District	<1	South Branch Little River
City of Aberdeen	<1	Wishkah River
City of Port Townsend	51	Little Quilcene River; Big Quilcene River
City of Sequim	135	Dungeness River
Iskra Bros. Logging Company Water System	8	Twin Culvert
Lake Sutherland Water District	14	Falls Creek
Meadowland Water Association	<1	Hathaway Creek
Neilton Cooperative Water Company	<1	McCall Creek

Total	Approximately 212 acres	

Roads Having High Risk of Herbicide Delivery

Roads are the primary vector for invasive plants to enter the Forest. Approximately 85 percent of the identified invasive plants are along roads or in disturbed areas near roads, such as recreation sites, administrative sites, and skid trails in second growth forest. Native soil has been removed along roads, and fill and surfacing have been placed within the road prism. Ditches have been compacted, allowing them to deliver run-off to streams, which may include herbicides used in broadcast treatments along the roads. Road cutbanks can be a combination of disturbed soil and exposed bedrock.

The R6 2005 FEIS describes roadside ditches as an herbicide delivery mechanism; potentially posing a high risk of herbicides reaching concentrations of concern for listed aquatic species (see Chapter 3.5). Ditches may function as an intermittent or perennial stream extend the stream network. Roadside ditches can act as delivery routes or intermittent streams during high rainfalls, or as settling ponds following rainfall events.

The 2003 Olympic National Forest Roads Analysis was used to identify roads having a potential for herbicide delivery, including roads in close proximity to streams and fish habitat and/or those having high stream crossing density. A list and map of these road segments is in Appendix D. Infestations are scattered within roadside treatment areas; treatments would not be continuous along any road segment.

Roadside treatment areas include compacted ditch lines, disturbed soil and exposed bedrock. Due to the extensive reworking of properties of soils along roads, the SRI may be misleading for roadside treatment areas. Roadside soils are assumed to function with a high runoff rate and PDFs were developed accordingly.

Table 51 displays the infested acres of roadside and other treatment areas and the portions within Riparian Reserves and Aquatic Influence Zones.

Table 51. Infested Acres by Treatment Area Description

Treatment Area Description	Total Infested Acres	Infested Acres Likely Within Riparian Reserve	Infested Acres Within Aquatic Influence Zone	Acres within Roadside Treatment Areas High Potential For Herbicide Delivery to Streams
Roadside	3,270	1,051	525	1,420
Administrative Sites, Campgrounds, Summer Homes	130	95	48	0
Meadows, Wetlands, and Floodplains[25]	80	10	6	0
Forests	215	50	25	0

[25] These treatment areas contain wet and dry meadows, wetlands and/or floodplains. The treatment area is larger than the meadows, wetlands or floodplains themselves. Some of these areas occur on the drier east side of the Olympic National Forest where Riparian Reserves make up less proportion of a watershed.

Trails	135	45	23	0
Total Acres	3,830	1,251	627	1,420

3.4.3 Environmental Consequences

Aquatic Conservation Strategy

Treatment of invasive plants is consistent with recommendations in watershed analysis done for key watersheds on the Olympic National Forest. None of the invasive plant treatments in the scope of this document would retard achievement of ACS objectives because the scale of treatment is small and the potential for harm is low:

- Less than one percent of the National Forest system lands across all watersheds is currently infested.
- In no case is more than six percent of National Forest Service system lands within any single 6th field watershed currently infested. These infestations cover less than three percent of any single 6th field watershed when other ownership acreage is added. However, other ownership acreage may also be infested – the current inventory does not cover other ownerships.
- Standards for invasive plant treatment and riparian reserves (listed in Chapter 1.x) require that the Forest Service minimize delivery of herbicides of concern to water bodies.

Alternative D is associated with the greatest risk of herbicide delivery to streams (see section on water quality below). Broadcast treatments along intermittent streams and roadside ditches in Alternative D have the potential to deliver herbicides to streams and other water bodies, possibly meeting or exceeding concentrations of concern at the immediate site of indirect delivery. In the case of intermittent streams, actual concentrations coming in contact with perennial streams would depend on the herbicide properties and delivery mechanisms (i.e., leaching, soil movement).

Geology and Soils

Effects of Manual and Mechanical Treatment

Manual and mechanical treatments are approved in all alternatives. While the relative amounts of such treatments vary between the alternatives, the differences in terms of effects from such treatments are negligible.

Alternative C relies on these treatments most heavily (over 2,000 acres are estimated to be treated without herbicides in this alternative but even this acreage comprises a small proportion of any watershed). Effects of manual and mechanical treatments were analyzed in the R6 2005 FEIS (Appendix M) and are summarized in this section. The public has not raised key issues with such treatments. Manual treatments, such as lopping or shearing, cause an input of organic material (dead roots) into the soil. As the roots are broken down in the soil food web, nutrients will be released. Rainfall may cause these nutrients to be lost to surface runoff or to groundwater. Bare soils combined with high nutrient levels provide ideal conditions for the establishment of many invasive species.

Removal of plant roots will break mycorrhizal hyphae in the soil and probably cause a transient reduction of mycorrhizal function. Studies on crop plants have shown that leaving an undisturbed mycorrhizal network in the soil after harvest (e.g. zero-till agriculture) significantly increases the nutrient uptake of the subsequent crop (Evans and Miller, 1990). Establishment of native plants may be more successful on undisturbed soil.

Manual and mechanical treatments may slightly increase the potential for delivery of fine sediment to streams. Weed wrenching of scotch broom may loosen soil and cause minor amounts of erosion (scotch broom currently covers about 200 acres within treatment areas including Cranberry Bog Botanical Area).

Using mowing equipment on existing roads is not expected to impact soils. Mowing or use of foaming or steaming machines off roads has the potential to compact soil. Soil compaction eliminates soil pores and so reduces water infiltration, aeration, and the ability of plants to root effectively. However, the limited amount of mechanical treatment proposed eliminates risk of extensive soil impacts.

Other mechanical treatments, such as the use of motorized hand tools, are expected to have effects similar to manual treatments.

Herbicide Characteristics in Soils

The effect of a chemical treatment on the soil depends on the particular characteristics of the chemical used, how it is applied, and the physical, chemical and biological condition of the soil medium. These characteristics were used to form Project Design Features to minimize effects from the used of herbicides to soil. Soil attributes at greatest risk from chemicals are erosion from removal of ground cover and damage to soil organisms. General characteristics for the proposed herbicides are displayed below; these were compiled from the R6 2005 FEIS, label information and SERA Risk Asssessments for the Mount Hood National Forest and Columbia River Gorge National Scenic Area Site-Specific Invasive Plant Treatment DEIS and are used by permission here.

Chlorsulfuron

Studies on the effects of chlorsulfuron on soil biota include lab and field studies on nematodes; fungi; populations of actinomycetes, bacteria, and fungi; and soil microorganisms.

- No effects of chlorsulfuron were found for soil biota at recommended application rates, with the exception of transient decreases in soil nitrification.
- The 'no observable effects concentration' for soil is 10 mg/kg, based on cellulose and protein degradation.
- Chlorsulfuron degrades in aerobic soil.
- Non-microbial hydrolysis plays an important role in chlorsulfuron breakdown, and hydrolysis rates increase as pH increases.
- Adsorption to soil particles, which affects the runoff potential of chlorsulfuron, is strongly related to the amount of organic material in the soil.
- Chlorsulfuron adsorption to clay is low.
- Chlorsulfuron is moderately mobile at high pH.
- Leaching is reduced when pH is less than six.
- Modeling results indicate that runoff would be negligible in relatively arid environments as well as sandy or loam soils.
- In clay soils, off-site loss could be substantial (up to about 55 percent of the applied amount) in regions with annual rainfall rates of 15 to 250 inches.

Clopyralid

Studies of clopyralid effects on soil invertebrates have been conducted, including field studies on the effects to microorganisms.

- Soil concentrations from USDA Forest Service applications are expected to be 1,000 less than concentrations that would cause toxic effects. Therefore, no effects to soil invertebrates or microorganisms are expected from use of clopyralid.
- Clopyralid is degraded by soil microbes, with an estimated half-life of 14 to 29 days, meaning that one-half of the amount applied remains in the soils after 90 days, one-fourth of the applied amount remains after 28 to 58 days, one –eight after 42 to 87 days, and so on.
- Increased soil moisture decreases degradation time.
- Clopyralid is weakly adsorbed and has a moderate leaching potential overall but high leaching potential in sandy soils.
- Modeling results indicate clopyralid runoff is highest in clay soils with peaks after rainfall events.
- Clopyralid percolation is highest in sandy loam soils.

Glyphosate

Numerous soil bacteria, fungi, invertebrates, and other microorganisms have been studied for effects of glyphosate application.

- Studies suggest glyphosate does not adversely affect soil organisms.
- Glyphosate is readily metabolized by soil microorganisms and some species can use glyphosate as a sole source of carbon.
- It is degraded by microbial action in both soil and water.
- Sylvia and Jarstfer (1997) found that after 3 years, pine trees in plots with grassy invasive plants had 75 percent fewer mycorrhizal root tips than plots that had been treated 3 times per year with a mixture of glyphosate and metsulfuron methyl to remove invasive plants.
- Glyphosate degrades in soil, with an estimated half-life of 30 days.
- Glyphosate is highly soluble, but adsorbs rapidly and binds tightly to soil.
- Glyphosate has low leaching potential because it binds so tightly to soil.
- Modeling results indicate glyphosate runoff is highest in loam soils with peaks after the first rainfall.

Imazapic

Imazapic is a relatively new herbicide, and there are no studies on the effects of imazapic on either soil invertebrates or soil microorganisms.

- If imazapic was extremely toxic to soil microorganisms, it is reasonable to assume that secondary signs of injury to microbial populations would have been reported.
- Imazapic degrades in soil, with a half-life of about 113 days.
- Half-life is decreased by the presence of microflora.
- Imazapic is primarily degraded by microbes and it does not degrade appreciably under anaerobic conditions.
- Imazapic is weakly adsorbed in high soil pH, but adsorption increases with lower pH (acidic soils) and increasing clay and organic matter content.
- Field studies indicate that imazapic remains in the top 12 to 18 inches of soil and do not indicate any potential for imazapic to move with surface water.
- Modeling results indicate imazapic runoff is highest in clay and loam soils with peaks after the first rainfall.
- Imazapic percolation is highest in sandy soils.

Imazapyr

There are no studies on the effects of imazapyr on soil invertebrates, and incomplete information on the effects on soil microorganisms.

- One study indicates cellulose decomposition, a function of soil microorganisms, can be decreased by soil concentrations higher than concentrations expected from USDA Forest Service applications.

- There is no basis for asserting adverse effects to soil microorganisms.
- Imazapyr degrades in soil, with a half-life of 25 to 180 days.
- Degradation rates are highly dependent on microbial action.
- Anaerobic conditions slow degradation.
- Adsorption increases with time as soil dries and is reversible.
- Field studies indicate that imazapyr remains in the top 20 inches of soil and do not indicate any potential for imazapyr to move with surface water.
- In forest field studies, imazapyr did not run off and there was no evidence of lateral movement.
- Modeling results indicate imazapyr runoff is highest in clay and loam soils with peaks after the first rainfall.
- Imazapyr percolation is highest in sandy soils

Metsulfuron methyl

Studies on the effects of metsulfuron methyl on soil biota are limited to Pseudomonas species, though there are a few studies of insects that live in soil. The lowest observed effect concentration is 5 mg/kg, based on the Psuedomonas study. At recommended use rates, no effects are expected for insects.

- Effects to soil microorganisms appear to be transient
- Metsulfuron methyl degrades in soil, with a variable half-life up to 120 days.
- Half-life is decreased by the presence of organic matter though microbial degradation of metsulfuron methyl is slow.
- Non-microbial hydrolysis is slow at high pH but rapid at lower pH.
- Adsorption to soil particles, which affects the runoff potential of metsulfuron methyl, increased with increased pH and organic matter.
- Metsulfuron methyl has low adsorption to clay.
- Modeling results indicate that off-site movement due to runoff could be significant in clay soils.
- Metsulfuron methyl percolates in sandy soils.

Picloram

Picloram is a restricted use pesticide in the state of Washington, meaning it may only be used by a certified applicator (this is also a standard for all herbicide use on the Olympic National Forest). The persistence of picloram increases with soil concentration, thus increasing the likelihood that it becomes toxic to soil microorganisms in the short-term.

- Since picloram is toxic to microorganisms at low levels, toxic effects can last for some time after application.
- Persistence in soils could affect soil microorganisms by decreasing nitrification.
- Long-term effects to soil microorganisms are unknown.
- Picloram applied at a typical application rate is likely to change microbial metabolism, though detectable effects to soil productivity are not expected.

- Field studies have not noted substantial adverse effects associated with the normal application of picloram that might be expected if soil microbial activity were substantially damaged.
- Substantial effects to soil productivity from the use of picloram over the last 40 years have not been noted.
- Picloram has been studied on a number of soil invertebrates.
- Metabolites may increase toxicity for some soil microorganisms.
- Picloram has a typical half-life of 90 days.
- However, picloram soil degradation rates vary in soil, depending on application rate and soil depth.
- Picloram is water soluble, poorly bound to soils that are low in clays or organics, has a high leaching potential, and is most toxic in acidic soil.
- Picloram should not be used on coarse-textured soils with a shallow water table, where groundwater contamination is most likely to occur.
- Picloram percolation is highest in loam and sandy soils. However, modeling results indicate picloram runoff (not percolation) is highest in clay soils.

Sethoxydim

Sethoxydim has not been studied on soil invertebrates.

- Assays of soil microorganisms noted transient shifts in species composition at soil concentration levels far exceeding concentrations expected from USDA Forest Service application.
- No adverse effects to soil organisms are expected.
- Sethoxydim is degraded by soil microbes, with an estimated half-life of 1 to 60 days. Adsorption of sethoxydim varies with organic material content.
- Modeling results indicate sethoxydim runoff is highest in clay and loam soils with peaks after the first rainfall.

Sulfometuron methyl

There are no studies on the effects of sulfometuron methyl on soil invertebrates. However, it is toxic to soil microorganisms. Microbial inhibition is likely to occur at typical application rates and could be substantial. Soil residues may alter composition of soil microorganisms. Sulfometuron methyl applied to vegetation at rates to control undesirable vegetation would probably be accompanied by secondary changes in the local environment that affect the soil microbial community more certainly than direct toxic action of sulfometuron methyl on microorganisms.

- The typical half-life for sulfometuron methyl varies from 10 to 100 days, depending on soil texture. Half-life decreases as soil particle size decreases. Presence of soil microorganisms also decreases half-life, though microbial breakdown occurs slowly. Sulfometuron methyl degradation occurs most rapidly at lower pH soils where rates are dominated by hydrolysis.
- Sulfometuron methyl mobility is generally greater at higher soil pH and lower organic matter content.

- Modeling results indicate sulfometuron methyl runoff is highest in clay and loam soils with peaks after the first rainfall. Sulfometuron methyl percolation is highest in sandy soils. Monitoring results generally support modeling results.
- Sulfometuron methyl applied to vegetation at typical application rates would probably be accompanied by secondary changes to vegetation that affect the soil microbial community more certainly than direct toxic action of sulfometuron methyl on soil microorganisms.

Triclopyr

The five commercial formulations of triclopyr contain one of two forms of triclopyr, BEE (butoxyethyl ester) or TEA (triethylamine). Triclopyr BEE is much more toxic to aquatic organisms than triclopyr TEA. A breakdown product, TCP (3,5,6-trichloro-2-pyridinol), is more toxic than either form of triclopyr. Site-specific cumulative effects analysis buffer determinations need to consider the form of triclopyr used and the proximity of any aquatic triclopyr applications, as well as toxicity to aquatic organisms.

- Triclopyr has not been studied on soil invertebrates.
- Soil fungi growth was inhibited at concentrations 2 to 5 times higher than concentrations expected from USDA Forest Service application rates.
- Triclopyr has an average half-life in soil of 46 days, while TCP has an average half-life in soil of 70 days. Warmer temperatures decrease the time to degrade triclopyr.
- Soil adsorption is increased as organic material increases and decreased as pH increases. Triclopyr is weakly adsorbed to soil, though adsorption varies with organic matter and clay content. Both light and microbes degrade triclopyr.

Summary of Soils Concerns and Project Design Features (PDFs)

Clopyralid has high potential mobility in sandy soils. It is degraded by soil microbes not hydrolysis and therefore can be persistent in groundwater. Therefore, clopyralid would not be used on high-porosity soils (more than 20% coarse fragments or coarser texture than loamy sand).

Chlorsulfuron does not adhere to clay particles. Therefore, chlorsulfuron would be avoided on soils with high clay content (finer than loam).

Picloram and sulfometuron methyl persist longest in the soil and may also have adverse effects on aquatic organisms. Therefore, the PDFs limit the frequency of use of these herbicides, and they would not be used on shallow or coarse soils. The Proposed Action avoids use of picloram on roads having high potential for herbicide delivery.

Effects on Riparian Condition and Water Quality

None of the alternatives have the potential to influence stream flow and channel morphology due to the small portion of any watershed that would be treated. Treating invasive plants would improve riparian stability where invasive plants such as knotweeds have colonized along stream channels and out-competed native species. All invasive plant treatments carry some risk that removing invasive plants could exacerbate stream instability; the restoration plan accounts for these areas and prescribes mulching, seeding and planting as needed to revegetated riparian and other treated areas.

Manual and mechanical treatments within riparian areas could accelerate sediment delivery to streams through ground disturbance. However, most of the treatments areas are previously disturbed roadways and trails so ground disturbance is not a significant concern. Modification of surface ground cover can also change the timing of run-off. For all alternatives, treatment areas comprise a small portion of any watershed so no effects to stream flows are plausible.

A primary issue for this analysis is the potential for herbicides to enter streams and impact domestic drinking water sources and/or aquatic organisms. This section describes how Project Design Features minimize the possibility that herbicides would enter water and impact water quality. Effects on aquatic organisms and human health are discussed in later in this chapter.

Based on the R6 2005 FEIS, herbicides were grouped by their potential to harm aquatic resources. The herbicides of lower concern for aquatic resources are: clopyralid, imazapic, and metsulfuron methyl. The herbicides of moderate concern for aquatic resources are: chlorsulfuron, imazapyr, sulfometuron methyl. The herbicides of greatest concern are: non-aqueous glyphosate, triclopyr, picloram, and sethoxydim. Streamside buffers vary depending on the level of concern.

Drift, Run-off and Leaching

The routes for herbicide to contaminate water are; direct application, drift into streams from spraying, runoff from a large rain storm soon after application, and leaching through soil into shallow ground water or into a stream. This section addresses each of these delivery routes.

No direct application of herbicide to water is intended in any alternative. Some invasive plants may grow in wetlands or along stream channels and hand treatment of these plants may result in limited delivery to surface waters (particularly at the Cranberry Bog Botanical area and Middle Hoh River Floodplain site). Aquatic formulations could be used in these situations; however concentration of herbicide that could reach streams from these treatments would be far below levels of concern (see analysis of fish and other aquatic organisms for more information).

Effects from drift, runoff and leaching were considered in the herbicide risk assessments, prepared for the R6 2005 FEIS, assuming broadcast treatments occurring directly adjacent to streams. The Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model was used to estimate the amount of herbicide that may potentially reach a reference stream via runoff, drift and leaching in a 96 hour period, assuming broadcast treatments on a 50-foot strip along about 1.6 miles of perennial stream. SERA risk assessments evaluated the hazards associated with each herbicide based on the concentrations of herbicide predicted by the GLEAMS model using these parameters.

The Biological Assessment submitted to National Marine Fisheries Service (NMFS) in 2005 considered whether ecosystem conditions associated with a variety of bioregions (ecotypes) might affect herbicide concentrations/hazards predicted using the GLEAMS model (R6 2005 FEIS, Biological Assessment, Appendix B). The Biological Assessment found that risk assessment modeling is likely to overestimate herbicide concentration in most site conditions within the Western Cascades (Olympic National Forest fits best into this ecotype). However, herbicide concentrations in water could be higher than predicted by GLEAMS modeling in smaller steeper-sided drainages during periods of low flow, especially at higher elevations in the western Cascades. These conditions commonly occur within the project area.

Even considering the steepest, smallest dry season drainage occurring on the Forest, GLEAMS modeling likely overestimates the herbicide concentrations that would plausibly enter streams from this project, mainly because broadcast treatments are prohibited within 50 feet of perennial streams in all alternatives (broadcast application of any herbicide except aquatic formulations are prohibited within 100 feet of perennial streams). Spot treatments using herbicides of higher concern to aquatic organisms along streams would also be buffered. Hand and spot treatments are inherently far less likely to deliver herbicide to water because the herbicide is applied to individual plants, so drift, runoff and leaching are greatly minimized. Small amounts of some herbicides can trans-locate from the plant to the soil or adjacent plant, but the concentrations of herbicide that may be delivered to streams from this mechanism is likely to be less than GLEAMS predictions for broadcast treatment.

Bergs (2004) compiled monitoring results for broadcast herbicide treatments given various buffers along waterbodies. The results showed that any buffer helps lower the concentration of herbicide in streams adjacent to treatment areas. In California, when buffers between 25 and 200 feet were used, herbicides were not detected in monitored streams (detection limits of 1to 3 mg/m^3).

In South Carolina, buffers of 30 meters (comparable to 100 feet) during ground applications of the herbicides imazapyr, picloram and triclopyr resulted in no detectable concentrations of herbicide in monitored streams (USDA HFQLG EIS, Appendix B, 2003).

Even smaller buffers have successfully protected water quality. For example, where imazapyr was aerial sprayed without a buffer, the stream concentration was 680 mg/ml. With a 15-meter buffer, the concentration was below detectable limits (Berg, 2004).

Berg collected samples of several herbicides (including sulfometuron methyl and glyphosate) following roadside application one, seven and fourteen days after treatment. Rainfall of one-third inch occurred throughout the period. Berg detected concentrations of sulfometuron-methyl and glyphosate along road shoulders through the period. In the fall the road was again sprayed, and the ditch line of the road was checked during rainstorms for three months. Sulfometuron-methyl was detected along the shoulder in the ditch line, but was below detectable limits in the nearby stream. Glyphosate was not found at the shoulder, ditch line or stream.

This study indicates that the greatest risk of herbicides moving off site is from large storms soon after herbicide application. In addition, this study also indicates that sulfometuron methyl may persist in the environment as it was detectable along the shoulder of the road (but not in the stream) the entire duration (three months) of the study.

Berg also reported that herbicide applied in or along dry ephemeral or intermittent stream channels may enter streams through run-off if a large post-treatment rainstorm occurred soon after treatment. This risk is minimized if intermittent and ephemeral channels are buffered (ibid.). If a large rainstorm occurs sediment contaminated by herbicide could be carried into streams. As most ditch lines on the Olympic are heavily vegetated, this is less likely to occur on the Olympic than in a drier environment.

Dry sediment contaminated by herbicide could plausibly be carried by wind and enter a stream or water body. This is an unlikely scenario as most of the forest is heavily vegetated so there is less bare soil for movement by wind.

Accidental Spill

Concentrations of herbicides in the water as a result of an accidental spill depend on the rate of application and the streams' ratio of surface area to volume. The persistence of the herbicide in water depends on the length of stream where the accidental spill took place, velocity of stream flow, and hydrologic characteristics of the stream channel. The concentration of herbicides would decrease rapidly down-stream because of dilution and interactions with physical and biological properties of the stream system (Norris et al.1991).

Accidental spills are not considered within the scope of the project. Project design features would reduce the potential for spills to occur, and if an accident were to occur, minimizes the magnitude and intensity of impacts. An herbicide transportation and handling plan is a project requirement. This plan would address spill prevention and containment.

Lakes, Wetlands and Floodplains

Herbicides affect lakes and wetlands differently than streams. Dilution by flow or tributary inflow is generally less effective in lakes. Dilution is partially a function of lake size, but dilution could be rapid in small lakes with large water contributing areas. Decreases in herbicide concentration in lakes, ponds, and other lentic water bodies are largely a function of chemical and biological degradation processes rather than of dilution. Evaporation of water from a lake's surface can concentrate chemical constituents. As vegetation within water dies the oxygen level within the lake can decrease.

Some invasive plants may grow in wetlands or stream channels and treatment of these plants may result in direct application to surface waters (particularly at the Cranberry Bog Botanical area and Middle Hoh River Floodplain site). To minimize risk to wetlands no more than 10 acres or half of a wetland would be treated in any 30-day period. The design features for wetlands limit the area treated at one time for two reasons:

1. They lower the amount of herbicide in the water body at one time and gives time for the herbicide to degrade. Many of the herbicides degrade quickly in water.
2. When vegetation is killed in the water it uses up oxygen as it decays. If only half an area is treated it lowers the acreage affected by vegetation decay and leaves refugia for aquatic organisms in other parts of the lakeside, pond or wetland.

Approximately 96 acres in and around summer homes on Quinault Lake have invasive plants inventoried. About 26 acres are estimated to occur within 100 feet of the lake. To minimize impacts to the lake, no more than 10 acres within 100 feet of the lake would be treated in any 30-day period. Treatments would be sequenced accordingly.

Small, unmapped ponds found during implementation planning would have a similar restriction on herbicide use within 100 feet of the wetland.

Municipal Watersheds and Domestic Water Supplies

Coordination with water boards and users would occur and herbicide use within 1000 feet upstream (slope distance) of known water intakes would be coordinated with the water manager or owner. In all alternatives, existing municipal watershed agreements would be followed.

Most of the infestations in municipal watersheds are along roads. Some of these roads are currently proposed for broadcast treatment, assuming density of invasive plants warrant this method. Herbicide use may be excluded or limited to spot and/or hand treatments according to memoranda of understanding.

All alternatives comply with the Olympic National Forest Standard related to using herbicides only as a last resort and only when water quality will not be adversely affected, because:

- Herbicides are proposed for target species that cannot be effectively controlled using other methods.
- All alternatives protect drinking water supplies. There are no plausible scenarios that could lead to drinking water contamination sufficient to affect public health, given the types of herbicide proposed and the manner they will be used. Concentrations of herbicides that may reach groundwater or streams are low and below levels of concern for people.
- About 210 acres are proposed for treatment within municipal watersheds, about half of which are estimated to be within the Aquatic Influence Zone. This is a very small scale of herbicide use in relation to the size of the municipal watersheds. Treatment is not currently proposed within1000 feet of any intake (except for one small infestation within 1000 feet of the Lake Southerland Water District intake).

Roads

Approximately 1,420 roadside treatment acres (43 percent of the infested roadsides) are associated with conditions that indicate high potential for herbicide delivery. Infestations occur along about 734 miles of road (approximately 2 acres per mile of road).

Approximately 70 percent of the streams on the Olympic National Forest are intermittent. When conditions are dry, intermittent streams and roadside ditches are far less likely to contribute to delivery of herbicides to live streams.

Alternative Effects Comparison

Alternative A (No Action)

Direct and Indirect Effects

Under the No Action alternative, manual and mechanical treatments would occur on about 672 acres (in combination with herbicides on 86 of these acres). The herbicides currently available for use under this alternative are glyphosate, picloram and dicamba. The primary non-herbicide treatments would be hand pulling and mowing.

Effects to soils would be localized with this alternative. Invasive plant treatments could result in small areas of localized erosion and sedimentation. These effects would be minimal given the small amount of land treated, especially within Aquatic Influence Zones, and the scattered nature of the treatments. These effects would last one season until vegetation became re-established.

The treatments proposed are unlikely to result in significant amounts of decaying plants or nutrients entering a stream at one time, and therefore no measurable effect to oxygen levels is anticipated. Most invasive plants provide little shade; therefore removing them would not lead to a measurable change in temperature. Knotweeds and other invasive plants would continue to destabilize stream banks.

Measurable chemical contamination is unlikely. No effect to stream flows is expected under this alternative.

Cumulative Effects

Treatments would occur on an extremely small percentage of any watershed on the Olympic National Forest (less than 1/10th of 1 percent of the Forest would be treated). Direct and indirect effects are so insignificant and temporary that treatment under No Action could not plausibly contribute to significant cumulative effects.

Alternative B
Direct and Indirect Effects

Under Alternative B, all 3,830 infested acres would be treated using herbicides, manual and mechanical methods. Herbicides would be a part of the prescription on most acreage, particularly the first few years of treatment.

A minor localized increase in fine sediments could result from invasive plant removal along streams, particularly if vegetation is removed from stream banks. These effects would only last a season until vegetation became re-established and are not considered significant. Restoration would occur on approximately 65 percent of the sites to ensure revegetation occurs and erosion is controlled. Forest BMPS and standards and guidelines would be followed to ensure that water resources were protected.

Broadcast has more potential than other application methods to contact soil and affect soil organisms and/or productivity. Broadcast treatments are also associated with a risk of leaving large areas of soil bare. Mulching, seeding, and/or planting would occur as described in the restoration plan, which would reduce the risk of erosion or other adverse soil conditions in bare areas.

To protect soil organisms and therefore soil productivity, sulfometuron methyl would be used no more than once a year to avoid accumulating herbicides in the soils. Picloram would only be used no more than once every two years to protect soil productivity and avoid accumulation of this persistent herbicide. The Project Design Features use properties of the soils to control movement of herbicides off-site. Treatments would occur during times of the year when soils are driest if possible. If herbicide treatment is necessary when soils are wet, aquatic-labeled herbicides or those that pose low risk to aquatic organisms would be used according to label directions.

Project Design Features also minimize the chance of herbicides reaching streams or wetlands. Buffer widths vary depending on herbicide risk ranking and application method. Wetlands would be treated using non-herbicide methods where such treatments are likely to be effective. For instance, Scotch broom might be hand pulled within the Cranberry Bog. Hand treatments are not effective for treating of knotweed, so some herbicide use may occur in or near stream channels. Effective treatment of knotweed and replacement with native vegetation would lead to stream bank and intermittent channel stabilization over time.

Broadcast treatments with Aquatic Influence Zones would be limited to herbicides posing low levels of concern for aquatic organisms. No broadcast treatment would occur on roads having a high potential for herbicide delivery (see list and map in Appendix D). Broadcast would be allowed only on the remaining 34 percent of the treatment areas. No picloram would be used on roads having a high potential for herbicide delivery (not even with hand or spot treatments).

Herbicides of greater concern to aquatic organisms would not be applied using any method within 15 feet of ditches that feed streams, or 50 to 100 feet from intermittent streams, even when ditches or intermittent streams are dry. Only aquatic glyphosate or aquatic imazapyr would be broadcast across dry intermittent streams.

No herbicide application could occur if precipitation is forecast within 24 hours of application. The longer the time between application and the rain event, the more herbicide would be taken up by plants and be unavailable for movement offsite. If rain occurred soon after application, herbicide could be carried into a perennial stream. As the treatments are scattered even if a large rain event occurs soon after treatment, it is unlikely that herbicide concentration would approach a threshold of concern.

Given these Project Design Features, treatments are unlikely to affect functioning of wetland or water bodies, and significant adverse effects on beneficial uses of water are unlikely.

Cumulative Effects

Most of the herbicides used under this alternative do not negatively affect soil organisms at typical application rates. Of the ten, two (picloram and sulfometuron methyl) have the potential to affect soil organisms at typical application rates. These herbicides have half-lives of 90 days and 10-100 days depending on soil conditions. Cumulative soil productivity is protected by the PDFs that restrict the amount of these two herbicides that may be used and the frequency of application. Thus, at any one site, herbicides would be degraded before more would be used, and no cumulative chemical loading would occur in the soil so cumulative impacts to soil productivity would be avoided in all situations.

Buffering waterbodies lowers the potential for herbicide to enter water at any treatment site. Herbicides of moderate and high risk have larger buffers than lower risk and aquatic labeled-herbicides.

Alternative B is unlikely to have significant effects to soil or water resources and therefore is unlikely to approach a threshold of concern and therefore would not contribute to significant cumulative effects. No adverse cumulative effects are expected from implementation of this alternative.

Alternative C

Direct and Indirect Effects

Herbicides would be used on fewer acres than Alternative B, and no broadcast treatment would occur in any situation. Alternative C has no broadcast treatment so there is little potential to create large bare areas of ground prone to erosion from the herbicide treatments. Similarly to Alternative B, Alternative C would minimize the risks associated with the use of picloram and sulfometuron. The greater proportion of manual and mechanically treated acres does not result in a greater degree of impact. Up to 3817 acres of non-herbicide treatment could occur under this alternative including 2510 acres of treatment within the inner riparian reserve. However, most of the non-herbicide treatments would occur with herbicide treatments such as cut and paint, or would occur after herbicide treatments have lowered the size of the infestation.

With more treatment by non-herbicide methods, Alternative C has the greatest potential for erosion and sediment delivery to streams. There are approximately 203 acres of potential weed- wrenching of scotch broom, about half of which is likely to lie within Aquatic Influence Zones or along roads having a high risk for herbicide (sediment) delivery. Infested site are scattered across the Forest so are unlikely to even manual or mechanical treatments are unlikely to result in significant erosion or sedimentation of streams.

Alternative C increases the risk of trampling and instability of stream banks due to its reliance on non-herbicide treatments, particularly in areas where Scotch broom or other invasives grows directly along stream banks. This would be a short-term effect until revegetation occurred. The risk of long-term adverse effects from these treatments is low. As in Alternative B, a minor localized increase in fine sediments could result from treating when vegetation is removed along streams, particularly from the stream banks. These effects would only last a season until vegetation became reestablished and are not considered significant. Restoration would occur on approximately 65 percent of the sites to ensure revegetation occurs and erosion is controlled.

Invasive plants provide little shade therefore removing them would not lead to a measurable change in temperature. The treatments proposed are unlikely to result in significant amounts of decaying plants or nutrients entering a stream at one time and therefore no measurable effect to oxygen levels is anticipated. In the long-term temperature would be improved on streams currently impacted by invasive plants.

This alternative includes no broadcast spray and only no herbicide use in Riparian Reserves or along any road having a high potential to deliver herbicide (see Appendix D for a map and list of these roads).

About 1,025 acres would be treated with herbicides, all outside of Aquatic Influence Zones. Thus, there would also little risk of runoff carrying herbicide to streams.

Cumulative Effects

The cumulative effects of Alternative C are similar to Alternative A within Aquatic Influence Zones and roadside treatment areas that have a high risk of delivering herbicide to streams. The cumulative effects of Alternative C are similar to Alternative B outside these areas.

Alternative D

Direct and Indirect Effects

Alternative D would result in effects similar to Alternative B within most 6^{th} field watersheds. Herbicide use would be subject to application of PDFs for perennial streams, municipal watersheds, wetlands, ponds and lakes, and would have effects similar to Alternative B in these areas. However, Project Design Features related to intermittent streams and high potential for herbicide delivery roads would *not* be applied.

Broadcast treatments along intermittent streams or along roads having high potential to deliver herbicide could result in concentrations of concern to aquatic organisms if a rainstorm occurred soon after treatment, especially if herbicide posing higher risk to aquatic organisms were applied. The longer the time between application and the rain event, the more herbicide would be taken up by plants and be unavailable for movement offsite. Adverse effects to water quality would be temporary because herbicides would quickly become diluted downstream to concentrations below levels of concern.

Within the following 6^{th} field watersheds, acres broadcasted within the Aquatic Influence Zone may approach or exceed GLEAMS model parameters (approximated by 10 acres of broadcast within the inner half of an intermittent Riparian Reserve within a 6^{th} field watershed – this is an extremely cautious approach since the GLEAMS model is based on a much smaller land base):

> **South Fork Calawah River**: Approximately 74 infested acres are estimated to lie within 100 feet of an intermittent stream. These acres are not concentrated within a single part of the watershed but as many of the roads in this watershed are associated with high risk for delivery of herbicide to streams, there is potential for herbicide concentrations to reach thresholds of concern under Alternative D.
>
> **Upper West Fork Satsop River Watershed:** About 33 infested acres are estimated to lie within 100 feet of an intermittent stream. One of the treated roads parallels Spoon Creek. The treatments are all high in the watershed where the streams tend to be smaller with less flow. There is potential for undesirable effects to the West Fork Satsop River and Spoon Creek within this watershed.
>
> **West Fork Humptulips River Watershed:** Many of the treatment areas are along roads that parallel streams. This watershed could have up to 34 acres of broadcast treatment within riparian reserves of intermittent streams. There are roads within treatment areas listed as high risk for herbicide delivery. The treatment areas are primarily roads and tend to follow West Fork Humptulips River or tributaries to the river. However, the river is much larger than the stream simulated in the GLEAMS modeling; therefore the concentrations would be much less than worst case predictions.
>
> **East Fork Humptulips River Watershed:** The treatments are a combination of roads and plantations. Many of the roads parallel the River or tributary streams. This watershed could have up to 24 acres of broadcast treatment of riparian reserves within the inner riparian area of intermittent streams. The roads are considered high risk for delivery of herbicides to streams. There is potential for short-term adverse effects from herbicide treatments if all the treatments

within the inner riparian reserves and high aquatic risk roads were treated on the same day, and a large rain event occurred.

Quinault Lake: Most of the treatment areas are on roads, developed areas of summer homes and campgrounds in this area. Approximately 31 acres of broadcast treatment along intermittent streams could occur under Alternative D. Few of the roads in this area are considered high risk for delivery of herbicide to streams.

Jefferson Creek Watershed: There is potential for up to 16 acres of treatment in the inner riparian reserves of this watershed. The roads in the watershed are not high risk for herbicide delivery to streams. The treatments are along roads that parallel both Jefferson and Washington Creeks. Given that the treatments areas are not concentrated in one area of the watershed it is unlikely that adverse effects would occur from herbicide treatments. Any herbicide that is delivered to water would likely be diluted below the amounts modeled in the GLEAMS model for the regional EIS.

Middle Sol Duc River Watershed: Approximately 17 acres of broadcast could occur within the inner riparian reserves of intermittent streams under this alternative. It is unlikely that adverse affects would occur because the treatment are scattered across the watershed along Bear Beaver and Cold Creeks. They are primarily along roads but include other disturbed areas including part of the Saddle/Bear planned timber sale.

Upper South Fork Skokomish River: There are approximately 15 acres of broadcast within the inner riparian reserve along intermittent streams within the watershed. These treatments are primarily along the S F Skokomish River, Brown Creek, Pine Creek, Cedar Creek and Lebar Creek. It is unlikely that there would be adverse effects from treatments as the intermittent streams feed into many different perennial streams and are not concentrated in any part of the watershed.

Main Stem Hamma Hamma River Watershed: The treatments parallel the river for over seven miles and also follow Boulder Creek. The roads are high risk for delivery of herbicide to the streams. However the approximately 13 acres of treatment of the inner riparian reserves along intermittent streams is scattered along miles of treatment areas and therefore herbicide concentrations reaching streams are unlikely to reach concentrations modeled in the regional EIS.

North Fork Calawah River Watershed: There are approximately 24 acres of potential broadcast treatment of the inner riparian reserves along intermittent streams in this watershed. The roads in this watershed are at high risk for delivery of herbicide to streams. The treatments are not concentrated in one area but are scattered across the watershed, therefore, it is unlikely that adverse effects would occur from herbicide treatments within this watershed.

Without further mitigation, broadcast treatments along roads having high potential for herbicide delivery and intermittent streams may not comply with Forest Plan standards. To meet the standards, either broadcast treatments would need to be eliminated in these areas, or herbicides selected for broadcasting would have to be among those of low risk to aquatic organisms, or monitoring would have to occur to ensure that herbicides do not enter water in concentrations of concern relative to aquatic organisms.

Cumulative Effects

Like the other alternatives, Alternative D is unlikely to contribute to significant cumulative effects, even under the worst-case plausible scenario of broadcast treatment near intermittent streams or along roads that have a high potential for herbicide delivery, even if treatment was soon followed by a rain storm. Because additional mitigation and/or monitoring would be recommended should this alternative be selected, cumulative adverse effects are likely to be similar to Alternative B.

Alternative Comparison – Soil and Water

Table 52. Comparison of Herbicide Use within Aquatic Influence Zones

	Character of Herbicide Use Within Aquatic Influence Zones	Estimated Acres of Herbicide Use Allowed Within Aquatic Influence Zone	Estimated Proportion of Project Where Broadcast Methods are Allowed	Estimated acreage of project where herbicide treatment may occur on roads with high potential to deliver herbicides	Estimated proportion of project where broadcast of herbicidemay occur on roads with high potential to deliver herbicides
No Action (Alternative A)	None	Restricted to hand applications of aquatic glyphosate.	0 %	0	0 %.
Proposed Action (Alternative B)	Buffers restrict broadcasting near perennial and intermittent streams; treatment of wetland emergent or streamside target vegetation would require low aquatic risk or aquatic labeled herbicides.	Approximately 620 acres	34%	1,420	0 %
Alternative C	None	Restricted to hand applications of aquatic glyphosate.	0 %	0 %	0 %

	Character of Herbicide Use Within Aquatic Influence Zones	Estimated Acres of Herbicide Use Allowed Within Aquatic Influence Zone	Estimated Proportion of Project Where Broadcast Methods are Allowed	Estimated acreage of project where herbicide treatment may occur on roads with high potential to deliver herbicides	Estimated proportion of project where broadcast of herbicidemay occur on roads with high potential to deliver herbicides
Alternative D	Buffers restrict broadcasting near perennial and wet intermittent streams; treatment of wetland emergent or streamside target vegetation would require low aquatic risk or aquatic labeled herbicides. No restrictions beyond label guidance and Forest Plan Standards would apply to dry intermittent streams.	Approximately 620 acres	86%	No additional restrictions on these roads.	37%

3.5 Aquatic Organisms and Habitat ___________________

The potential effect of invasive plant treatments on aquatic organisms is a primary public issue (Issue Group 5). Many people express concern about the effects of herbicide use on fish and the aquatic ecosystem. Many laws, policies, standards and guidelines relate to aquatic ecosystems and activities near streams. The Soil and Water section above describes how invasive plant treatments within the scope of this EIS may result in short term and localized sediment and loss of streamside cover. The Soil and Water section also discusses how herbicides may enter streams. The following section focuses on the potential effects on aquatic organisms should any alternative result in herbicide delivery to streams.

Aquatic Standards and guidelines within the Northwest Forest Plan created a consistent approach to evaluating and protecting aquatic and riparian habitats throughout Region Six. Standards and guidelines prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the ACS objectives. Treatments in all alternatives are compatible with Riparian Reserve standards and guidelines (see Chapter 1).

All alternatives (including No Action) May Impact sensitive aquatic species, but none will affect the viability of any species or cause any species to be listed under the Endangered Species Act (Chapter 3.5 and Appendix C include a Biological Evaluation for sensitive species). All alternatives May Affect aquatic species listed or proposed for listing under the Endangered Species Act and are thus subject to Biological Assessment and Consultation with the USDI - Fish and Wildlife Service and USDC – National Marine Fisheries Service (aka NOAA Fisheries).

3.5.1 Affected Environment

Effects of Invasive Plants on Aquatic Ecosystems

As described previously, invasive plants found growing adjacent to or within aquatic influence areas can invade, occupy, and dominate riparian areas and indirectly impact aquatic ecosystems and fish habitat. Target species such as knotweed and blackberry can choke streams, become sediment traps, and block fish access. For example, invasive blackberries may dominate small streams or spread their thick root systems within and across streams, blocking fish access.

Invasive plants can change stand structure and alter future inputs of wood and leaves that provide the basic foundation of the aquatic ecosystem food webs. Native vegetation growth may change as a result of infestation, and the type and quality of litter fall, and quality of organic matter may decline, which can alter or degrade habitat for aquatic organisms. For example, native vegetation regeneration was reduced as a result of knotweed infestations (Lauren Urgenson, pers. Comm.). The amount of nitrogen to aquatic ecosystems through riparian litter fall may be compromised because knotweed retains more nitrogen than native species. The availability of nitrogen to aquatic biota and native vegetation may be significantly reduced because knotweed can uptake or hold on to 75 percent of leaf nitrogen in the root system (ibid). Primary and secondary consumers that form the basic food source for fish and other aquatic organisms may be indirectly affected.

Aquatic Species of Local Interest

The Olympic National Forest has a total of 15 Aquatic Species of Local Interest. Ten of these are on the July 2004 Regional Forester's Sensitive Species list (Table 53) and five are either Proposed, Endangered, and Threatened fish species (Table 54).

Appendix C displays brief summaries regarding the life history and other information for each of these species, compiled from a variety of sources. Additional information related to life history and status of populations at the Evolutionary Significant Unit (ESU) or Distinct Population Segment (DPS) scale can be found in the following sources:

- R6 2005 FEIS and Fisheries Biological Assessment (BA), especially the Environmental Baseline
- NMFS and USFWS Federal Register documents (http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Index.cfm), (http://www.fws.gov/pacific/bulltrout/),
- Shared Strategy for Puget Sound for Puget Sound Chinook Salmon, Hood Canal summer chum salmon, and bull trout population in the Puget Sound area (http://www.sharedsalmonstrategy.org/plan/docs/)
- Draft Coast Puget Sound Bull Trout Recovery Plan (http://www.fws.gov/pacific/bulltrout/recovery.html)

Table 53. Regional Forester's Sensitive Species on Olympic National Forest, Washington

Species	ESU or DPS	5th Field Watersheds on NF
Chinook Salmon	Washington Coast	Soleduck River, Calawah River, Bogachiel River, Hoh River, Clearwater River*, Queets River, Whale Creek/Raft River*, Upper Quinault River, Lower Quinault River*, Humptulips River, Wishkah River*, Wynoochee River, Satsop River*
Coho Salmon	Puget Sound/Strait of Georgia	Elwha River*, Dungeness River, Sequim Bay, Discovery Bay, Upper West Hood Canal Frontal, Big Quilcene River, Dosewallips River, Duckabush River, Hamma Hamma River*, Lower West Hood Canal Frontal*, Skokomish River
Chum Salmon	Puget Sound/Strait of Georgia	Elwha River*, Dungeness*, Sequim Bay*, Discovery Bay*, Upper West Hood Canal Frontal*, Big Quilcene River*, Dosewallips* River, Duckabush River, Hamma Hamma River*, Lower West Hood Canal Frontal*, Skokomish River
	Pacific Coast	Pysht River/Clallam River*, Lyre River/Twin River*, Hoh River, Clearwater River*, Whale Creek/Raft River*, Upper Quinault River, Lower Quinault River*, Humptulips River, Wishkah River*, Wynoochee River*, Satsop River*, Queets River,
Sockeye Salmon	Lake Pleasant Sockeye	Soleduck River*
	Quinault Lake	Upper Quinalt River
Coastal Cutthroat Trout	Puget Sound	Elwha River, Dungeness River, Sequim Bay, Discovery Bay, Upper West Hood Canal Frontal, Big Quilcene River, Dosewallips River, Duckabush River, Lower West Hood Canal Frontal, Hamma Hamma River, Skokomish River
	Olympic Peninsula	Pysht River/Clallam River, Lyre River/Twin River, Soleduck River, Calawah River, Bogachiel River, Hoh River, Clearwater River, Queets River, Whale Creek/Raft River, Upper Quinault River, Lower Quinault River,
Olympic Mudminnow	N/A	Lower Quinalt River, Satsop River*
Salish Sucker	N/A	Skokomish River*

*Watersheds with an asterick indicate fish species present lower in watershed off National Forest lands.

**Watersheds with a double asterick indicate historic distribution within the watershed on National Forest lands.

Table 54. Species Listed and Proposed For Listing ESA and their Critical Habitat on Olympic National Forest, Washington

Species	DPS or Critical Habitat	Status	Federal Register Reference	5th Field Watersheds on NF (Critical Habitat)
Steelhead	Puget Sound	Proposed	71 FR 15666 3/29/06	Elwha River*, Dungeness River, Dosewallips River, Duckabush River, Hamma Hamma River*, Skokomish River
Chinook Salmon	Puget Sound	Threatened	64 FR 14308 3/24/99	Elwha River*, Dungeness River, Dosewallips River, Duckabush River, Hamma Hamma River*, Skokomish River
	Puget Sound Critical Habitat	Designated	70 FR 52629 09/02/05	Same as above
Coho Salmon	Lower Columbia River	Threatened	70 FR 37160 6/28/05	Humptulips River, Satsop River, Wynoochee River
Chum Salmon	Hood Canal Summer-run	Threatened	64 FR 14508 03/25/99	Dungeness*, Sequim Bay*, Discovery Bay*, Dosewallips River*, Duckabush River, Big Quilcene River*, Upper West Hood Canal Frontal*, Hamma Hamma River*, Skokomish River**
	Hood Canal Summer-run Critical Habitat	Designated	70 FR 52629 09/02/05	Same as Threatened
Bull Trout	Coastal Puget-Sound	Threatened	64 FR 58910 11/01/99	Hoh River, Queets River, Upper Quinault River, Lower Quinault River*, Wishkah River*, Satsop River**, Wynoochee River**, Humptulips River, Skokomish River, Dungeness River, Elwha River

*Watersheds with an asterick indicate fish species present lower in watershed off National Forest lands.

**Watersheds with a double asterick indicate historic distribution within the watershed on National Forest lands.

Designated Critical Habitat for Pacific Salmon

NMFS designates critical habitat based on physical and biological features that are essential to the listed species. Essential features of designated critical habitat are: (1) substrate, (2) water quality, (3) water quantity, (4)water temperature, (5) water velocity, (6) cover/shelter, (7) food for juveniles, (8) riparian vegetation, (9) space, and (10) safe passage conditions (50 CFR 226.212). Tables 53 and 54 list the main riverson the Olympic National Forest that serve as migration corridors and rearing habitat for adult and juvenile salmonids.

The three freshwater primary constituent elements of critical habitat are:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;

(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;

(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.

Recent designated critical habitat on the Olympic National Forest includes the stream channels in each designated reach, and a lateral extent as defined by the ordinary high water line (Sept. 2, 2005; 70 FR 52629). The primary constituent elements essential for conservation of listed ESUs are those sites and habitat components that support one or more fish life stages, including freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors. The main 5th field watersheds on Olympic National Forest with designated critical habitat are the Dungeness/Elwha, Hood Canal, Dosewallips, Duckabush, Hamma Hamma, and Skokomish Rivers (see Table 54).

Designated Critical Habitat for Coastal Puget Sound Bull Trout

Critical habitat for the Coastal Puget Sound bull trout does not include National Forest land. But designated critical habitat is likely to be adjacent to, or in relatively close proximity to National Forest land and the mechanisms for effect could be transported onto adjacent critical habitat (e.g. sediment carried downstream).

The primary constituent elements (PCE) of bull trout habitat are: (1) permanent water having low levels of contaminates such that normal reproduction, growth and survival are not inhibited; (2) water temperatures ranging from 2 to 15 degrees C (36 to 59 degrees F), with adequate thermal refugia available for temperatures at the upper end of this range.

Specific temperatures within this range will vary depending on bull trout life history stage and for, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence; (3) complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures; (4) substrates of sufficient amount, size, an decomposition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine substrate less than 0.63 cm (0.25 in) in diameter and minimal substrate embeddedness are characteristic of these conditions; (5) a natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, a hydrograph that demonstrates the ability to support bull trout populations; (6) springs, seeps, groundwater sources, and subsurface connectivity to contribute to water quality and quantity; (7) migratory corridors with minimal physical, biological, or chemical barriers between spawning, raring, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows; (8) an abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish; and (9) few or no predatory, interbreeding or competitive non-native species present.

Essential Fish Habitat (Magnuson-Stevens Act)

The Sustainable Fisheries Act of 1996 (Public Law 104-267) amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to require Federal action agencies to consult with the Secretary of Commerce regarding any action or proposed action authorized, funded, or undertaken by the agency that may adversely affect essential fish habitat (EFH) identified under the Magnuson-Stevens Act for Chinook, coho and pink salmon. The EFH regulations at CFR section 600.920(e)(l)(i) enable Federal agencies to use existing consultation/environmental review procedures to satisfy EFH consultation requirements if they meet the following criteria: 1) The existing process must provide the NOAA Fisheries (NOAA Fisheries) with timely notification (60-90 days) of actions that may adversely affect EFH; 2) Notification must include an assessment of impacts of the proposed action as discussed in section 600.920(g): and 3) NOAA Fisheries must have made a "finding" pursuant to section (e)(3) that the existing process satisfies the requirements of section 305 (b)(2) of the Magnuson-Stevens Act.

Essential Fish Habitat is defined in the Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Essential Fish Habitat includes all freshwater streams accessible to anadromous fish (Chinook, coho, and Puget Sound pink salmon), marine waters, and inter-tidal habitats.

Olympic National Forest may incorporate an EFH assessment into this EIS pursuant to 40 CFR section 1500. NEPA and ESA documents prepared by the Olympic National Forest should contain sufficient information to satisfy the requirements in 50 CFR 600.920(g) for EFH assessments and must clearly be identified as an EFH assessment.

The geographic extent of EFH on Olympic National Forest is specifically defined as all currently viable waters and most of the habitat historically accessible to Chinook, coho, and pink salmon within the watersheds identified in Table 53. Salmon EFH excludes areas upstream of longstanding naturally impassible barriers (i.e., natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers.

3.5.2 Environmental Consequences

One primary public issue related to the Proposed Action was the potential for herbicides used to treat invasive plants to adversely affect aquatic organisms, especially the aquatic species of local interest listed in table 53 and table 54, and their habitats. The R6 2005 FEIS and Fisheries Biological Assessment analyzed the risk of herbicide use to aquatic plants, algae, macroinvertebrates and fish, including listed species. The analysis relied on SERA and Forest Service Risk Assessments to determine effects to fish and other aquatic organisms if herbicide is delivered to streams and other water bodies. The Project Design Features (PDFs) listed in Chapter 2 were developed to avoid scenarios of concern to fish species of local interest considering the R6 2005 FEIS analysis and local conditions. These restrictions go beyond label requirements by limiting the amount and type of herbicide that may be used in the Aquatic Influence Zone or along roads with high potential to deliver herbicide to streams and other water bodies.[26]

The alternatives vary regarding the level of risk associated with potential effects to aquatic organisms. For example, Alternative C does not involve any use of herbicides within Riparian Reserves (twice the size of the Aquatic Influence Zone) or along roads that have a high potential for herbicide delivery.

[26] The type of infestations known on the Olympic National Forest may be effectively treated, even when considering the restrictions in the PDFs. Should conditions change and the PDFs become too restrictive, the project would need to be revised and further NEPA analysis and ESA consultation would apply.

Therefore, Alternative C avoids nearly all risk of delivery of herbicides to water bodies. Alternative D takes more risk by allowing broadcast treatments across dry stream channels and along roads that have higher potential for herbicide delivery.

Fish and other aquatic organisms have the potential to be adversely affected by contact with concentrations of herbicide that exceed levels of concern in water. For example, herbicides applied near a stream could inadvertently contact aquatic invertebrates that rely on terrestrial plants to fulfill their life cycle and thus reduce the availability of food for fish. Herbicides can alter the structure and biological processes of both terrestrial and aquatic ecosystems; these effects of herbicides may have more profound influences on communities of fish and other aquatic organisms than direct lethal or sublethal toxic effects (Norris et al. 1991). Herbicides used for aquatic invasive plant control have been shown to affect aquatic ecosystem components, however concentration of herbicides coming in contact with water following land-base treatments are unlikely to be great enough to cause such changes (ibid).

Sublethal effects can include changes in behaviors or body functions that are not directly lethal to the aquatic species, but could have consequences to reproduction, juvenile to adult survival, or other important components to health and fitness of the species. Sublethal effects are further discussed in the R6 2005 FEIS. These effects are unlikely to occur as a result of this project due to the layers of caution associated with herbicide use (see discussion on PDFs below).

Residues in food from direct spraying are likely to occur during and shortly after application. Drift from herbicides considered for use may affect aquatic vegetation at low concentrations, however they show little tendency to bioaccumulate and are likely to be rapidly excreted by organisms as exposure decreases (Norris et al. 1991). Therefore, while the herbicides considered for use in this project may kill individual aquatic plants, aquatic habitats and the food chain would not be adversely impacted because the amount of herbicide that could be delivered is relatively low in comparison with levels of concern from SERA Assessments and the duration to which any non-target organism (including aquatic plants) would be exposed is very short-lived and impacts to aquatic plants would be very localized.

The application rate and method, along with the behavior of the herbicide in the environment, influence the amount and length of time an herbicide persists in water, sediment, or food sources. Once in contact, the herbicide must be taken up by the organism and moved to the site of biochemical action where the chemical must be present in an active form at a concentration high enough to cause a biological effect (Norris et al. 1991).

None of the alternatives propose applying herbicides directly to water in any situation, so the potential for high concentrations causing acute toxicity effects is extremely remote. An accidental spill could result in concentrations of herbicides that could harm aquatic organisms. Project Design Features that apply to all action alternatives would reduce the likelihood and impact of a spill (see Soil and Water section about accidental spills above).

The movement, persistence, and fate of an herbicide in the environment determine the likelihood and the nature of the exposure fish and other aquatic organisms will receive. Stream and lake sediments may be contaminated with herbicides by deposition of soils carrying adsorbed herbicides from the land or by adsorption of herbicides from the water (Norris et al. 1991).

Persistence of the herbicide is the predominant factor affecting its presence in the soil. Effects on soil are discussed in more detail in the Soils and Water section. Stream and lake sediments may be contaminated with herbicides by deposition of soils carrying adsorbed herbicides from the land or by adsorption of herbicides from the water (Norris et al. 1991).

Persistence of the herbicide is the predominant factor affecting its presence in the soil. The potential for chronic leaching has been minimized through Project Design Features, which are discussed in more detail in the Water and Soils section.

Aquatic Risk Ranking

The R6 2005 FEIS, Fisheries Biological Assessment and SERA Risk Assessments (1997a, 1997b, 1999a, 1999b, 2001a, 2001c, 2003a, 2003b, 2003c, 2003d, 2003e, 2003f) considered the effects to fish and other aquatic organisms if herbicide is delivered to streams and other water bodies. The SERA Risk Assessments used the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) chemical fate model to estimate hypothetical herbicide concentrations from typical Forest Service broadcast operations under a given set of site parameters (more information on GLEAMS methodology is in SERA xxx). Under the GLEAMS parameters, the concentration of some herbicides in water exceeded levels of concern for fish and other aquatic organisms.

Based on the GLEAMS model results, the Fisheries BA classified three herbicides (clopyralid, imazapic, and metsulfuron methyl) as low risk to fish and other aquatic organisms because levels of concern were not exceeded for fish, macroinvertebrates and algae.[27] Nonyphenol polyethoxylate (NPE) based surfactants were also classified as low risk. Chlorsulfuron, imazapyr, and sulfometuron methyl were considered of moderate risk. Sethoxydim, glyphosate, picloram and triclopyr were considered higher risk herbicides. The R6 2005 ROD specifically limited triclopyr to spot and hand methods (no broadcast of triclopyr allowed as per standard 16) to avoid scenarios of concern related to triclopyr.

Table 55. Aquatic Risk Rankings for Herbicides

Low Risk	Clopyralid, imazapic, and metsulfuron methyl
Moderate Risk	Chlorsulfuron, imazapyr, sulfometuron methyl
High Risk	Sethoxydim, glyphosate, picloram, triclopyr

Characteristics of the four higher risk herbicides are listed below.

Sethoxydim

Sethoxydim was associated with some levels of concern in the R6 2005 FEIS, however risk assessments incorporated the toxicity of the naphtha solvent in the Poast formulation of this herbicide. The toxicity of the sethoxydim alone is about 100 times less for fish than that of the Poast formulation. Since the naphtha solvent tends to volatilize or adsorb to sediments, using Poast formulation data to predict effects from runoff may overestimate potential effects (SERA 2001). Adverse affects to fish and other aquatic organisms are not likely because the amount of sethoxydim used for this project would be lower than toxic levels, even if the Poast formulation were used.

[27] Low risk herbicides include those for which levels of concern were not exceeded for any organism except aquatic plants.

Picloram

Acute toxicity of picloram varies considerably with formulation and with fish species. Formulations like Tordon 22K (potassium salt) is known to be considerably less toxic to several fish species compared to ester formulations. Adverse affects to fish and other aquatic organisms are not likely to occur, especially when the likelihood of picloram coming in contact with water is low. Project Design Features and Buffers established for picloram greatly reduce the likelihood of picloram coming in contact with water. Any amount of picloram in water as a result of drift would be negligible and more than likely non-detectable due to streams buffers in all alternatives.

Although leached picloram may be transported to aquatic ecosystems as a result of rainfall, studies have shown that less than 5 percent of the picloram applied to a watershed are transported in surface runoff (Norris et al. 1991). Where soil compaction has occurred or where intermittent streams have been treated, residues of picloram could be mobilized following heavy rainfalls, and thus, if picloram is used near the Aquatic Influence Zone, it could be transported to streams on the Olympic National Forest. Runoff is a greater issue on the Olympic National Forest than elsewhere due to high amounts of rainfall throughout the year in some places and the highly dissected stream.

As shown in the R6 2005 FEIS, chronic exposure of picloram to fish did not reach levels of concern. Acute exposures, however, can affect fish development, growth, swimming response, and liver histopathology. These acute exposures use an amount of picloram much greater than what would be applied at each treatment site by spray methods in any alternative on the Olympic National Forest.

Glyphosate

Glyphosate is highly soluble in water but much less so in organic solvents. In general, it is very immobile in soil, being rapidly adsorbed by soil particles, and subject to some degree of microbial degradation. The degree of glyphosate decomposition varies by soil types. Studies show that concentrations of glyphosate have been detected in runoff occurring 1 day after treatment at the highest rate. Most amounts transported to streams by runoff take place in the first heavy rainfall event. Eyed eggs of fish seem to be a resistant life stage, with sensitivity increasing as the fish enters the sac-fry and swim-up stages.

Glyphosate exceeded the LOC for fish in the R6 2005 FEIS, however the amount of glyphosate that a fish would plausibly encounter is much less than the acute exposure that could cause harm. The formulation of glyphosate with surfactant would not be broadcast near streams. The less harmful formulation of glyphosate without the surfactant (aquatic form) would be required near streams, and only spot or hand application methods would be approved, thereby significantly reducing the amount of glyphosate potentially coming in contact with water compared to exposure scenarios modeled in the SERA risk assessments.

Triclopyr

Data indicate that Garlon 3A (the triethylamine salt of triclopyr) is only slightly toxic or practically non-toxic to organisms tested. Garlon IV (butoxyethyl ester of triclopyr), however, is highly toxic to fish, whereas unformulated triclopyr is only slightly toxic. Project Design Features do not allow the use of Garlon IV within 50 feet of surface waters, thereby reducing the probability of fish coming in contact with Garlon IV. The long-term persistence of triclopyr does not seem to be a significant problem in forest settings because of its rapid disappearance.

Photo-degradation is a major reason for the disappearance of triclopyr from water (Norris et al. 1991).

Exposure scenarios modeled in the SERA risk assessments significantly overestimated the risk of acute adverse affects from the application of triclopyr, as well as other herbicides. Because triclopyr would only be applied by spot or hand methods (as per R6 2005 ROD standard 16), the likelihood of toxic levels of triclopyr coming in contact with water is very low.

Herbicide Concentration Model

The Fisheries BA also conducted the GLEAMS Ecotype Analysis for the Western Cascades (includes the Olympic National Forest) to determine if herbicide concentrations in water could be greater than predicted when local conditions were considered, rather than the hypothetical parameters used in the GLEAMS model. The Fisheries BA concluded that the GLEAMS model parameters may underestimate herbicide delivery to smaller stream channels with steep side slopes, with this risk increasing with altitude. Olympic National Forest system lands are mountainous and steep, and there are many higher gradient, smaller streams within the Forest boundary.

The Western Cascade Ecotype Analysis concluded that herbicide concentration would be overestimated in streams with flows higher than 1.8 cfs. Only in the smallest perennial streams would spring base flow not exceed 1.8 cfs, and storm flows would further increase flow.

Risk assessment modeling almost certainly overestimates herbicide concentrations in stream in all but the smallest perennial tributaries during the spring. However, during the summer and fall, a larger portion of the perennial streams would be expected to flow near or below the 1.8 cfs modeled; however even in the summer and fall, storms can raise flows four times annual low flows.

Stream buffers in all alternatives reduce the amount and type of herbicide that would be applied, and likelihood that any chemicals will drift, run off or leach into surface waters. The PDFs restrict broadcast spraying and use of all but lower risk or aquatic labeled herbicides near perennial and wet intermittent streams in all alternatives, which compensates for the risk associated with herbicide use indicated by the SERA Risk Assessments and the R6 2005 FEIS and Fisheries Biological Assessment.

On the Olympic National Forest, 70 percent of the streams are intermittently dry (Stoddard, personal communication with Carol Thornton, 2005). These streams have the potential to fluctuate from moderate to low to no flow from one summer day to the next. Thus, stream buffers on dry streams further reduce risk that herbicides would be delivered to water bodies through runoff or leaching into stream channels. Roads having high potential to deliver herbicide through ditch networks may function as intermittent streams. Design features for these roads are also considered in this project level analysis (see the Soil and Water section above and Roads section below).

Local soil types did not appear to markedly change expected herbicide delivery for most herbicides likely to be applied in watersheds in the Western Cascades, with the possible exceptions of triclopyr and glyphosate in pumice ash soils (from the Fisheries BA for the R6 2005 FEIS).

Given the local conditions on Olympic National Forest, PDFs that limit the amount of herbicide delivered to streams are key to eliminating and minimizing impacts on aquatic organisms, as is required to comply with R6 2005 ROD Standards 19 and 20. The wet and dry stream, lake, wetland and road ditch buffers are all designed to limit the amount of herbicides that could potentially enter water and to favor low risk or aquatic-labeled herbicides as appropriate. Restrictions on broadcast applications along roads that have a high potential for herbicide delivery would further decrease chances of herbicide delivery to streams.

High Potential for Herbicide Delivery Roads

Roadside ditches can act as delivery routes or intermittent streams during high rainfalls or as settling ponds following rainfall events. Because the proposed action includes treatment of road prisms with herbicides, the concern for herbicides being indirectly delivered to waterbodies containing fish via roadside ditchlines was addressed by identifying roads that have a high potential for herbicide delivery.

Roads Analysis completed for the Olympic National Forest identified roads that pose a high risk to aquatic resources, specifically streams. Aquatic risk factors used to identify high risk roads in the Roads Analysis were: geologic hazard, proximity (delivery) to fish habitat, stream crossing density, stream proximity, and upslope hazard. Of the five categories used to identify "high aquatic risk" roads, three relate directly to processes that contribute to the potential delivery of herbicides to streams: proximity (delivery) to fish habitat, stream crossing density, and stream proximity. In this case, sediment delivery was used as a surrogate for herbicide delivery.

An estimated 1,420 acres of infestations are on roads considered high potential for herbicide delivery. Appendix D includes a map and list of these roads (by sixth field sub-watershed). Nearly all watersheds have roads with high risk of herbicide delivery; invasive plants are widely scattered along the roads.

Worst-Case Scenarios

Two worst-case scenarios were considered for local conditions on the Olympic National Forest. These are scenarios where herbicide concentrations could exceed a level of concern for fish and other aquatic organisms, based on the R6 2005 FEIS and Fisheries BA.

One worst-case scenario is that herbicide is broadcast near streams and along road ditches during summer. As expected, a high rainfall event could wash herbicide into stream networks that quickly rise from their base low flow. The other scenario is use of aquatic-labeled herbicide to treat emergent vegetation – herbicide is applied to plants with part of their stem or roots in standing water or wet (hydric) soils.

Each alternative is compared relative to the likelihood that fish or other aquatic organisms may be impacted under these worst-case conditions. Any use of herbicide in Aquatic Influence Zones or along roads with high potential to deliver herbicides is associated with some risk, however the alternatives vary widely as to the degree of risk that would occur.

Even in the worst case scenario, adverse effects would be temporary and localized, because herbicide would be quickly washed downstream and diluted. The level of concern is extremely low becauses concentrations of herbicide are likely to be far below a level of detectable impact.

Analysis was completed for two areas that represent the worst-case scenario: Cranberry Botanical Bog (wetland) and Middle Hoh River floodplain site. These areas contain reed canary grass and other invasive species known to grow along streams and other waterbodies. Herbicide delivery to water is exemplified by these two treatment areas because spot and hand applications of aquatic labeled herbicides would be permitted below the high water mark to treat the emergent invasive plants. While treatments would be preferred during dry times of the year, when herbicide is least likely to contact water, these areas may remain wet year round.

Spot applications of aquatic triclopyr would be allowed only when conditions are dry for wetlands and ponds (when water is not present) and when intermittent streams are dry. Glyphosate and triclopyr are a high risk to aquatic organisms, and imazapyr a moderate risk.

Aquatic triclopyr was not modeled because PDFs include a 15-foot buffer on the use of spot applications, greatly reducing contact with water. The Cranberry Botanical Bog and the Middle Hoh River Floodplain sites have the greatest likelihood of herbicides coming in contact with water as a result of drift because of the possibility of treating invasive plants that may be emergent from water or growing in saturated soils. The model assumes a fixed water volume and broadcast applications occurring next to the water (these parameters may not be varied).

Results of the aquatic glyphosate worksheet analysis showed a HQ of 3 at the average water concentration rate for the Cranberry Bog and a HQ of 6 for the Middle Hoh River floodplain site (table 56). Hazard quotient values for imazapyr were extremely low, not reaching any level of concern. The HQ values for aquatic glyphosate are greater than the threshold of concern for fish. However, because these values are based on use of broadcast application methods (which would not be allowed on wetlands or over perennial or wet intermittent streams) the likelihood that these levels would be reached is greatly overestimated.

In addition, the concentration of herbicide to these wet areas is likely overestimated because the volume of water in the wetlands far exceeds the modeled parameters. A simple calculation for potential herbicide concentration was conducted to account for actual treatment size and duration (table 56).

Table 56. Risk Assessment Worksheet Results, Worst Case Scenario

Herbicide/ location	Annual Precipitation (inches)	Avg. Water Contam. Rate (mg/L per lb/acre)	Concentration in water (dose) (mg/L)	Toxicity Index (mg/L)	Hazard Quotient
Glyphosate					
Cranberry Bog (pond)	50	1.39087	2.78174	0.5	6
Middle Hoh (stream)	150	0.86220	1.7244	0.5	3
Imazapyr					
Cranberry Bog (pond)	50	0.00080	0.00036	5.0	0.00007
Middle Hoh (stream)	150	0.00166	0.000747	5.0	0.00010

Sources: Precipitation records, local site knowledge; SERA 2003, 2004.

Table 57. Calculated Doses for Wetland Treatments

		Calculated dose levels	
Aquatic formulations	**Acute toxicity indices**	**Cranberry Bog Botanical Area**	**Middle Hoh River Floodplain site**
Glyphosate (no surfactant)	0.5 Mg/L	0.149 Mg/L	0.00026 Mg/L
Imazapyr	5 Mg/L	0.034 Mg/L	0.00006 Mg/L
Triclopyr	0.26 Mg/L	0.075 Mg/L	0.0001 Mg/L

When both tables are considered together, calculated dose levels for the Cranberry Bog Botanical area and the Middle Hoh River floodplain site are significantly lower than toxicity levels identified for the federally listed salmonids. Project Design Features do not allow the modeled concentrations to be reached. Therefore, it is highly unlikely that there would be adverse effects to aquatic organisms as a result of spot-spray applications of aquatic glyphosate and imazapyr.

Inerts, Adjuvants, Impurities and Surfactants

This section is incorporated from the R6 2005 FEIS and addresses effects on aquatic organisms from inerts, adjuvants, impurities and surfactants.

Inerts, Adjuvants, and Impurities

Inert compounds are those that are intentionally added to a formulation, but have no herbicidal activity and do not affect the herbicidal activity. Inerts are added to the formulation to facilitate its handling, stability, or mixing. Impurities are inadvertent contaminants in the herbicide, usually present as a result of the manufacturing process. Adjuvants are compounds added to the formulation to improve its performance. They can either enhance the activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with its application (special purpose or utility modifiers). Surfactants are one type of adjuvant that makes the herbicide more effective by increasing absorption into the plant, for example.

Many of the inert ingredients are proprietary in nature and have not been tested on laboratory species. SERA obtained clearance to access confidential business information (i.e. the identity of proprietary ingredients) and used this information in the preparation of the risk assessments. However, toxicity data to support any assessment of hazard or risk are usually very poor, even when the identity of the inert is known.

Chlorsulfuron – The identity of inerts used in chlorsulfuron are confidential, but SERA reviewed them for preparation of the risk assessment (SERA 2003 Chlorsulfuron). EPA has not classified any of the inerts as toxic. These inert ingredients do not affect the assessment of risk.

Clopyralid – Identified inerts include monoethanolamine and isopropyl alcohol, both approved food additives. These inert ingredients do not impact the assessment of risk.

Glyphosate – There are at least 35 glyphosate formulations that are registered for forestry applications (SERA, 2003-Glyphosate) with a variety of inert ingredients. SERA obtained clearance to access confidential business information (i.e. the identity of proprietary ingredients) and used this information in the preparation of the risk assessment. Surfactants (discussed below) were the only additives identified that impact risk (SERA, 2003-Glyphosate).

Imazapic - The identity of inerts used in imazapic formulations are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003-Imazapic). EPA has not classified any of the inerts as toxic.

Imazapyr – The identity of inerts used in imazapic formulations are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003-Imazapyr). No apparently hazardous materials were identified in the review of inerts. The NCAP website (http://www.pesticide.org/FOIA/picloram.html) identifies only glacial acetic acid, an approved food additive, as an inert ingredient. Isopropanolamine is also present, and it is classified as a List 3 inert.

Metsulfuron methyl - The identity of inerts used in metsulfuron methyl formulations are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003-Metsulfuron methyl). EPA has not classified any of the inerts as toxic.

Picloram – The formulations Tordon K and Tordon 22K contain the following inerts: potassium hydroxide, ethoxylated cetyl ether, alkyl phenol glycol ether, and emulsified silicone oil (NCAP website; www.pesticide.org/FOIA/picloram.html). Potassium hydroxide is an approved food additive. The other compounds are all on EPA's List 4B, inerts of minimal concern. They may also contain the surfactant polyglycol 26-2, which is on EPA's List 3: Inerts of Unknown Toxicity, discussed in the following section. The toxicity data on the formulations encompasses toxic risk from the inerts.

Sethoxydim - The formulation Poast® contains 74 percent petroleum solvent that includes naphthalene. The EPA has placed this naphthalene on List 2 (“agents that are potentially toxic and a high priority for testing”). Petroleum solvents and naphthalene depress the central nervous system and cause other signs of neurotoxicity (SERA, 2001). Poast® has also been reported to cause skin and eye irritation. There is no information suggesting that the petroleum solvent has a substantial impact on the toxicity of sethoxydim to experimental animals, with the important and notable exception of aquatic animals (SERA, 2001). Poast® is much more toxic to aquatic species than sethoxydim.

Sulfometuron methyl - The identity of inerts used in Oust are confidential, but SERA reviewed them for preparation of the risk assessment (SERA, 2003-Sulfometuron). EPA has not classified any of the inerts as toxic.

Triclopyr - Formulations contain ethanol (Garlon 3A) or kerosene (Garlon 4), which are known to be neurotoxic. An environmental metabolite of triclopyr, referred to as “TCP”, is substantially more toxic in fish than either triclopyr acid or aquatic triclopyr. The risk characterization for TCP is considered quantitatively only for fish because toxicity data are available only for fish (SERA, 2003-Triclopyr).

Surfactants

Surfactants, or surface-acting agents, facilitate and enhance the absorbing, emulsifying, dispersing, spreading, sticking, wetting, or penetrating properties of herbicides. There is a fair amount of research on the effects of surfactants to aquatic organisms because they are widely used in detergents, cosmetics, shampoos and other products designed for human exposure.

Some glyphosate formulations contain polyethoxylated tallow amine (POEA) surfactant, which is substantially more toxic to aquatic species than glyphosate or other surfactants that may be used with glyphosate (SERA, 2003-Glyphosate, p. 4-14). In the SERA risk assessment, the toxicity of glyphosate is characterized based on the use of a surfactant, either in the formulation or added as an adjuvant in a tank mixture (SERA, 2003- Glyphosate, p. 4-14).

The primary active ingredient in many of the non-ionic surfactants used by the Forest Service is a component known as nonylphenol polyethoxylate (NPE). NPE is found in commercial surfactants at rates varying from 20 to 80 percent. NP and NPE are weakly estrogenic in aquatic organisms (1000 to 100,000 times weaker than natural estrogen).

During operational use of NPE surfactant, ambient levels of NP9E could average 12.5 ppb (range 3.1 to 31.2 ppb). The duration of these exposures from Forest Service use would generally be much shorter than those used in laboratory experiments, due to transport by flowing streams, dilution, and environmental degradation. These levels are not likely to adversely affect amphibians found in the Pacific Northwest for normal operations. However, overspray or accidental spills could produce concentrations of NP9E that could adversely affect amphibians, particularly in small stagnant ponds.

NPE based surfactants were classified as a low risk to aquatic organisms because predicted concentrations were less than the estimated or measured “no observable effect concentration”.

Effects of Non-Herbicide Treatments

All invasive plant treatments can result in increased erosion, stream sedimentation, and disturbance to aquatic organisms if carried out over a large enough area. Sedimentation can cover eggs or spawning gravels, reduce prey availability, and harm fish gills. 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 organism. Reductions in cover, shade, and sources of food from riparian vegetation could result from herbicide deposition in a streamside zone (Norris et al. 1991).

Riparian vegetation affects habitat structure in several important ways. Roots of riparian vegetation hold soil, which stabilizes banks, prevents addition of soil run-off to water bodies with subsequent increases in turbidity or filling substrate interstices, and helps to create overhanging banks. Riparian and emergent aquatic vegetation provide hiding cover or refuge for fish and other aquatic organisms.

The presence of people or crews with hand-held tools along streambanks could lead to localized, short-term adverse effects to fish habitat because of trampling, soil sloughing due to stepping on banks and removal of invasive plant roots. However, the invasive plant populations on the Olympic National Forest are not extensive enough for this to be a plausible result on any alternative. The restoration plan would quickly respond to bare areas. Effective invasive plant treatment and restoration of treated sites would improve the function of riparian areas and lead to improved fish habitat conditions.

All alternatives would benefit aquatic ecosystems to the extent they effectively restore riparian habitats, especially habitats adjacent to fish bearing streams. The impacts of invasive plants on these habitats can last decades, while the impacts of treatment tend to be short term. Passive and active restoration would accelerate native vegetative recovery in treated sites.

The effects of non-herbicide methods on fish are not of great public concern and were addressed in the Appendix J of the R6 2005 FEIS.

Effects from foaming on aquatic habitats have not been extensively stuided. For example, Waipuna™ is a foamy, biodegradable mixture of corn and coconut sugar extracts, and that the foam is an "organic," naturally-occurring compound. As such, it is not regulated (or labeled) as a herbicide product by the U.S. EPA. The foam should not be applied to areas where it can be inadvertently delivered to surface water, as concentrations of foam at 3 mg/liter can be toxic to fish. When applied to soil, the foam is generally applied at concentrations of 0.0004 mg/liter and it is degraded by soil microorganisms within 28 days, so the foam is likely to be benign to soil organisms. The effects of the "organic" foam on the environment, while probably benign, have not been extensively studied. Therefore, it is recommended that this method be limited to administrative sites and along major road corridors. Surface waters and areas where vehicles (pick-up trucks) cannot have easy access would be avoided.

Direct and Indirect Effects by Alternative

Alternative A (No Action)

The No Action Alternative A would continue the currently approved use of herbicides on 86 acres of the Olympic National Forest. Aquatic-labeled glyphosate may be injected in streamside knotweed as part of the existing program. Otherwise, treatments with herbicide would be unlikely to occur near fish habitat. Alternative A does not allow any use of herbicides other than the 86 identified acres (no early detection or rapid response approach included). Little potential exists for herbicides to enter water in concentrations above any threshold of concern that could adversely affect aquatic organisms or ecosystems.

Worst-Case Scenario

No worst case scenarios are associated with the very low level of herbicide use and low level of use within the Aquatic Influence Zone under Alternative A.

Effects on Designated Critical Habitat and Essential Fish Habitat

No adverse effects from treatment would occur on Designated Critical or Essential Fish Habitat. However, under Alternative A, invasive plants are more likely to continue to degrade these habitats because so little of the infestations would be treated. Non-herbicide methods may also have adverse effects (see discussion below under Alternative C).

Alternative B (Proposed Action)

The Proposed Action includes limitations on the type and application method of herbicides in Aquatic Influence Zones and along roads that have high potential for herbicide delivery to streams. The PDFs apply to known sites and those detected in the future. In both cases, the limitations in the PDFs ensure that herbicide use will not exceed a level of concern for aquatic organisms tested by the SERA risk assessments.

In general, the following PDFs avoid the potential for delivery of herbicides associated with moderate or greater levels of concern for aquatic organisms. The exception is the use of aquatic-labeled glyphosate allowed near water or on emergent vegetation. Worst-case scenarios were considered involving the use of glyphosate. [28]

In the case of spot spray applications for emergent invasive plants, localized effects to individual quatic plants are possible. These localized effects would not disrupt aquatic ecosystem function of the aquatic food web because of the scale of treatment. Treatment would take place during low water periods following the in-stream work guidelines for WDFW. In many cases, fish will not be present at the immediate location of treatment because of flow conditions and residual depth necessary for fish to rear. In addition, fish will avoid the presence of human beings and will more than likely swim away from predator like shadows overcasting waterbodies. The possibility of a fish being present in the immediate water column where spot spray applications may be taking place is very low. However, there is the possibility of aquatic glyphosate coming in contact with water as a result of drift from spot spray applications. Spot applications of aquatic glyphosate would not result in harmful amounts coming in contact with water and harming fish, invertebrates, and algae. Some aquatic plants may be damaged at the immediate spot spray locations.

Effects of Project Design Features

The following Project Design Features (PDFs) would minimize or eliminate risk of adverse effects to aquatic organisms:

- Fueling of gas-powered equipment would not occur within 150 feet of surface waters in order to reduce any impacts as a result of an accidental spill.[29]
- No use of picloram on roads that have high potential to deliver herbicide. No broadcast of triclopyr.
- Broadcast application of herbicides is limited to the following situations:

  Outside established buffers for aquatic influence zones along perennial/intermittent streams and other waterbodies;

  Outside established buffers when water is present within roadside ditches;

  On roads that do not have a high potential for herbicide delivery; and,

  Only aquatic labeled or lower risk herbicides would be permitted to be broadcast within 15 feet of dry streams.

These restrictions serve to limit the potential amount of higher or moderate risk herbicide that may come in contact with water where fish or other aquatic organisms are present, even if an unexpected storm occurred shortly after treatment. The amount of herbicide that would be available for runoff, leaching and/or drift is necessarily limited by these restrictions on broadcast use. Spot and hand/select

[28] Aquatic Imazapyr may be used following appropriate risk assessment of inert ingredients as per R6 2005 ROD Standard 18.

[29] An exception for refueling with 5 gallons or less exists.

treatments do not have high potential to deliver herbicide because the treatments are directed at target vegetation and herbicide is quickly taken up by the plant.

With the exception of aquatic labeled herbicides, broadcast applications of all herbicides would not occur within 100 feet of perennial and intermittent streams or on roads that have a high potential for herbicide delivery. The majority of herbicides have 50-foot buffers for spot treatments, except for low risk and aquatic labeled herbicides. Spot applications of aquatic labeled formulations of glyphosate and imazapyr may be used up to the water's edge or within 15 feet of water present in roadside ditches that are outside the stream buffer. Spot applications of aquatic labeled triclopyr may not be used within 15 feet of perennial and wet intermittent streams or other waterbodies.

In addition to buffers, herbicides would not be used during or in advance of expected rainfall. Activities that would need to take place below the ordinary high water mark (i.e., manual/spot/hand applications) would follow in-stream work periods established by the Washington Department of Fish and Wildlife (WDFW) Guidelines for Timing of In-Water Work Periods (January 2005). These guidelines were specifically established to reduce the likelihood of negative impacts to fish and fish habitat. Each watershed and county has specific in-water work periods to match summer low flow periods, thereby reducing impacts from trampling and increasing distance between the water's edge and potential drift from broadcast sprays.

Table 58 summarizes concerns for aquatic organisms and PDFs that minimize or eliminate potential adverse affects to aquatic organisms; herbicides with greater risks to aquatic organisms are discussed first.

Table 58. Project Design Features for Herbicide Use in Alternative B

Herbicide	Summary of Concerns for Aquatic Organisms (SERA Risk Assessments)	Project Design Feature minimizing or eliminating adverse affect
Picloram (Tordon K, Tordon 22K)	High mobility in soils; leaching potential greatest in sandy soils w/low organic matter; Exposures exceed level of concern for listed fish at typical and highest application rate, potential adverse effects to amphibians at typical and highest application rates (fish used as a surrogate); Salmonids appear to be marginally more sensitive to technical grade Picloram (acid) than other fish species	No use of picloram on roads that have a high potential for herbicide delivery. No broadcast applications within 100 feet of waterbodies or dry intermittent channels. No use of picloram within 50 feet of waterbodies or dry intermittent channels.

Herbicide	Summary of Concerns for Aquatic Organisms (SERA Risk Assessments)	Project Design Feature minimizing or eliminating adverse affect
Glyphosate (Accord XRT, Rodeo, Roundup, Roundup Pro, Aquamaster, etc, including 35 formulations)	Low likelihood of runoff due to strong adsorption to soil; Aquatic formulation exceeds level of concern for federally listed fish at typical and highest application rate; exposures below level of concern for aquatic invertebrates, algae, and plants; Surfactants (tallow amine or POEA) in non-aquatic use formulations very toxic to aquatic organisms, surfactant formulations may cause fish mortality at high application rate only, low toxicity to aquatic invertebrates; aquatic plants and algae are susceptible to glyphosate but exposures are below levels of concern;	No broadcast applications within 100 feet (non-aquatic formulations) or 50 feet (aquatic formulation) of waterbodies or on roads that have a high potential for herbicide delivery, or within 15 feet of standing water in road side ditches. No use of non-aquatic glyphosate within 50 feet of waterbodies or dry intermittent channels.
Triclopyr (Garlon 3A, Garlon IV, Forestry Garlon IV, Pathfinder II, Remedy, Remeby RTU, Redeem R&P)	Very high mobility in soils; Ester formulation (Garlon IV) and Metabolite TCP is toxic to fish and aquatic invertebrates; Salt/acid formulation low toxicity to fish; exposures exceed level of concern for federally listed fish at typical rate but not other fish even at highest application rate; no TCP exposures exceed level of concern; only salt from exceeds level of concern for aquatic plants, and algae not at risk; ester formulation much more toxic to amphibians than salt formulation; exposure to runoff of either salt or ester form could adversely affect responsiveness of tadpoles	No broadcast applications of triclopyr are allowed. No use of triclopyr within 50 feet of waterbodies or dry intermittent streams For aquatic formulations, no spot-spray applications within 15 feet of waterbodies or standing water in road side ditches. No use of ester formulations within 50 feet of waterbodies or dry intermittent streams
Sethoxydim (Poast, Poast Plus)	Moderate mobility in soil; rapidly degrades in soil; Highly toxic to fish due to petroleum inert; Exposure exceeds level of concern for federally listed fish at typical rate and maximum exposure assumptions; No data on effects to amphibians (fish used as a surrogate)	No broadcast applications within 100 feet of waterbodies or dry intermittent channels, or on roads that have a high potential for herbicide delivery, or within 15 feet of standing water in road side ditches. No use of sethoxydim within 50 feet of waterbodies or dry intermittent channels.
Imazapyr (Arsenal, Arsenal AC, Chopper, Stalker, Habitat*)	Exposure to fish and invertebrates very far below levels of concern; No data on effects to amphibians (fish used as a surrogate); Potential risk to aquatic plants at typical application rate, no risk to algae	No broadcast applications within 100 feet (non-aquatic formulation) and 50 feet (aquatic formulation) of waterbodies, or within 15 feet of standing water in road side ditches.

Herbicide	Summary of Concerns for Aquatic Organisms (SERA Risk Assessments)	Project Design Feature minimizing or eliminating adverse affect
Chlorsulfuron (Telar, Glean, Corsair)	Exposure to fish and aquatic invertebrates far below levels of concern (no effects to egg and fry); No data on effects to amphibians (fish used as a surrogate); Peak exposures could damage aquatic plants at typical and high application rates; algae may be damaged at high rates	No broadcast applications within 100 feet of waterbodies or 50 feet of dry intermittent channels, or within 15 feet of standing water in road side ditches.
Sulfometuron methyl (Oust, Oust XP)	May leach or runoff into water, Exposures below level of concern to fish (highly toxic to embryo hatch), can cause malformations in amphibians	No broadcast applications within 100 feet of waterbodies or 50 feet of dry intermittent channels, or within 15 feet of standing water in road side ditches.
Metsulfuron Methyl (Escort XP)	High mobility in soils; Exposures to fish very far below level of concern (no effects to egg & fry); No data on effects to amphibians (fish used as a surrogate); Can damage aquatic plants in acute exposures, no risk to algae	No broadcast applications within 100 feet of waterbodies or 15 feet of dry intermittent channels, or within 15 feet of standing water in road side ditches.
Clopyralid (Transline)	Weakly absorbed to soil; Relatively rapid breakdown reduces potential for runoff or leaching; Exposures very far below levels of concern for fish and aquatic invertebrates; No data on effects to amphibians (fish used as a surrogate); Aquatic plants and algae are not susceptible	No broadcast applications within 100 feet of waterbodies or 50 feet of dry intermittent channels, or within 15 feet of standing water in road side ditches.
Imazapic (Plateau)	Moderately mobile in soils and leachable in coarse soils; Exposures far below level of concern for fish (no effects to egg & fry); No data on effects to amphibians (fish used as a surrogate); Potential risk to aquatic plants at highest application rate only; no risk to algae	No broadcast applications within 100 feet of waterbodies or 15 feet of dry intermittent channels, or within 15 feet of standing water in road side ditches.

Worst-case Scenario

Under the Proposed Action, two worst-case scenarios remain that involve the use of aquatic labeled glyphosate. One possible scenario is that aquatic labeled glyphosate is used within wet ditch lines during the summer before a high rainfall event occurs. The rainfall could wash glyphosate into streams that quickly rise from their base low flow. This scenario is unlikely because PDFs restrict herbicide application when rain is forecast within 24 hours. The risk of an unexpected storm washing glyphosate in quantities large enough to harm aquatic organisms thefore very low because glyphosate is absorbed by target species very quickly and would not be available for runoff.

The other scenario is use of aquatic labeled herbicide to treat wetland emergent vegetation – herbicide is applied to plants with part of their stem or roots in standing water or hydric soils. Spot applications of aquatic triclopyr would be allowed only when conditions are dry for wetlands and ponds (when water is not present) and when intermittent streams are dry. Glyphosate and triclopyr are a high risk to aquatic organisms, and imazapyr a moderate risk. This situation may occur within two sample areas: Cranberry Botanical Bog (wetland) and Middle Hoh River floodplain site. These areas contain reed canary grass and other invasive species known to grow along streams and other waterbodies.

Herbicide delivery to water is exemplified by these two treatment areas because spot and hand applications of aquatic labeled herbicides would be permitted below the high water mark to treat the wetland emergent vegetation. While treatments would be preferred during dry times of the year, when herbicide is least likely to contact water, these areas may remain wet year round.

The use of aquatic labeled glyphosate and imazapyr at the Cranberry Botanical Bog and the Middle Hoh River Floodplain sites was modeled through the SERA Risk Assessment worksheets (reference?). These two sites have the greatest likelihood of herbicides coming in contact with water as a result of drift because of the possibility of treating invasive plants that may be emergent from water or growing in saturated soils. The model assumes a fixed water volume and broadcast applications occurring next to the water (these parameters may not be varied).

Results of the worksheet analysis showed a HQ of 3 at the average water concentration rate for the Cranberry Bog and a HQ of 6 for the Middle Hoh River floodplain site. These HQ values are greater than the threshold of concern for fish using aquatic labeled glyphosate. However, because these values are based on use of broadcast application methods (which would not be allowed on wetlands or over perennial or wet intermittent streams) the likelihood that these levels would be reached is extremely low.

In addition, the concentration of herbicide to these wet areas is likely overestimated because the volume of water in the wetlands far exceeds the modeled parameters. A simple calculation for potential herbicide concentration was conducted to account for actual treatment size and duration (tables 59 and 60).

Table 59. Risk Assessment Worksheet Results, Worst Case Scenario

Herbicide/ location	Annual Precipitation (inches)	Avg. Water Contam. Rate (mg/L per lb/acre)	Concentration in water (dose) (mg/L)	Toxicity Index (mg/L)	Hazard Quotient
Glyphosate					
Cranberry Bog (pond)	50	1.39087	2.78174	0.5	6
Middle Hoh (stream)	150	0.86220	1.7244	0.5	3
Imazapyr					
Cranberry Bog (pond)	50	0.00080	0.00036	5.0	0.00007
Middle Hoh (stream)	150	0.00166	0.000747	5.0	0.00010

Sources: Precipitation records, local site knowledge; SERA 2003, 2004.

Table 60. Calculated Doses for Wetland Treatments

		Calculated dose levels	
Aquatic formulations	**Acute toxicity indices**	**Cranberry Bog Botanical Area**	**Middle Hoh River Floodplain site**
Glyphosate (no surfactant)	0.5 Mg/L	0.149 Mg/L	0.00026 Mg/L
Imazapyr	5 Mg/L	0.034 Mg/L	0.00006 Mg/L
Triclopyr	0.26 Mg/L	0.075 Mg/L	0.0001 Mg/L

When both tables are considered together, calculated dose levels for the Cranberry Bog Botanical area and the Middle Hoh River floodplain site are significantly lower than toxicity levels identified for the federally listed salmonids.

Effects on Designated Critical Habitat for Species Proposed or Listed under the Endangered Species Act

Invasive plant treatment would have many beneficial effects on critical habitat for federally listed fish species. In the long-term, treatment of invasive weeds on Olympic National Forest would increase native vegetation growth and successional patterns leading to cover and food. Thus, it improves freshwater PCE for federally listed fish species. Potential downstream effects to critical habitat for bull trout are not likely given the PDFs that limit the potential for herbicide concentrations coming in contact with water where fish are present

In 1996, NMFS developed a methodology for making ESA determinations for individual or grouped activities at the watershed scale, termed the "Habitat Approach". A Matrix of Pathways and Indicators (MPI) was recommended under the Habitat Approach to assist with analyzing effects to listed species. The MPI was used by Olympic National Forest in previous years to analyze programmatic activities' effects on listed NMFS fish species. When using the MPI, Project effects to the Pathways (significant pathways by which actions can have potential effects on anadromous salmonids and their habitats) and Indicators (numeric ratings or narrative descriptors for each Pathway) are used to determine whether proposed actions would damage habitat or retard the progress of habitat recovering towards properly functioning condition.

As noted above, the Sept. 2, 2005 designated critical habitat PCE's pertinent for analysis on the Olympic National Forest's freshwater habitats include spawning sites, rearing sites, and migration corridors. The Habitat Approach's MPI has numerous habitat-associated Indicators that closely "cross-walk" with the PCE's of the Sept 2, 2005 designated critical habitat. Table 61 displays a "cross-walk" between the MPI Indicators and PCE's of the September 2, 2005 designated critical habitat used to assess effects on designated critical habitat. As noted in this tabular analysis, the key features that define PCEs of the Sept. 2, 2005 designated critical habitat crosswalk effectively and fully with MPI indicators.

Table 61. MPI for Primary Constituent Elements Crosswalk

Primary Constituent Elements	Matrix of Pathways and Indicators
Spawning Habitat, as defined by water quality, water quantity, substrate	**Water Quality**: Temperature, Suspended Sediment, Substrate **Flow/Hydrology**: Change in Peak/Base flows **Habitat Elements**: Substrate/Embeddedness
Rearing as defined by adequate water quantity and floodplain connectivity	**Channel Conditions and Dynamics**: Floodplain connectivity **Flow/Hydrology**: Change in Peak/Base flow
Rearing as defined by adequate water quality and forage	**Water Quality**: Temperature, Substrate **Habitat Elements**: Large Woody Debris, Pool Frequency and Quality, Off-channel Habitat
Rearing as defined by adequate natural cover	**Habitat Elements**: Large Woody Debris, Pool Frequency and Quality, Large Pools, Off-channel Habitat
Migration as defined by habitat free of artificial obstructions, and adequate water quality, water quantity, and natural cover	**Habitat Access**: Physical Barriers **Water Quality**: Temperature **Flow/Hydrology**: Change in Peak/Base flow **Habitat Elements**: Large Woody Debris, Pool Frequency and Quality, Large Pools

The following is an analysis of the effects on Primary Constituent Elements of the Sept. 2, 2005 designated critical habitat, as determined via analysis of MPI indicators. Please refer to the Soils and Water section for additional information on potential effects to specific physical parameters.

Pathway: Water Quality
Indicator: Temperature
PCE Crosswalk: Spawning, Rearing, Migration habitat PCEs

Stream temperature is controlled by many variables at each site. These include topographic shading, stream orientation, channel morphology, discharge, air temperature, and interactions with ground water, none of which would be influenced by invasive plant treatments. Treatment of invasive plants using integrated methods, specifically herbicides, along small streams may increase solar radiation at a localized level (i.e. on a small portion of a stream) if invasive plants are the only source of shade. Where invasive plants provide the only source of shade (i.e. knotweed is the tallest), removing 100% of the shade producing cover can change forest floor microclimates and water temperature at the localized level. However, the precise effects to water temperature from treating invasive plants will depend on the size of the stream, how close to the stream a treatment site is, how much is treated along the stream, and what vegetation is currently available to shade the stream.

A significant amount of vegetation would need to be removed to change water temperature in the stream, and shade would have to be provided only by the invasive plant removed – a situation that is not likely on Olympic National Forest. Many of the treatment sites in previously disturbed areas requiring herbicide use had riparian harvest or other ground disturbing activities (i.e. flood) that removed most of trees that provided stream shade. This implies that the greatest changes to water temperature may have already taken place.

One reason treatment of invasive plants is being proposed is to recover stand structure and, in time, provide more stream shade with the establishment of native coniferous and deciduous trees. The PDFs prohibits broadcast applications within 100 ft. of wet perennial and intermittent waterbodies, and along roads that have a high likelihood of deliverying herbicides to streams in order to prevent any potential adverse affects to stream channels or water quality conditions. This PDF will protect overhanging vegetation and smaller trees that are currently providing shade closest to the stream and other waterbodies.

The treatment of invasive plants with broadcast applications outside of the 100 ft buffer should have little affect on stream temperature because the invasive plants treated would be no taller than the ones left within the buffered area. Spot-spray applications would not be sufficient enough to impact enough vegetation influencing water temperature. Any short term impacts occurring from loss of small shade provided by invasive plants at the treatment site would not elicit an effect and would far outweigh the long term benefits of the restored and increased growth of native riparian vegetation, specifically coniferous and deciduous trees.

Pathway: Water Quality
Indicator: Sediment/Turbidity
PCE Crosswalk: Spawning habitat PCEs

Treatment of invasive plants has a low probability for producing sediment because very little ground disturbance will take place when invasive plants are treated with spot-spray or hand applications. If sediment is produced, it would be as a result of heavy manual labor related to uprooting invasive plants or excessive trampling along streambanks. However, the integration of manual/mechanical/herbicide treatments would limit the potential for excessive trampling and not soley rely on manual labor. Manual labor such as hand pulling to control invasive plants may result in localized soil disturbance, but increases of sediment to streams would likely be undetectable. Not all vegetation in a treated area would be pulled or removed, so some ground cover plants would remain. Not all sediment from pulling weeds along roads would reach a stream because many relief culverts intercept ditch flow and drain it on to the forest floor away from streams. Handpulling is very labor intensive and costly. Thus, only a few acreas per year could be treated using this technique across a watershed. When compared to the total acres within a watershed, project-related soil disturbance from handpulling would be negligible.

Pathway: Channel Condition & Dynamics
Indicator: Floodplain Connectivity
PCE Crosswalk: Rearing habitat PCE

Some invasive plant treatments can have positive effects on floodplains and streambanks when infestations of invasive plants on valley bottom areas are removed. Valley-bottom infestations often encroach floodplains where road-related and recreational activities have led to the establishment of invasive plant populations. Removal of such infestations is expected to benefit aquatic and terrestrial communities in the long term by increasing floodplain area available for nutrient, sediment and large wood storage, and flood flow refugia. There is no risk of negatively impacting channel condition and dynamics as a result of treating invasive plants.

Pathway: Habitat Access
Indicator: Physical Barriers
PCE Crosswalk: Migration habitat PCE

Invasive plant treatments will not create physical barriers or otherwise degrade access to aquatic habitat. On the contrary, where blackberries have been established along streambanks, lack of treatment may result in the increase of their root system which could cross the stream channel resulting in an aggaded channel blocking fish access during low flow.

Pathway: Habitat Elements
Indicator: Substrate/Sediment
PCE Crosswalk: Spawning, Rearing habitat PCEs

Invasive plant treatmetns is not expected to affect substrate composition. All PDFs that minimize sediment would be implemented, such as no heavy equipment within riparian areas. These practices would reduce, but not eliminate sediment. Some sediment may enter stream channels as a result of extensive manual labor and could result in exposed soils. The amount of sediment that enters a stream is expected to be small, infrequent, short duration, and at a localized level. Short- term effects such as localized increases in fine sediment in gravels or along channel margins may be seen at the immediate treatment site. However, substrate quality would not decrease over time because treatment of invasive plants would not result in a chronic sediment source.

Pathway: Habitat Elements
Indicator: Large Woody Debris, and Pool Area, Quality and Frequency
PCE Crosswalk: Spawning habitat PCE

Treatment of invasive plants would not impact pool area, quality and frequency. Treatment of invasive plants in riparian reserves would not impact current wood debris in streams. The PDF that establishes a 100 ft buffer for broadcast applications provides protection to the recruitment of conifer seedlings within riparian areas which will sustain channel and habitat features in the future. With the treatment of invasive plants, riparian stands in time would develop larger recruitment trees and would increase the size of inchannel debris. This would be of most importance on the Froest because loss of large woody debris was identified as a critical habitat issue for White River, and loss of pool habitat for the Nooksack and Stillaguamish Rivers (Bishop and Morgan, 1996). The use of spot-spray applications of aquatic glyphosate and aquatic imazapyr may result in some minor non-target vegetation impact because of drift. However, the amount necessary to drift into the entire riparian area and kill trees is not possible with spot-spray applications.

Pathway: Flow/Hydrology
Indicator: Change in Peak/Base Flows
PCE Crosswalk: Spawning, Rearing, Migration habitat PCEs

Hydrologic changes from invasive plant treatments would never be large enough to cause effects at a subwatershed scale. There is no risk of increasing water yield at the subwatershed scale as a result of treating invasive plants. The only negative effect on designated critical habitat would result from the short term, localized increases in turbidity and sedimentation due to people implementing non-herbicide treatment methods along the waters edge. As previously discussed, the levels of fine sediment and turbidity increases at the project scale are expected to be insignificant and discountable, a one time event, and short-term. Any fines as a result of non-herbicide treatment methods are expected to be washed out by the end of the high flow period. However, the majority of fine sediment deposition is expected to be deposited in low-velocity areas including the pool tail crest regions on top of LCR chinook redds in the lower reaches of watersheds.

However, the small increase in fine sediment does not have a negative effect on any PCE of critical habitat. All spawning gravel in the action area, including the pool tail crest regions, is expected to be usable for the next LCR chinook and LCR coho fall spawning.

The potential for increased erosion into aquatic areas as a result of removing the protective cover and rooting along streambanks or waterbodies is reduced by establishing a 50’ buffer for broadcast sprays of aquatic labeled herbicides. The 50’ buffer along waterbodies was established to avoid the potential for some erosion that could occur, at least in the short term, from the use of aquatic labeled glyphosate and aquatic labeled imazapyr (known to be non-selective) as a result of killing both weeds and native vegetation. Broadcast spray of aquatic labeled triclopyr is not allowed.

Effects on Essential Fish Habitat Assessment

The Magnuson-Stevens defines adverse effects as any impact, which reduces the quality and/or quantity of Essential Fish Habitat. Non-herbicide treatment methods would have localized effects to habitat indicators for EFH at the project scale. Herbicide treatment methods may result in insignificant amounts of herbicides coming in contact with water as a result of drift and runoff from roadside ditches. Effects from both non-herbicide and herbicide treatment methods would be insignificant and discountable under Alternative B because of PDFsand established buffers along perennial and intermittent streams, and roads that have the potential to deliver herbicides to waterbodies. As discussed above under direct and indirect effects from herbicide and non-herbicide treatment methods, EFH for Chinook, coho, and pink salmon would not be adversely affected

PDFs will be applied and Northwest Forest Plan standards would be met. Conservation measures and management alternatives are listed in the Pacific Coast Salmonid Plan that help conserve and enhance salmon EFH. These measures should be applied unless more specific or different measures based on the best and most current scientific information are developed prior to, or during, the EFH consultation process and communicated to the appropriate agency. The PDFs in this EIS are more detailed measures and should take the place of ones listed in the Pacific Coast Salmonid Plan. However, there may be conservation measures that are different and complement the PDFs.

Summary of Effects (Proposed Action)

Project Design Features minimize and avoid concentrations of herbicide exceeding a level of concern coming in contact with fish and other aquatic organisms:

- Established buffers along perennial and intermittent streams greatly reduce the potential for drift of herbicide to surface waters;
- No broadcasting of herbicides are allowed along roads that have a high potential for herbicide delivery, thereby significantly reducing the likelihood of herbicides delivered to streams via road-side ditches;
- Broadcast spray of triclopyr is prohibited, thereby greatly reducing risk of triclopyr coming in contact with surface waters;
- Timing restrictions relative to weather conditions and fish species life stage avoid the possibility of herbicides coming in contact with water during sensitive life stages.
- With the eliminated potential for concern for increased risk to aquatic species, the potential for effects to the aquatic food web is greatly reduced.

The Proposed Action (Alternative B) may affect listed fish species.[30] The potential for herbicides to enter streams in concentrations above the threshold of concern for aquatic organisms and ecosystems is low. This is true whether known sites are being treated or new sites are found, because either way, even under the most ambitious conceivable treatment scenario, the PDFs minimize risks.

Direct and Indirect Effects of Alternative C

Alternative C eliminates most use of herbicides in Riparian Reserves (twice the size of the Aquatic Influence Zone); eliminates use of herbicides within roadside treatment areas having high potential for herbicide delivery, and does not allow any broadcast of any herbicide in any situation. No direct or indirect effects on fish and other aquatic organisms from herbicide use would be anticipated; effects would be similar to No Action regards herbicide use.

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[30] Consultation with regulatory agencies is required for a finding of “May Affect.” A Biological Assessment will be prepared for the Preferred Alternative and

Effects of Project Design Features

The PDFs for Alternative C completely eliminate concerns related to herbicide use. Non-herbicide methods would be favored, so more disturbance from manual crews or mechanical equipment would be likely. However, even under the most ambitious conceivable program, effects on aquatic organisms from non-herbicide treatments would be similar to the Proposed Action. The increased manual/mechanical acreage, treated according to PDFs, would not trigger any threshold of concern. This is true for known sites as well as new sites detected in the future.

Worst-Case Scenario

Alternative C does not involve any worst-case scenarios, because so little herbicide would be permitted near streams or on having high risk of herbicide delivery.

Effects on Designated Critical Habitat

Alternative C may have beneficial effects on critical habitat for federally listed fish species. It would be difficult in the long-term to effectively eradicate or control invasive weeds on Olympic National Forest that are currently posing threats to the growth of native vegetation along intermittent streams and/or roadside treatment areas that have high potential to deliver herbicide. Because intermittent streams are associated with debris flows, where most large wood and spawning gravel is delivered, invasion of weeds can interrupt natural patterns of debris flows if invasions are extensive enough.

Negative effects on designated critical habitat would result from the short term, localized increases in turbidity and sedimentation due to people implementing non-herbicide treatment methods along the waters edge. As previously discussed, the levels of fine sediment and turbidity increases at the project scale are expected to be insignificant and discountable when treatments are limited to a one time event, and short-term. Because effective treatment within riparian areas may be difficult without the use of herbicides, there is the possibility of multiple entries that could lead to more soil disturbance. Any fines as a result of non-herbicide treatment methods are expected to be washed out by the end of the high flow period. Extensive and intensive treatments along the waters edge or on an island could result in fine sediment deposition in low-velocity areas that have pool tail crest regions above redds.

The potential for small increases in fine sediment as a result of non-herbicide treatment methods would not have a negative effect on any PCE of critical habitat. All spawning gravels, including the pool tail crest regions, is expected to be usable for the next spawning period. The small amount of fine sediment generated by non-herbicide treatment methods is expected to be mostly flushed out of the low velocity areas by the end of the high flow period. An increase in suspended sediments anywhere in the Olympic National Forest as a result of non-herbicide treatment methods is expected to be below levels that are documented to have a negative effect on salmonid rearing habitat.

Effects on Essential Fish Habitat (EFH)

Non-herbicide treatments under Alternative C would have localized effects to habitat indicators for EFH at the project scale. Because herbicide treatment methods are not allowed in riparian areas, there will be more reliance on non-herbicide treatment methods. The use of non-herbicide treatment methods may result in increased sediment at the project scale, however, it is unlikely that it would lead to an adverse affect because perennial streams remain buffered and the likelihood of significant amounts of sediment being delivered to fish-bearing streams is extremely low. As discussed above under direct and indirect effects from herbicide and non-herbicide treatment methods, EFH for Chinook, coho, and pink salmon would not be adversely affected under alternative C.

Summary of Effects (Alternative C)

Alternative C may affect listed fish species. The potential for herbicides to enter streams in concentrations above the threshold of concern for aquatic organisms and ecosystems is very low. This is true whether known sites are being treated or new sites are found because the potential for herbicide use to affect aquatic organisms or habitats is nil in this alternative.

Direct and Indirect Effects of Alternative D

Alternative D has a higher probability of adverse effects than the other alternatives due to greater likelihood that broadcast treatments or higher risk herbicides would be used along dry intermittent streams and roadside treatment areas with high potential to deliver herbicide. Label directions would still need to be followed relative to herbicide application near any surface waters.

Effects of Project Design Features

Alternative D adopts similar PDFs as the Proposed Action to avoid harm to soil, water and aquatic organisms:

> Established buffers along perennial streams and other wet areas greatly reduce the potential for drift of herbicide to surface waters;
> Broadcast spray of triclopyr is prohibited, thereby greatly reducing risk of triclopyr coming in contact with surface waters;
> Timing restrictions relative to weather conditions and fish species life stage avoid the possibility of herbicides coming in contact with water during sensitive life stages.

However, Alternative D does not have certain limitations that better resolve the issue of herbicide delivery. Adverse effects are possible under the worst-case scenarios described below.

Worst-case Scenarios

Herbicides coming in contact with water could kill aquatic vegetation, especially in and below intermittent streams and along roadside ditches. The worst case scenario would involve broadcast spraying of a higher risk herbicide along a road that has a high potential of delivering herbicides to streams with fish and other aquatic organisms. A storm soon after herbicide application could wash herbicide into streams and result in concentrations exceeding levels of concern for fish and other aquatic organisms. Localized, short-term adverse effects to aquatic plants from use of herbicide in this situation would be most likely under this alternative. However, such a localized loss of aquatic plants would not be extensive enough to adversely affect fish and other aquatic organisms.

Herbicide concentrations would likely still be below levels used in the exposure scenarios modeled by SERA risk assessments (see discussion above) because of the low proportion of infestations within any 6^{th} field watersheds, the patchy distribution of most roadside infestations, and the application of Project Design Features specifically for wet areas.

The scenario of treatment of wetland emergent target vegetation is the same as the Proposed Action, because Alternative D has the same PDFs associated with treatments near wetlands and wet intermittent or perennial streams.

Effects on Designated Critical Habitat

Alternative D may have similar beneficial effects on critical habitat for federally listed fish species as alternative B. Negative effects on designated critical habitat would result from the short term, localized increases in the amount of herbicides coming in contact with water due to herbicide treatments within intermittent streams and along roadside ditches that have the potential to deliver herbicides to surface waters. The amount of herbicides coming in contact with water is expected to be insignificant and discountable at the project scale, especially if treatments are limited to a one time event, and short-term. However, there is the potential for vegetation die off below intermittent streams. This can inadvertently impact sac-fry fish. Any amount of herbicides coming in contact with water is expected to be diluted. Extensive and intensive herbicide treatments in intermittent streams and along hydrologically connected roadside ditches could result in some amount of herbicide being deposited in low-velocity areas that have pool tail crest regions above redds.

The potential for small amounts of herbicides coming in contact with water would not necessarily adversely affect adult fish, but could have a negative effect on any PCE of critical habitat. All spawning gravels immediately below intermittent streams or hyrdologically connected roadside ditches, are at risk of exposing yolk-sac fry to some amount of herbicide. Thus, alternative D could adversely affect critical habitat at the project scale. The amount of herbicide coming in contact with water under alternative D is expected to be below levels that were used for federally listed fish species in the SERA risk assessments.

Effects on Essential Fish Habitat (EFH)

Non-herbicide treatments would have localized effects to habitat indicators for EFH at the project scale. Herbicide treatment methods may result in a certain amount of herbicides coming in contact with water as a result of drift and runoff from roadside ditches and intermittent streams. Although amounts may not be toxic to adult fish, water contamination does have an influence on quality of habitat, therefore, impacting EFH to some extent because some vegetation may die. Effects from both non-herbicide and herbicide treatment methods would be insignificant, however under EFH definitions and criteria there could be an adverse affect to water necessary for Chinook and coho yolk-sac fry. As discussed above under direct and indirect effects from herbicide and non-herbicide treatment methods, EFH for Chinook, coho, and pink salmon would adversely affected under Alternative D.

Herbicide use as designed under Alternative D might not comply with water quality standards, given that glyphosate, picloram and triclopyr may harm aquatic organisms at concentrations modeled assuming average parameters for broadcast near streams. Such use may occur in Alternative D. Alternative D would likely not comply with the Aquatic Conservation Strategy and Riparian Reserve Standards and Guidelines, because of the likelihood that herbicides would have adverse effects to aquatic ecosystems.

The patchy distribution of invasive plants would serve to limit the risk, but under worst-case scenarios herbicides may adversely affect fish and other aquatic organisms. Effects from use of herbicide on wetland emergent target vegetation would be similar to the Proposed Action. However, Alternative D is associated with a much greater level of risk assuming an unexpected storm followed broadcast treatment of high or moderate risk herbicides in or near dry intermittent streams and within roadside treatment areas having high risk of herbicide delivery. Herbicide treatments in this situation under Alternative D are likely to adversely affect fish species of local interest.

For Alternative D to comply with standards, additional Project Design Features would have to be adopted for dry intermittent streams and roadside treatment areas having a high potential for herbicide delivery, including restrictions on use or application methods approved for herbicides of moderate or greater concerns to aquatic organisms.

Cumulative Effects Analysis for Fish and Aquatic Organisms

For all alternatives except D, the lack of potential direct and indirect effects reduces the potential for cumulative effects, even when this project is considered with other past, present and future projects. While some commonly used herbicides are associated with hazards to aquatic organisms, the contribution of this project would be very low.

Alternative D would have the potential to contribute to significant cumulative adverse effects if rainfall occurred soon after extensive broadcast treatments and other landowners or managers simultaneously used herbicides on neighboring lands. This risk would be greatest in the 6th field watersheds where the

Forest Service proposes to treat more than 10 acres within 100 feet of streams (see previous section on Soil and Water for list).

Such a scenario is plausible, but unlikely to occur, since broadcast treatment would not be used when it is not necessary and PDFs consider expected rainfall. However under this worst-case situation, Alternative D might fail to comply with environmental standards, policies and laws intended to minimize or eliminate adverse effects on aquatic organisms.

Alternative Comparison

Table 62. Herbicide Effects to Aquatic Organisms Alternative Comparison

Indicators	No Action (A)	Proposed Action (B)	Alternative C	Alternative D
Potential for herbicides to enter streams in concentrations above the threshold of concern for aquatic organisms and ecosystems.	Very Low	Low	Very Low	Moderate to High

3.6 Effects of Herbicide Use on Workers and The Public_

3.6.1 Introduction

The effect of herbicides on human health is a primary public issue (Issue Group 1). This section focuses on plausible effects to workers and the public from herbicide exposure. The R6 2005 FEIS evaluated human health risks from herbicide and non-herbicide invasive plant treatment methods. Hazards normally encountered while working in the woods (strains, sprains, falls, etc) are possible during herbicide and non-herbicide invasive plant treatment operations. Such hazards are mitigated through worker compliance with occupational health and safety standards and are not a key issue for this project-level analysis.

Many people express concern about the effects of herbicides on human heath. Workers and the public may be exposed to herbicides used to treat invasive plants under all alternatives in this project; however no exposures exceeding a threshold of concern are predicted. This conclusion is based on facts about chemistry of the herbicides considered for use and the mechanisms by which exposures of concern might occur.

The R6 2005 FEIS considered potential hazards to human health from herbicide active ingredients, metabolites, inert ingredients, and adjuvants. As a result, the R6 2005 ROD standards were adopted to minimize herbicide exposures of concern to workers and the public. Site-specific Project Design Features (PDFs) were developed to further minimize or eliminate exposures of concern to workers and the public plausible given the regional standards. The PDFs ensure that herbicides and surfactants are used in rates low enough, or methods selective enough, to avoid exposures of concern.

The R6 2005 FEIS relied on professional risk assessments completed Syracuse Environmental Research Associates, Inc (SERA) using peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information. The SERA Risk Assessment full citations are listed in Chapter 3.1.5. Appendix Q of the R6 2005 FEIS provides detailed information about the human health hazards associated with the herbicides considered for invasive plant treatments.

The following terminology is used throughout this section to describe relative toxicity of herbicides proposed for use in the alternatives.

Exposure Scenario: The mechanism by which a person may be exposed to herbicides active ingredients or additives. The application rate and method influences the amount of herbicide to which an organism may be exposed.

Threshold of Concern: A level of exposure below which there is a low potential for adverse effects to an organism. This level was made more conservative in the R6 2005 FEIS to add a margin of safety to the risk assessment process (see Figure 2, section 3.1.5).

Hazard Quotient (HQ): The Hazard Quotient (HQ) is the amount of herbicide or additives to which an organism may be exposed divided by the exposure threshold of concern. An HQ less than or equal to 1 is indicates an extremely low level of risk. A HQ below 1 indicates a level below a threshold of concern.

3.6.2 Affected Environment

Many people live near, spend time, work in, drink water from, or depend on forest products from the Olympic National Forest. Several municipal watersheds lie on the Forest (see Soil and Water section above). Public concern for drinking water quality in these watersheds is high.

These people may be inadvertently exposed to chemicals from invasive plant management projects on the National Forest. Municipal watersheds, dispersed and developed recreation areas (trailheads, campgrounds, picnic areas, recreation sites, boat ramps, ski areas, work centers, etc) and special forest product collection areas currently occur in the vicinity of invasive plant sites.

All kinds of people gather special forest products such as blackberries, huckleberries, salal, bear grass, mushrooms and herbs, for personal use and commercial sale. Some of these products are target species (blackberries, St. John's wort) but most are not. Special forest product harvesters may have more contact with contaminated vegetation than the general public. A recent unpublished study of commercial permit holders on the Gifford Pinchot National Forest demonstrated that the largest ethnic groups involved with forest product gathering were Hispanics and Southeast Asians (Khmer, Khmer Krom, Laotian and Vietnamese). National Forest system lands are adjacent to other land ownerships; the majority of watersheds on the Forest also contain Olympic National Park, American Indian Lands, commercial forestlands, and other private parcels.

Infested sites are scattered and occupy less than one percent of Olympic National Forest system lands. Invasive plant treatments on the Olympic National Forest are implemented in partnership with the local counties. Crews most often come from the communities in and around the National Forest boundary. Herbicide applicators are well-trained in safe herbicide handling and transportation practices (Lucero presentation, May 2005).

3.6.3 Environmental Consequences

Worker Herbicide Exposure Analysis

Herbicide applicators are more likely than the general public to be exposed to herbicides. Worker exposure is influenced by the application rate selected for the herbicide; the number of hours worked per day; the acres treated per hour; and variability in human dermal absorption rates. Appendix Q: Human Health Risk Assessment in the R6 2005 FEIS displayed risks for typical and maximum label rates under a range of conditions. Four potential exposure levels were evaluated for workers, ranging from predicted average exposure (typical application rate-typical exposure variables) to a worst-case predicted exposure (maximum application rate-maximum exposure variables).

In routine broadcast and spot applications, workers may contact and internalize herbicides mainly through exposed skin, but also through the mouth, nose or lungs. Contact with herbicide formulations may irritate eyes or skin.

The ten herbicides proposed for use under the action alternatives, used at rates and methods consistent with PDFs, have little potential to harm a human being. Appendix Q of the R6 2005 FEIS lists the HQ values for all herbicides considered for this project. In most cases, even when maximum rates and exposures are considered, HQ values were below the threshold of concern (HQ values ranged from 0.01 to 1).

Risk assessments indicate concern for worker exposure to triclopyr, especially the Garlon 4 formulation. This is one reason why broadcast application of triclopyr is not allowed under R6 2005 ROD Standard 16. However, a potential worst-case scenario exists exceeding a level of concern for workers given a backpack (spot) application of the Garlon 4 formulation of triclopyr. PDFs eliminate this scenario by favoring use of Garlon 3A, minimizing application rates of all triclopyr formulations, and following safe work practices and label advisories.

For all other herbicides and surfactants, the amount of plausible worker exposure is below levels of concern for all application methods, including broadcast. Project Design Features for all action alternatives reduce both the application rate and the quantity of drift if triclopyr and/or NPE are used. Broadcast of triclopyr is not permitted in any situation (as per Standard 16), and non-NPE surfactants would always be favored where effective.

Chronic (daily over 90 days) worker exposure was also considered in SERA Risk Assessments; chronic exposures also do not amount to levels of concern because the herbicide ingredients are water-soluble and are not retained in the body (they are rapidly eliminated).

Public Herbicide Exposure Analysis

The general public would not be exposed to substantial levels of any herbicides used in the implementation of this project. R6 2005 FEIS Appendix Q considered plausible direct, acute and chronic exposures from herbicide ingredients. Few plausible scenarios exist that exceed even the most conservative threshold of concern for public health and safety. Appendix Q shows Risk Assessment results assuming a human being contacts sprayed vegetation or herbicide or consumes sprayed vegetation, contaminated water, and/or fish.

Direct Contact

There is virtually no chance of a person being directly sprayed given broadcast, spot and hand/select methods considered for this project. A person could brush up against sprayed vegetation soon after herbicide is applied. Such contact is unlikely because public exposure would be discouraged during and after herbicide application. For all herbicides except triclopyr, even if a person were directly sprayed with herbicide applied at typical broadcast rates, chemical exposure would not exceed a level of concern.

Exposures exceeding a conservative level of concern could occur if a person accidentally contacts vegetation spot-sprayed with triclopyr (especially Garlon 4). However, such contact is implausible because no broadcast spraying with triclopyr would occur under any alternative (the R6 2005 ROD added Standard 16 to the Olympic National Forest Plan to only allow spot or hand/selective treatment if triclopyr is used. The use of Garlon 4 is further limited by the PDFs (for instance, no use of Garlon 4 would be allowed within 150 feet of any water body or stream channel; Garlon 4 would be avoided in special forest product gathering areas, campgrounds, or administrative sites). Gathering areas, campgrounds and administrative sites may be closed immediately after triclopyr application to eliminate accidental exposures.

Eating Contaminated Fish, Berries or Mushrooms

The public may also be exposed to herbicide if they eat contaminated fish, berries, or mushrooms (etc). Several exposure scenarios for recreational and subsistence fish consumption were considered in the SERA Risk Assessments; none are near any herbicide exposure level of concern. Fish contamination is unlikely given the Project Design Features that reduce potential herbicide delivery to water.

Members of the public could eat invasive blackberries that have been sprayed, however the target vegetation would quickly be browned and unappetizing. Non-target, native berries or mushrooms may be affected by drift or runoff.

The R6 2005 FEIS considered exposure scenarios for both short term and chronic consumption of contaminated berries. The herbicide dose from eating a quantity of mushrooms would be greater than for the same quantity of berries (Durkin and Durkin, 2005). The dose, however, would be less than the dose from a dermal contact with sprayed vegetation scenario, and below the threshold of concern (HQ <1).

Appendix Q displayed the exposure scenarios and HQ values associated with eating berries or other herbicide contact. Of the ten herbicides considered in this project, triclopyr remains the single herbicide with exposure scenarios exceeding a level of concern if berries or mushrooms containing herbicide residue are consumed. To respond to this concern, PDFs limit the application methods and rate of application for triclopyr (especially Garlon 4). In addition, under worst-case scenarios and maximum label rates, exposure to NPE surfactant may also exceed a level of concern. Thus PDFs limit the rate of NPE that may be applied. Special forest product gathering areas may be closed to public use immediately after triclopyr application to avoid inadvertent exposure.

People who both harvest and consume special forest products may be exposed both through handling contaminated plant material and chewing or eating it. Chewing and eating contaminated plant material cause different exposure and dose patterns. Such doses would be additive, but are unlikely to exceed a threshold of concern (see cumulative effects, below).

Drinking Contaminated Water

Acute exposures and longer-term or chronic exposures from direct contact or consumption of water, fruit or fish following herbicide application were evaluated in the R6 2005 FEIS. Risks from two hypothetical drinking water sources were evaluated: 1) a stream, into which herbicide residues have contaminated by runoff or leaching from an adjacent herbicide application; and 2) a pond, into which the contents of a 200-gallon tanker truck that contains herbicide solution is spilled. The only herbicide scenarios of concern would involve a person drinking from a pond contaminated by a spill of a large tank of herbicide solution. The risk of a major accidental spill is not linked in a cause-and-effect relationship to how much treatment of invasive plants is projected for a particular herbicide; a spill is a random event. A spill could happen whenever a tank truck involved in a herbicide operation passes a body of water. The potential risk of human health effects from large herbicide spills into drinking water are mitigated by Project Design Features that require a Herbicide Transportation and Handling Plan be developed as part of all project safety planning, with detailed spill prevention and remediation measures to be adopted.

Environmental Justice and Disproportionate Effects

The R6 2005 FEIS found that some minority groups may be disproportionately exposed to herbicides, either because they are disproportionately represented in the pool of likely forest workers, or they are disproportionately represented in the pool of special forest product or subsistence gatherers.

The R6 2005 FEIS suggested that Hispanic forest workers and American Indians may be minority groups that could be disproportionately affected by herbicide use.

Hispanic and non-Hispanic herbicide applicators would be more likely to be exposed to herbicides than other people. Contractors for the Forest and/or County would likely implement herbicide treatments. County invasive plant control departments do not indicate that they employ any specific population group that could be disproportionately affected during invasive plant treatments. Regardless, effects to all County or contract employees engaged in invasive plant control would be negligible due to Project Design Features and compliance with occupational health and safety standards.

People of Hispanic and Southeast Asian (Khmer, Khmer Krom, Laotian and Vietnamese) descent are minority groups that tend to gather mushrooms. However, no mushrooms are target species and Project Design Features are in place to protect fungi. Whenever herbicide treatment is going to happen, the Forest will notify tribes, plant collectors and the general public with media postings, handouts attached to permits, annual tribal contacts and on-the-ground signing. Information about invasive plant treatments would be added to existing multi-lingual mushroom gathering permit material to eliminate inadvertent exposures if appropriate. Some areas may be closed to gathering following treatment to avoid exposures. Even given plausible inadvertent exposures, the HQ values would not exceed the threshold of concern. .

Direct and Indirect Effects of the Alternatives

No Action

The herbicide applications approved in No Action were previously analyzed in the 1998 EA and found to pose no significant potential risks to health for workers or the public.

Action Alternatives

All alternatives similarly resolve issues related to human health. No individual worker or public exposures of concern are predicted for any alternative. Alternative C has the least risk of adverse effects from herbicide use of all action alternatives because it eliminates or severely restricts herbicide on an estimated two-thirds of the project acreage. However, the Project Design Features, particularly the perennial stream buffers, limitations on application rate of some herbicides also eliminate plausible exposures of concern in Alternatives B and D. No adverse effects to public drinking water supplies or health and safety are predicted in any alternative. Exposures of concern would be minimized on inventoried and currently unknown sites because the Project Design Features would be applied to all situations.

Table 63. How Human Health Concerns are Addressed

	Project Design Feature to Minimize Exposures of Concern
Workers	Reduced application rates of some herbicides; limitations on broadcast of triclopyr as per Standard 16.
Public	Reduced application rates of some herbicides; limitations on broadcast of triclopyr as per Standard 16. These limitations reduce risks to the general public, even considering multiple exposures.

	Project Design Feature to Minimize Exposures of Concern
Workers	Reduced application rates of some herbicides; limitations on broadcast of triclopyr as per Standard 16.
Public	Reduced application rates of some herbicides; limitations on broadcast of triclopyr as per Standard 16. These limitations reduce risks to the general public, even considering multiple exposures.
Special Forest Products	Reduced application rates of some herbicides; posting areas, supplying info to permittees; Using flagging to mark treated areas; Ensuring some areas are available that will not be treated. Detectable impacts are implausible except in the event of an unpredictable exposure. Even multiple exposures (eating contaminated fish, drinking contaminated water, skin irritation) would not result in exposure levels of concern.
Drinking Water	Detectable impacts are implausible except in the event of a spill. Transportation and Handling Safety Plan and Spill Plan.

Cumulative Effects of All Alternatives

The proposed use of herbicides in all alternatives could result in cumulative doses of the same or different herbicides to workers or the general public. Cumulative doses are possible within the context of this project, or when combined with herbicide use on adjacent private lands or home use by a worker or member of the general public.

A person could be exposed to herbicide repeatedly over the course of their lifetime and exposure may occur any place that herbicides are used. Appendix Q of the R6 2005 FEIS evaluated chronic exposure scenarios, including repeated drinking of contaminated water, repeated consumption of contaminated berries, and repeated consumption of contaminated fish over a 90-day period. The HQ values for chronic exposures of all herbicides considered for this project were below 1.

A person could be exposed to herbicides by more than one scenario, for instance, a person handling, and then consuming sprayed berries. The cumulative impact of such cases may be quantitatively characterized by adding the HQ values for each individual exposure scenario. An example of this scenario was considered for this cumulative effects analysis: the scenario assumes glyphosate contacts a person's bare skin (HQ for dermal exposure is less than 0.01), and that person immediately eats contaminated berries and fish (HQ values for oral exposure are less than 0.01). Even if these three exposures occurred simultaneously, the combined HQ values are still far below a threshold of concern (HQ < 1).

Some of the herbicides considered for use in this project have HQ values greater than glyphosate; however, the combined HQ values for dermal and oral exposure are still likely to be very low. The body would metabolize some of the initial dose before receiving the second dose, thus reducing the cumulative dose. The risk of adverse effects to human health is low because the herbicides proposed for this project are water-soluble, are quickly eliminated from the body, and do not bioaccumulate in the human body.

Risk assessments indicated a cause for concern about the health effects from exposure to triclopyr; Project Design Features avoid broadcast with this herbicide and severely restrict the use of its more toxic formulation (Garlon 4). In addition, risk assessments indicate a concern regarding use of NPE surfactant. NPE surfactant use is also restricted by the Project Design Features, which would ensure that no thresholds of concern would be exceeded, even if the most ambitious treatment scenario was implemented. All alternatives comply with standards, policies and laws aimed at protecting worker safety and public health.

3.7 Project Costs, Financial Efficiency and Jobs _______

3.7.1 Introduction

The treatments proposed by the Forest Service are likely to be funded through a variety of mechanisms and partnerships including county, state, federal and private sources. The economic efficiency analysis compares the relative total and average costs of implementing each alternative. Concerns about project cost, financial efficiency, and jobs were expressed during scoping (Issue Group 3).

The differences between alternatives also result in differences in labor force required to complete the work. Members of the public expressed that job creation is a positive indirect effect of the project that should be presented in the EIS.

The following project cost, economic efficiency and job analysis considers the most ambitious conceivable program discussed throughout this chapter. It also characterizes the costs of treating the highest priority infestations found on about 32 percent of the project area (see Chapter 2, Treatment Area Priority). The following assumptions are built into the economic analysis:

- Eradicate/control acres will be harder to treat and will cost 1.5 times as much as containment acres to effectively treat each year.
- Each year's treatment is expected to be 80% effective where herbicides are in the range of available methods, and 25% effective if herbicide use is severely restricted as in No Action (see Botany and Treatment Effectiveness for rationale for these percentages).
- Alternative B has 34 percent of its herbicide treatment acres modeled for broadcast treatment and Alternative D has 84 percent of its herbicide treatment acres modeled for broadcast treatment. These estimates likely include more broadcasting than would actually occur, based on the nature of the current infestations. However, this assumption helps show the maximum increased efficiency that could be gained by allowing the flexibility gained by relaxing some Project Design Features in Alternative D. Broadcast to spot/hand ratio remains the same in Alternatives D and B through the life of the project.
- Non-herbicide treatments that are combined with herbicide treatments are modeled to start occurring in the second year of treatment. The first year is assumed to be 100% herbicide, even though the final prescriptions are likely to include some manual and mechanical treatment during or before herbicide application. This assumption allows for the maximum differentiation between the impacts of herbicide use in the alternatives.
- Over time, the proportion of herbicide use compared to non-herbicide methods is expected to decrease in Alternatives B and D. These alternatives are assumed to follow a pattern of declining herbicide use over time, as shown in table 64 and figure 4. No Action and Alternative C maintain the same proportion of herbicide to non-herbicide (13 and 30 percent respectively).

Table 64. Pattern of Herbicide to non-Herbicide Over Time, Alternatives B and D

Year	Percent Herbicide Use	Percent Non-Herbicide Use
2007	96%	4%
2008	75%	25%
2009	50%	50%
2010	0%	100%

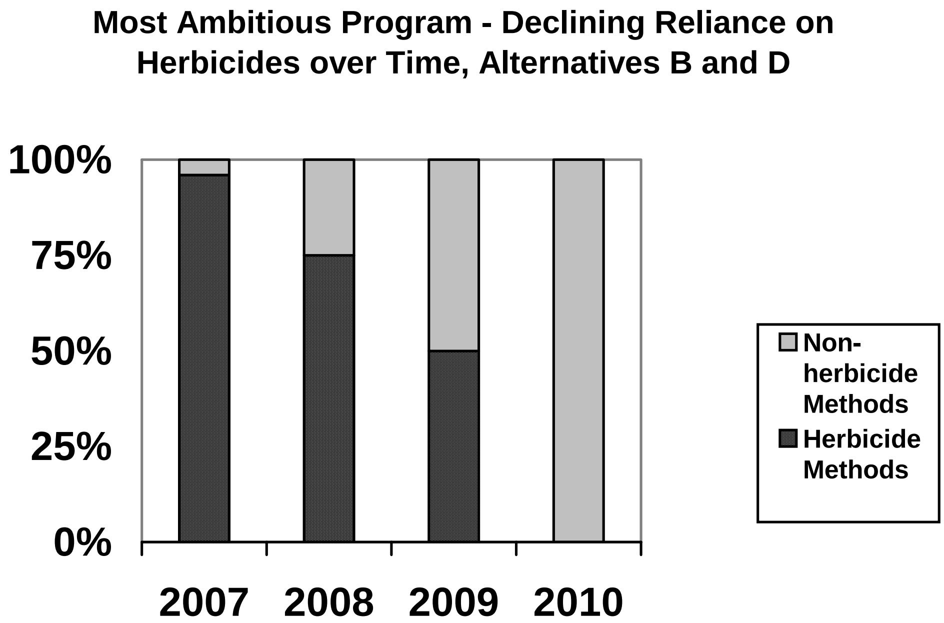

Figure 4 Declining Reliance on Herbicide over Time – Alternatives B and D

3.7.2 Treatment Costs by Method

The following costs were used in the analysis:

- Base cost for broadcast is $100 per acre, increased for eradicate/control by 1.5 to $150
- Base cost for Spot/Hand is $250 per acre, increased for eradicate/control by 1.5 to $375
- Base cost for Manual is $340 per acre, increased for eradicate/control by 1.5 = $460
- Base cost for Mechanical is $100 per acre, increased for eradicate/control by 1.5 to $150
- Annual inventory and monitoring was estimated to cost $20,000 per year.
- Active restoration was estimated to cost about $500 per acre, applied to two-thirds of the project acreage. Active restoration was assumed to occur on approximately 650 acres per year in Alternatives B and D and about 371 acres per year under Alternative C.

Base costs were used for acreage with a treatment strategy of containment, and applied to all acreage treated under No Action.

3.7.4 Total and Average Project Costs

This section reveals the results of the economic analysis, including the total cost of the most ambitious conceivable treatment scenario, projected from 2007 to 2011.

Table 65. Cost Comparisons by Alternative

Alternative	Total Cost 2007-2011	Maximum Annual Cost	Average Annual Cost	Average Cost Per Acre
A (No Action)	$664,000	$255,340	$149,000	$988
B (Proposed Action)	$2,183,000	$751,785	$490,000	$570
C	$3,496,000	$1,247,700	$785,000	$ 1,025
D	$2,070,000	$657,300	$465,000	$540

Table 66 and Figure 5 display the range of annual funding that would be required for the most ambitious treatment scenarios.

Table 66. Estimated Acres Treated and Cost By Year

Year	Acres Treated (Herbicide, Manual, Mechanical)	Cost ($)
No Action		
2007	672	255,340
2008	504	159,110
2009	378	124,430
2010	284	98,350
2011	213	62,260
Proposed Action (Alternative B)		
2007	3,830	751,785
2008	765	532,520
2009	148	376,935
2010	29	342,920
2011	0	311,500
Alternative C		
2007	3,410	1,247,700
2008	1,979	1,169,400
2009	1,133	487,300
2010	657	445,500
2011	381	324,700
Alternative D		
2007	3,830	657,285
2008	765	514,47
2009	148	374,985
2010	29	342,920
2011	0	311,500

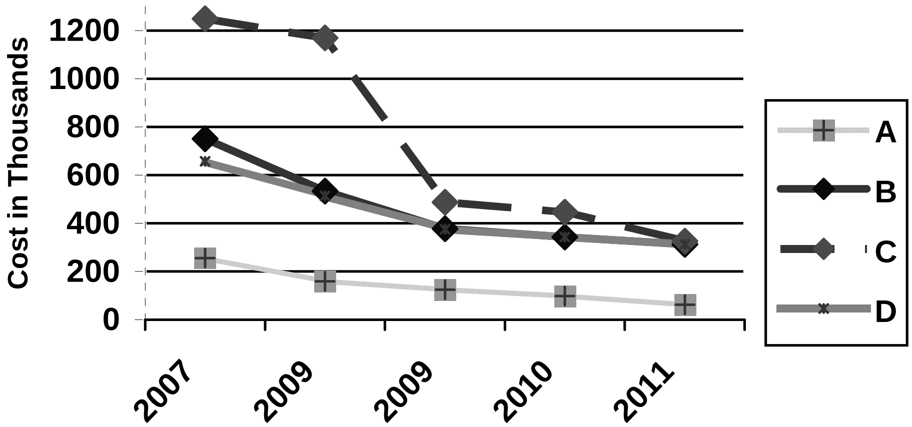

Figure 5. Alternative Costs per Year in Thousands

The most ambitious treatment scenarios are unlikely to be accomplished, unless funding is increased several-fold. Assuming the current fuding estimate of $100,000 was available for invasive plant treatments and restoration each year over five years, approximately 20 percent of the total current infested acreage (750 acres) would be effectively treated. High priority sites would likely be treated, but other infestations would continue to spread. Cost of treating existing infestations would continue to increase.

3.7.3 Jobs by Alternative

Some members of the public expressed that job creation is a valuable indirect effect of invasive plant treatment. They expressed that manual treatments are more likely to involve manual labor than other treatment methods, and thus should be favored. Indeed, nearly all of the costs associated with manual treatments involve labor costs and alternatives with a greater proportion of this treatment compared to other methods would tend to create more jobs per treatment acre.

Assuming full funding, the most ambitious treatment scenarios in each alternative would result in short-term employment opportunities. Employment opportunities would diminish over time as the invasive plants are eradicated, controlled, contained, or suppressed and treated sites are restored.

The alternative comparisons above reflect total estimated costs of labor, equipment, and supplies; these vary depending on treatment type (manual, mechanical, and/or herbicide) and herbicide application method (spot/hand vs. broadcast).

Table 67 displays the assumptions used to determine the number of worker days per year (2007-2011) associated with the most ambitious treatment scenario under each alternative. These assumptions are based on methodology established on the Mount Hood National Forest in their Invasive Plant DEIS (USDA 2006), adapted to local conditions. Wages were estimated as 80 percent of labor cost (assuming the other 20 percent applies to taxes and benefits). Wages were assumed to average of $160 per worker day; actual wages range widely for machine operators, herbicide applicators, and hand laborers.

Table 67. Assumptions for Worker Days per Treatment Acre

Treatment Method	Total Cost Per Acre	Wage Cost as Percent of Total	Worker Day per Containment Treatment Acre	Worker Day per Control/Eradicate Treatment Acre
Herbicide-Broadcast	100	24	.15	.23
Herbicide-Spot/Hand	250	85	1.06	1.6
Mechanical	100	40	.2	.3
Manual	340	100	2	3
Restoration	500	50	1.18	1.18

Table 68. Number of Jobs for First Year of Most Ambitious Treatment Scenario

Alternative	Total Acres	Total Worker Days	Number of Jobs Assuming 6 Month Season
Alternative A	672	1,047	8
Alternative B	3,830	2,320	18
Alternative C	3,410	6,982	54
Alternative D	3,830	1,745	13

Future years' job numbers would decline rapidly after the first year of the most ambitious conceivable treatment, because less treatment would be needed in following years. However, restoration under Alternatives B and D would occur on approximately 623 acres per year in the years 2008 through 2011. Jobs associated with restoration in these years amount to about six additional jobs per six-month year. Restoration under Alternative C would occur on approximately 371 acres per year in the years 2008 through 2011. Jobs associated with restoration in these years amount to about three additional jobs per six-month year.

The project alternatives would require services of 3 to 12 people per six month year over a period of five years, assuming a constant budget of $100,000 per year; following a similar distribution to table 68 Alternative C creates the most jobs due to its reliance on manual treatment methods.

This job level is not significant to the economy of the counties surrounding the Olympic National Forest, although the most ambitious treatment scenario may require the help of workers from outside the local area.

3.8 Additional Environmental Effects

3.8.1 Heritage (Cultural) Resources

The USDA, Forest Service, Advisory Council on Historic Preservation and the Washington State Historic Preservation Office (Office of Archaeology and Historic Preservation), have a programmatic agreement addressing the management of cultural resources on national forests in the state of Washington (Agreement Number 97-06-59-10). There are several actions that were determined to have little or no potential to affect historic properties. Examples of these actions include fence construction, planting on disturbed areas, aerial seeding, pre-commercial thinning, encroachment thinning using hand methods to lop branches and cut small trees, and reforestation planting by hand.

While invasive plant treatments within the scope of this EIS are not specifically itemized in the Programmatic Agreement between the Forest Service and the Washington SHPO, the techniques, methods and effects are generally similar. Forest Service staff has coordinated with the Washington SHPO and affected Tribes to classify all actions within the scope of this EIS as having no effect on heritage resources.

One exception is weed wrenching of Scotch broom proposed within undisturbed, unsurveyed areas of the National Forest. Such treatments could occur under all action alternatives. While most Scotch broom infestations occur in disturbed areas (roadsides), some infestations are in less disturbed areas. Weed wrenching of larger-sized Scotch broom has the potential to disturb heritage resources in undisturbed sites. To mitigate for this possible effect, weed wrenching sites would be evaluated by a heritage resource specialist prior to and/or during treatment to eliminate disturbance to heritage resources.

3.8.2 Tribal and Treaty Rights

Several of the tribes are using similar herbicide treatments themselves and support the prescriptions on the forest.

Executive Order 12898 directs the agencies to consider patterns of subsistence hunting and fishing if an action will affect fish and wildlife.

The Chehalis, Jamestown S'Klallam, Hoh, Lower Elwha Klallam, Nisqually, Makah, Port Gamble S'Klallam, Quileute, Quinault, Shoalwater Bay, Skokomish, Squaxin Island and Suquamish Indian Tribes utilize the Olympic National Forest for recreation, hunting, fishing and gathering cultural plants. Minority groups use the forest to collect personal use and commercial forest products like huckleberries, salal, bear grass, mushrooms and herbs. The probability that Alternative B would directly or indirectly affect these people in any way is very low because of the various benign treatments with their built-in Project Design Features and public notifications. The majority of herbicide treatments would be along roadsides. The plants that people come to collect and utilize are usually found in more natural settings vs. a disturbed roadside, so most gathering will occur away from treatment areas. Further, should an invasive plant be discovered adjacent to a population of gathering plant, the latter non-target species can be protected from the very little overspray that might come from selective spot spraying using hand held barriers. Whenever herbicide treatment is going to happen, the Forest will notify tribes, plant collectors and the general public with media postings, handouts attached to permits, annual tribal contacts and on-the-ground signing. It would be very easy for such people to avoid any invasive plants that have been treated or others minimally affected by overspray.

No adverse effects are expected on fish and wildlife populations on which the thirteen Indian tribes rely. Many of the tribes have expressed support for herbicide treatments to combat invasive plants because the long-term benefits of controlling the invasive plants outweigh the few short-term risks or disruptions.

3.8.3 Environmental Justice and Civil Rights

Low income and minority groups would see no change to their use of the Forest under this alternative. There currently are no disparate effects on these populations by forest management activities

Executive Order 12898 directs federal agencies to identify and address the problem of adverse environmental effects by agency programs on minority and low income populations.

Contractors for the Forest and/or County would likely implement herbicide treatments. County invasive plant control departments do not indicate that they employ any specific population group that could be disproportionately affected during invasive plant treatments. Regardless, effects to all county or contract employees engaged in invasive plant control would be negligible given the counties are licensed herbicide applicators that follow label precautions.

3.8.4 Recreation and Scenery

Direct beneficial effects would include the limitation of non-native species in the viewshed, maintenance of diverse community of native grasses, forbs, and shrubs, and maintenance of conditions consistent with the ecological setting that supports the desired landscape character of mosaic of forested canopy and grassland openings. The alternative would meet the existing visual quality objectives and be beneficial to the landscape character by reducing risks of altered plant species composition and related effects. The scenic integrity and scenic stability would be maintained.

There are herbicide and manual treatments of invasive plants proposed in campground and recreation residence tracts. Again, the Forest would utilize a notification process so people knew in advance what plants are to be treated. The holders of special use permits for recreation residences on the Forest; e.g., Lake Quinault, are familiar with the problem of invasive plants like English Ivy and knotweed and have been actively engaged in efforts to control the plants around their cabins. Most would likely welcome safe herbicides.

There are herbicide and manual treatments of invasive plants proposed in campgrounds, visitor centers and trailheads. Again, the Forest would utilize a notification process so people knew in advance what plants are to be treated and where. This gives the public a very good opportunity to avoid places where herbicides are used should they wish to.

The only negative effect anticipated is if some forest visitors feel they must go elsewhere to avoid chemicals in their favorite spots. However, should the public still use the recreation sites just before, during or right after treatment, the risk of an adverse impact to visitors from treated plants is very low (see risk assessment).

Aggressive action proposed to control or eradicate invasive species would help sustain the landscape character with some short term effects to scenic integrity. Patches of dead vegetation, including desirable species, for at least one growing season would be a short-term negative effect. The unnatural appearance of mowed and brushed areas seen from immediate foreground distances (300 feet) would also be a short-term negative effect. Some treatment areas stretch for miles along the sides of roads. Such treatments might be more noticeable; however the effect would be short-term.

Direct beneficial effects would include the limitation of non-native species in the viewshed, maintenance of diverse community of native grasses, forbs, and shrubs, and maintenance of conditions consistent with the ecological setting that supports the desired landscape character of mosaic of forested canopy and grassland openings. The alternative would meet the existing visual quality objectives and be beneficial to the landscape character by reducing risks of altered plant species composition and related effects. The scenic integrity and scenic stability would be maintained.

There are herbicide and manual treatments of invasive plants proposed in campground and recreation residence tracts. Again, the Forest would utilize a notification process so people knew in advance what plants are to be treated. The holders of special use permits for recreation residences on the Forest; e.g., Lake Quinault, are familiar with the problem of invasive plants like English Ivy and knotweed and have been actively engaged in efforts to control the plants around their cabins. Most would likely welcome safe herbicides.

The 672 acres of invasive plant treatments currently happening on the forest, so far, have a manual and mechanical component with some herbicide use (up to 86 acres.) The treatments have not affected recreationists or scenery. Recreation uses have not been displaced by treatments, and the treatments have not led to visual impacts in the form of large areas of dead plants or de-vegetated zones along visually sensitive road corridors.

Alternative A would not keep up with the aggressive invasion by non-native species. Effects to scenic resources would include changing the landscape character in many areas to a homogeneous species composition in certain areas and in the forest understory that is inconsistent with the valued landscape character. The No Action Alternative would not be sufficient to fully maintain the native species. Conditions necessary for continued regeneration of oak species may be altered. In the long run, plant species diversity would be reduced. Japanese knotweed may overtake riparian vegetation and river banks altering the scenic pattern, form and texture of open areas and the forest understory extensively. The scenic integrity would be reduced.

3.8.5 Congressionally Designated Areas: Wilderness and Wild and Scenic Rivers

Five Wilderness Areas occur on the Olympic National Forest, four of these likely contain invasive plants (Buckhorn, Colonel Bob. the Mt. Skokomish and the Brothers Wilderness). The Wonder Mountain Wilderness has a low potential for invasive species. Invasive plants have adverse effects Wilderness values since they disrupt natural processes.

Treatments may also adversely affect Wilderness values. Wilderness visitors may notice the effects of invasive plant treatments. Browned out vegetation may be obvious. A visitor’s sense of solitude may be affected if they came upon an invasive plant worker. These encounters would be brief and no mechanized treatment would be approved. The Wilderness areas would continue to be free to evolve and respond without interference from invasive plant treatments.

No Wild and Scenic Rivers have been designated on the Olympic National Forests. A number of streams are eligible for consideration under the Wild and Scenic Rivers program, and the Dungeness, Grey Wolf and Duckabush Rivers have been recommended for listing. The overriding resource value being managed for all of the rivers is scenery.

As discussed above, invasive plant treatments with herbicides can temporarily affect scenery if large numbers of target plants are together and are seen in the dying or dead phase. They will not be noticed the following growing season when the residual live, green native vegetation dominates the view.

3.8.6 Energy Requirements and Conservation Potential

No unusual energy requirements are associated with this project. No unusual equipment would be used. Fossil fuels would be used in a prudent manner.

3.8.7 Irreversible or Irretrievable Use of Resources

No irreversible or irretrievable uses of resources are associated with this project. This project restores native vegetation in areas where non-native plants have been introduced. Herbicide treatments in accordance with the alternatives would have relatively short-lived impacts; effects on non-target species would be minimized; such effects would not be permanent.

3.8.8 Effects on Long-term Productivity

Positive effects on site productivity would be expected as native vegetation is restored. Some herbicides have potential to reduce soil productivity; Project Design Features are intended to avoid use of such herbicides where soil productivity is already low.

3.8.9 Consistency with Forest Service Policies and Plans

The proposed project is consistent with all Forest Service policies and existing plans, with the exception of Alternative D, which is associated with herbicide use that has the potential to exceed concentrations of concern for aquatic SOLI's.

3.8.10 Conflicts with Other Plans

No conflicts with existing plans have been noted. Jefferson County currently does not use herbicides on lands outside of National Forests. Use of herbicides in this county would be coordinated with the noxious weed board.

A recent lawsuit *Washington Toxics Coalition et al. v EPA*, regarding the lack of Endangered Species Act consultation on use of certain herbicides, was resolved by requiring certain buffers near streams. Herbicide use on federal land was exempt from the buffer zone requirement because such use already "implements safeguards routinely required" by the regulatory agencies.

3.8.11 Adverse Effects That Cannot Be Avoided

Most of the significant issues are resolved through adherence to Project Design Features that minimize or eliminate the potential for adverse effects. However, some adverse effects are inherent to invasive plant treatments and cannot be avoided. These include:

- Taxpayers will likely be responsible for the costs of treatment.
- Herbicide toxicity exceeding thresholds of concern are unlikely but possible given an herbicide spill or unpredictable weather event.
- Minor to moderate physical injuries due to forestry work are possible.
- Some common non-target plants are likely to be killed by treatments in close proximity. This is most likely with broadcast herbicide treatments and less likely (but possible) for all other treatment methods. The adverse effects of the invasive plants themselves far outweigh the potential for adverse effects of treatment.

CHAPTER 4. List of Preparers, Consultation and Coordination with Others (Tribes, Agencies)

4.1 List of Preparers

The following people were the primary authors of this Draft EIS. Many other Forest Service employees and others reviewed the document and provided input.

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Olympic National Forest Liaison

4.2 Consultation with Regulatory Agencies

The Forest Service has initiated consultation with the US Fish and Wildlife Service and NOAA Fisheries regarding potential adverse effects on Endangered Species. The consultation is tiered to programmatic consultation at the Regional Scale.

A Biological Assessment will be prepared for the Preferred Alternative. A Record of Decision will not be signed prior to receiving a Letter of Concurrence from the regulatory agencies supporting determinations of Not Likely to Adversely Affect and/or they issue a Biological Opinion describing terms and conditions associated with a determination of Likely to Adversely Affect.

4.3 Consultation with Tribal Governments

Government to government consultation is ongoing with several tribes including: Chehalis Confederated Tribes, Hoh Tribe, Jamestown S'Klallam Tribe, Lower Elwha, S'Klallam Tribe, Makah Tribe, Port Gamble S'Klallam Tribe, Quileute Tribe, Quinault Indian Nation, Shoalwater Bay Tribe, Skokomish Tribe, Squaxin Island Tribe, and the Suquamish Tribe. Letters have been sent to all tribal chairs, and follow up presentations and meetings have occurred at the request of the tribes.

No tribal members (who have identified themselves as such) have expressed disapproval of the project. In fact, the Quileute Tribe expressed full support of the Forest Service's intention to "address invasive weeds head-on." Informally, tribal representatives have stated they believe the long-term benefits of treating and controlling invasive plants outweigh the short-term risks to localized populations of culturally significant plants.

4.4 Consultation with Counties and Municipal Water Boards

The Forest Service has worked closely with the Clallam, Grays Harbor, Jefferson, and Mason County Weed Boards. County staff have presented information to the Forest Service and participated in field visits. The Counties often implement projects for the Forest Service and other land managers in the area and fully support this project.

Coordination with municipal water boards would occur as a part of implementation planning to ensure compliance with the Olympic National Forest Plan standards and Municipal Watershed Agreements.

4.5 Consultation with Others

Scoping has occurred on this project since 2004. The public has been apprised of project progress through the newspaper, direct mailings, Notices of Intent published in the Federal Register in 2004 and again in 2005, the Forest Schedule of Proposed Actions, informal meetings and discussions, and other media. Many organizations and individuals have expressed interest in the project; everyone who expressed interest was offered a hard copy or CD containing the DEIS and Appendices.

The full DEIS and Appendices is also available electronically by website: http://www.fs.fed.us/r6/olympic or on request (see cover page for more information or to request a CD or hard copy).

Hard copies have been distributed to Forest Service offices throughout the area. CDs and hard copies have been sent to the Environmental Protection Agency (who commented during scoping) and other federal agencies as required. The following is a list of individuals, organizations, agencies and tribal governments and groups to whom this DEIS was sent:

Individuals

Barbara and David Adams
Kenn Adcock
Nancy Alderson
Robert Amundson
Jim Anderson
Lynn Bergeron
Walter Blendermann
B. Boyles
Jack Burkhalter
Jean Cameron
Felix Capoeman
Betty Captein
F.Stuart Chapin
Carolee Colter
James Crudele
Ted Davenport
Jean Day
Jean Dunlop
John Edmundson
Stan Fouts
Michelle Franz
Enid Griffin
C.J. Guthrie
Donald and Alice Hack
Emery Ingham
John Irwin
Richard Johnson
Pam Kenyon
Kurt Kessler
Irene Kocher
Jack Konner
M.A. Kruse
Russell Kysar
Leroy Layton
Eugene Lynch
Ned Marshall
C.J. McClellan
Moyers
Lewis Nickerson
Pellissier
Charlotte Portner
Tim Plein
Nancy Russell
Michael Ryan
Michael Rysavy
A.L. Schwiesow
Greg Short
Sandra Smith
C.G. Spies
Phyllis Stuart
Nita Sullivan
Aubrey Taylor
Cheryl Thoen
Chris Thompson
Ray Triplett
Jim and Barbara Scott Trusky
Roberta Vandehey
Kathryn Venator
Carol Volk
Mitchell Williams

Organizations

Peter Von Ohlen
German Shorthair Pointer Club

Mark Copeland
Strategic Analysis

Freres Lumber Co. Inc.

Max Merlich
Columbia Helicopters Inc.

Loy Helmly
Black Butte Ranch

Georgie Nelson
Nelson Tree Farm

Dave Corkran
Mt. Hood Study Group

Env & Nat Resource Law Dept
Lewis and Clark College

John Scarborough
Olympic Forest Coalition

John Morgan
Ochoco Lumber Co.

Krista Thie
Longevity Herb Company

Mike Abbate'
Greenworks PC Landscape Architecture

Malcom Dick
American Forest Resource Council

Herbert Browne
Washington Native Plant Society

Michael Dianich
The Ptarmigans

Charles McTee
Glacier View Enterprises

Robert Marheine
Portland General Electric

Alex Brown
BARK

Carolyn Cox
NCAP

Emily Platt
Gifford Pinchot Task Force

Angela Crowley-Koch
Physicians For Social Responsibility

Arlene Brooks
WA State Director
Pacific NW Four Wheel Drive Assoc

George Wooten
Kettle Range Group

Peter Nichol
NW Ecosystem Alliance

Agencies

Aaron Shurtliff
Bonneville Power Administration

Peter Contreras and Elaine Somers
Environmental Protection Agency Region 10

Scott Robinson
Wash Dept of Nat. Res.

Darren Nienaber
Mason County Deputy Prosecutor

Steve McGonigal
Wash Nox Weed Board

Steve Acker
Olympic National Park

Al Carter
Grays Harbor County Commision

Wash. Dept. of Transportation

Marty Hudson
Klickitat Cty Nox. Weed Control Brd.

Speros K. Doulos
USDI-FWS Nat'l Fish Hatchery

Mary Ann Ducan-Cole
City of Stevenson

USDA, National Agricultural Library
USDI, Office of Environmental Policy and Compliance

County Weed Boards

Municipal Water Boards

Tribal Governments and Groups

Chehalis Confederated Tribes
Hoh Tribe
Jamestown S'Klallam Tribe
Lower Elwha S'Klallam Tribe
Makah Tribe
Port Gamble S'Klallam Tribe
Quileute Tribe
Quinault Nation
Puyallup Tribal Council
Shoalwater Bay Tribe
Skokomish Tribe
Squaxin Island Tribe
Suquamish Tribe
Nisqually Tribe
Point No Point Treaty Council
NW Indian Fisheries Commission

CHAPTER 5. REFERENCES, INDEX, ACRONYMS AND GLOSSARY

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5.2 Index

5.3 Acronyms

a.i. – Active ingredient
ACHP – Advisory Council on Historic Preservation
APHIS – Agricultural Plant Health and Insect Service
AQ – Aquatic
ATSDR – Agency for Toxic Substances and Disease Registry
ATV – All Terrain Vehicle
AWA – Administratively Withdrawn Areas
BCF – Bioconcentration factor
BEE – Butoxyethyl Ester

BIA – US Department of the Interior, Bureau of Indian Affairs
BLM – US Department of the Interior, Bureau of Land Management
BMP – Best Management Practices
BPA – Bonneville Power Administration
CAS – Chemical Abstract Service
CBI – Confidential Business Information
CE – Cumulative Effect
CFR – Code of Federal Regulations
CHU – Critical Habitat Unit
CTWS – Confederate Tribes of Warm Springs
CWA – Clean Water Act
DEIS – Draft Environmental Impact Statement
DEQ – Department of Environmental Quality
DPS – Distinct Population Segment
EDRR – Early Detection/ Rapid Response
EA – Environmental Assessment

EFH – Essential Fish Habitat
EIS – Environmental Impact Statement
ESU – Evolutionary Significant Unit
EO – Executive Order
EPA – Environmental Protection Agency
ESA – Endangered Species Act
FDA – US Food and Drug Administration
FEIS – Final Environmental Impact Statement
FEMAT – Forest Ecosystem Management Assessment Team
FHP – Forest Health Protection
FIRFA – Federal Insecticide, Fungicide, and Rodenticide Act
FSH – USDA Forest Service Handbook
FSM – Forest Service Manual
FWS – Fish and Wildlife Service
FY – Fiscal Year
GIS – Geographic Information Systems
GLEAMS – Groundwater Loading Effects of Agricultural Management
GMA – General Management Area
HQ – Hazard Quotient
ICBEMP – Interior Columbia Basin Ecosystem Management Project
IDT – Interdisciplinary Team
IWM – Integrated Weed Management
LFL – Likely to Cause a Trend to Federal Listing or Loss of Viability
LOAEL – Lowest-Observed-Adverse-Effect Level
LOC – Level of Concern
LSR – Late-Successional Reserve
MA-LAA – May Affect, Likely to Adversely Affect
MA-NLAA – May Affect, Not Likely to Adversely Affect
MI-NLFL – May Impact Individual, but Not Likely to Cause a Trend to Federal Listing or Loss of Viability
MIS – Management Indicator Species
MSDS – Materials Safety Data Sheet
NAA – Not Adversely Affected
NC – Nature Conservancy
NE – No Effect
NEPA – National Environmental Policy Act
NFMA – National Forest Management Act
NHPA – National Historic Preservation Act
NI – No Impact
NIS – Non-Ionic Surfactants
NLAA – Not Likely to Adversely Affect
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration, US Department of Commerce
NOEC – No Observable Effects Concentration
NOAEL – No-Observed-Adverse-Effect Level
NOEL – No-Observed-Effect-Level
NOI – Notice of Intent
NPE – Nonylphenol Polyethoxylate
NRF – Nesting, Roosting and Foraging Habitat
NRIS – National Resource Information System
NVUM – National Visitor Use Monitoring
NWFP – Northwest Forest Plan
ORV – Outstandingly Remarkable Values
OSHA – Occupational Safety and Health Administration
OSS – Oregon Slender salamander
PAYCO – Payments to Counties
PCE – Primary Constituent Elements
PDFs – Project Design Features
PIF – Partners in Flight
POEA – Polyethoxylated Tallow Amine
PPE – Personal Protective Equipment
PVT – Potential Vegetation Type
RfD – Reference Dose
R6 – USDA Forest Service, Pacific Northwest Region (Washington and Oregon)
ROD – Record of Decision
SERA – Syracuse Environmental Research Associates, Inc.
SHPO – State Historic Preservation Office
SMA – Special Management Area
SRI – Soil Resource Inventory
TCP – 3,5,6-Thrichloro-2-Pyridinol
TEA – Triethylamine
TES – Threatened, Endangered and Sensitive species
USDA Forest Service – United States Department of Agriculture Forest Service
USDI – United States Department of the Interior

5.4 Glossary

Active ingredient (a.i.) - In any pesticide product, the component (a chemical or biological substance) that kills or otherwise controls the target pests. Pesticides are regulated primarily on the basis of active ingredients. The remaining ingredients are called "inerts."
Acute effect - An adverse effect on any living organism in which severe symptoms develop rapidly and often subside after the exposure stops.
Acute exposure - A single exposure or multiple brief exposures occurring within a short time (e.g., 24 hours or less in humans). The classification of multiple brief exposures as "acute" is dependant on the life span of the organism. (See also, *chronic exposure* and *cumulative exposure*.)
Acute toxicity - Any harmful effect produced in an organism through an acute exposure to one or more chemicals.
Adaptation - Changes in an organism's physiological structure or function or habits that allow it to survive in new surroundings.
Adapted - How well organisms are physiologically or structurally suited for survival, growth, and resistance to pests and diseases in a particular environment.
Additive effect - A situation in which the combined effects of exposure to two chemicals simultaneously is equal to the sum of the effect of exposure to each chemical given alone. The effect most commonly observed when an organism is exposed to two chemicals together is an additive effect.
Adaptive management - A continuing process of action-based planning, monitoring, researching, evaluating, and adjusting with the objective of improving implementation and achieving the goals of the standards and guidelines.
Adjuvant(s) - Chemicals that are added to pesticide products to enhance the toxicity of the active ingredient or to make the active ingredient easier to handle or mix.
Administratively Withdrawn Areas (AWA) - Areas removed from the suitable timber base through agency direction and land management plans.
Adsorption - The tendency of one chemical to adhere to another material such as soil.
Aerobic - Life or processes that require, or are not destroyed by, the presence of oxygen. (See also, *anaerobic*.)
Affected Environment - Existing biological, physical, social, and economic conditions of an area subject to change, both directly and indirectly, as the result of a proposed human action.
Agent - Any substance, force, radiation, organism, or influence that affects the body. The effects may be beneficial or injurious.
Agency for Toxic Substances and Disease Registry (ATSDR) - Federal agency within the Public Health Service charged with carrying out the health-related analyses under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA).
Alien species - "With respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem" (Executive Order 13122, 2/3/99). (See also, *invasive*, *noxious*, and *weed species*.)
Allelopathy - The suppression of growth of one plant species due to the release of toxic substances by another plant.
Alluvial - Relating to clay, silt, sand, gravel, or similar detrital material deposited by flowing water. Alluvial deposits may occur after a heavy rain storm.
Ambient - Usual or surrounding conditions.

Amphibian - Any of a class of cold-blooded vertebrates (including frogs, toads, or salamanders) intermediate in many characteristics between fishes and reptiles and having gilled aquatic larvae and air-breathing adults.
Anadromous - Fish that spend their adult life in the sea but swim upriver to fresh water spawning grounds to reproduce.
Anaerobic - Life or process that occurs in, or is not destroyed by, the absence of oxygen. (See also, *aerobic*.)
Anions - Negatively charged ions in solution e.g., hydroxyl or OH- ion. (See also, *cations*.)
Annual - A plant that endures for not more than a year. A plant which completes its entire life cycle from germinating seedling to seed production and death within a year.
Annuity - Payment or receipt of a series of equal amounts at stated intervals for a specified number of time periods. An "annuity due" is a series of equal value outputs or inputs occurring for N equal time periods with "payments" made at the beginning of each period.
Anoxia - Literally, "without oxygen." A deficiency of oxygen reaching the tissues of the body especially of such severity as to result in permanent damage.
Aquatic Influence Zone – The inner half of a Riparian Reserve.
Aqueous - Describes a water-based solution or suspension.
Aquifer - An underground geological formation, or group of formations, containing usable amounts of groundwater that can supply wells and springs.
Arid - A terrestrial region lacking moisture, or a climate in which the rainfall is not sufficient to support the growth of most vegetation.
Background level - In pollution, the level of pollutants commonly present in ambient media (air, water, soil.)
Bacteria - Microscopic living organisms that metabolize organic matter in soil, water, or other environmental media. Some bacteria can also cause human, animal and plant health problems.
Basal application - In pesticides, the spreading of a chemical on stems or trunks of plants just above the soil line.
Base - Substances that (usually) liberate hydroxyl (OH-) anions when dissolved in water and weaken a strong acid.
Benchmark - A dose associated with a defined effect level or designated as a no effect level.
Benthic region - The bottom layer of a body of water.
Benthos - The plants and animals that inhabit the bottom layer of a water body.
Best Management Practices (BMP) - A practice or combination of practices determined by a state or an agency to be the most effective and practical means (technological, economic, and institutional) of controlling point and non-point source pollutants at levels compatible with environmental quality.
Bioaccumulation - The increase in concentration of a substance in living organisms as they take in contaminated air, water, or food because the substance is very slowly metabolized or excreted (often concentrating in the body fat.)
Bioassay - (1) To measure the effect of a substance, factor, or condition using living organisms. (2) A test to determine the toxicity of an agent to an organism.
Bioconcentration - The accumulation of a chemical in tissues of a fish or other organism to levels greater than in the surrounding water or environment.
Bioconcentration Factor (BCF) - The concentration of a compound in an aquatic organism divided by the concentration in the ambient water of the organism.
Biodegradability - Susceptibility of a substance to decomposition by microorganisms; specifically, the rate at which compounds may be chemically broken down by bacteria and/or natural environmental factors.
Biodiversity or biological diversity - The diversity of living things (species) and of life patterns and

processes (ecosystem structures and functions). Includes genetic diversity, ecosystem diversity, landscape and regional diversity, and biosphere diversity.
Biological control - The use of natural enemies, including invertebrate parasites and predators (usually insects, mites, and nematodes,) and plant pathogens to reduce populations of nonnative, invasive plants.
Biological magnification - The process whereby certain substances such as pesticides or heavy metals increase in concentration as they move up the food chain.
Biologically sensitive - A term used to identify a group of individuals who, because of their developmental stage or some other biological condition, are more susceptible than the general population to a chemical or biological agent in the environment.
Biomass - The amount of living matter.
Biota or Biome - All living organisms of a region or system.
Body Burden - The amount of a chemical stored in the body at a given time, especially a potential toxin in the body as the result of exposure.
Broadcast application - Herbicide treatment method generally used along roads; boom truck spray is directed at target species. Broadcast methods are used for larger infestations where spot treatments would not be effective.
Bryophytes - Plants of the phylum *Bryophyta*, including mosses, liverworts, and hornworts; characterized by the lack of true roots, stems, and leaves.
Buffer Zone - A strip of untreated land that separates a waterway or other environmentally sensitive area from an area being treated with pesticides.
Candidate species - Those plant and animal species that, in the opinion of the Fish and Wildlife Service (FWS) or National Oceanic and Atmospheric Administration (NOAA) Fisheries, may qualify for listing as “endangered” or “threatened.” The FWS recognizes two categories of candidates. Category 1 candidates are taxa for which the FWS has on file sufficient information to support proposals for listing. Category 2 candidates are taxa for which information available to the FWS indicates that proposing to list is possibly appropriate, but for which sufficient data are not currently available to support proposed rules.
Capillary fringe - The zone above the water table within which the soil or rock is saturated by water under less than atmospheric pressure.
Carcinogen - A chemical capable of inducing cancer.
Carrier - A non-pesticidal substance added to a commercial pesticide formulation to make it easier to handle or apply.
Chemical Abstracts Service (CAS) Registry Number - An assigned number used to identify a chemical. Chemical Abstracts Service is an organization that indexes information published in Chemical Abstracts by the American Chemical Society and that provides index guides to help locate information about particular substances in the abstracts. Sequentially assigned CAS numbers identify specific chemicals. The numbers have no chemical significance. The CAS number is a concise, unique means of chemical identification.
Cations - Positively charged ions in a solution. (See also, *anion*.)
Characteristic Landscape - The naturally established landscape within a scene or scenes being viewed.
Chemical Control - The use of naturally derived or synthetic chemicals called herbicides to eliminate or control the growth of invasive plants.
Chronic exposure - Exposures that extend over the average lifetime or for a significant fraction of the lifetime of the species (for a rat, chronic exposure is typically about two years). Chronic exposure studies are used to evaluate the carcinogenic potential of chemicals and other long-term health effects. (See also, *acute* and *cumulative exposure*.)
Chronic Reference Dose (RfD) - An estimate of a lifetime daily exposure level (in mg/kg/day) for the

human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. Chronic RfDs are specifically developed to be protective for long-term exposure to a compound (seven years to lifetime.)

Chronic toxicity - The ability of a substance or mixture of substances to cause harmful effects over an extended period, usually upon repeated or continuous exposure sometimes lasting for the entire life of the exposed organism.

Code of Federal Regulations (CFR) - Document that codifies all rules of the executive departments and agencies of the federal government. It is divided into fifty volumes, known as titles. Title 40 of the CFR (referenced as 40 CFR) lists all environmental regulations, including regulations for EPA pesticide programs (40 CFR Parts 150-189).

Competitive seeding - Treatment method; most effective after weed populations have been reduced by other control actions.

Congressionally Reserved Areas (CRA) - Areas that require Congressional enactment for their establishment, such as National Parks, Wild and Scenic Rivers, National Recreation Areas, National Monuments, and Wilderness. Also referred to as Congressional Reserves. Includes similar areas established by Executive Order, such as National Monuments.

Conifer - An order of the *Gymnospermae*, comprising a wide range of trees and a few shrubs, mostly evergreens that bear cones and have needle-shaped or scale-like leaves. Conifer timber is commercially identified as softwood.

Connected actions - Exposure to other chemical and biological agents, in addition to exposure to a specific pesticide formulation in a field application to control pest organisms.

Contaminants - For chemicals, impurities present in a commercial grade chemical. For biological agents, other agents that may be present in a commercial product.

Control - Means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions (Executive Order 13122, 2/3/99).

Cultural control - The establishment or maintenance of competitive vegetation, use of fertilizing, mulching, prescribed burning, or grazing animals to control or eliminate invasive plants.

Cumulative Effect (CE) - The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions—regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time (40 CFR 1508.7).

Cumulative exposure - Exposure resulting from one or more activities that are repeated over a period of time. (See also, *acute* and *chronic exposure*.)

Detritus - Loose fragments, particles, or grains formed by the disintegration of organic matter or rocks.

Discount - In economics, discounting is the process of carrying an end value backward in time at compound interest.

Distance Zones - Landscape areas denoted by specified distances from the observer. Used as a frame of reference in which to discuss landscape attributes or the scenic effect of human activities in a landscape.

Disturbance - An effect of a planned human management activity, or unplanned native or exotic agent or event that changes the state of a landscape element, landscape pattern, or regional composition.

Dosage/Dose - (1) The actual quantity of a chemical administered to an organism or to which it is exposed. (2) The amount of a substance that reaches a specific tissue (e.g. the liver). (3) The amount of a substance available for interaction with metabolic processes after crossing the outer boundary of an organism.

Dose Rate - In exposure assessment, dose per time unit (e.g. mg/day); also called dosage.
Dose Response - Changes in toxicological responses of an individual (such as alterations in severity of symptoms) or populations (such as alterations in incidence) that are related to changes in the dose of any given substance.
Drift - The portion of a sprayed chemical that is moved by wind off of a target site.
Emergent Vegetation - Plants growing out of or standing in water, in contrast to "submerged aquatic vegetation (SAV)," which grows entirely underneath the waters' surface.
Endangered Species - Any species listed in the *Federal Register* as being in danger of extinction throughout all, or a significant portion, of its range.
Endangered Species Act (ESA) - A law passed in 1973 to conserve species of wildlife and plants, determined by the Director of the U.S. Fish and Wildlife Service or the NOAA Fisheries to be endangered or threatened with extinction in all or a significant portion of its range. Among other measures, ESA requires all federal agencies to conserve these species and consult with the Fish and Wildlife Service or NOAA Fisheries on federal actions that may affect these species or their designated critical habitat.
Endemic - A species or other taxonomic group that is restricted to a particular geographic region due to factors such as isolation or response to soil or climatic conditions. (Compare to "*Indigenous*" and "*Native*.")
Environmental justice - Executive Order 12898 of February 11, 1994 requires federal agencies, to the greatest extent practicable and permitted by law, to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the commonwealth of the Mariana Islands.
Exposure assessment - The process of estimating the amount of contact with a chemical or biological agent that an individual or a population of organisms will receive from a pesticide application conducted under specific, stated circumstances.
Exotic – Non-native species; introduced from elsewhere, but not completely naturalized. (See also *alien* and *introduced species*.)
Extirpate - To destroy completely; wipe out.
Extrapolation - The use of a model to make estimates of values of a variable in an unobserved interval from values within an already observed interval.
Fauna - The animals of a specified region or time.
Federally listed species - Formally listed as a threatened or endangered species under the Endangered Species Act. Designations are made by the Fish and Wildlife Service or the National Marine Fisheries Service.
Federal Insecticide and Rodenticide Act (FIFRA) Pesticide Ingredient - An ingredient of a pesticide that must be registered with EPA under the Federal Insecticide, Fungicide, and Rodenticide Act. Products making pesticide claims must submit required information to EPA to register under FIFRA and may be subject to labeling and use requirements.
Fertilization - Treatment method involving adding of nutrients, which could improve the success of desirable species; may be limited, depending on species/soil characteristics.
Flora - Plant life, especially all the plants found in a particular country, region, or time regarded as a group. Also, a systematic set of descriptions of all the plants of a particular place or time.
Foaming - Hot foam is a mechanical method that is effective on seedlings and annuals and can be applied under certain weather conditions, including wind and light rain.
Food chain - A hierarchical sequence of organisms, each of which feeds on the next, lower member of the sequence.

Forage - Food for animals. In this document, term applies to both availability of plant material for wildlife and domestic livestock.
Formulation - A commercial preparation of a chemical including any inerts and/or contaminants.
Fungi - Molds, mildews, yeasts, mushrooms, and puffballs, a group of organisms that lack chlorophyll and therefore are not photosynthetic. They are usually non-mobile, filamentous, and multi-cellular.
Game fish - Species like trout, salmon, or bass, caught for sport. Many of them show more sensitivity to environmental change than non-game fish.
Grazing animals - Treatment method which requires matching the invasive species with the appropriate grazer for best success.
Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) – A model which displays herbicide concentrations in streams under a variety of conditions.
Groundwater - The supply of fresh water found beneath the Earth's surface, usually in aquifers, which often supply wells and springs.
Habitat - The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living.
Halftime or half-life - The time required for the concentration of the chemical to decrease by one-half.
Hand/Selective application- Herbicide treatment of individual plants through wicking, wiping, injecting stems, etc., with low likelihood of drift or delivery of herbicides away from treatment sites. This method ensures no herbicide directly contacts soil.
Hand-pulling/Grubbing - Treatment method which is labor-intensive but effective on single plants or on small, low-density infestations.
Hazard Quotient (HQ) - The ratio of the estimated level of exposure to a substance from a specific pesticide application to the RfD for that substance, or to some other index of acceptable exposure or toxicity. A HQ less than or equal to one is presumed to indicate an acceptably low level of risk for that specific application.
Hazard identification - The process of identifying the array of potential effects that an agent may induce in an exposed of humans or other organisms.
Herbaceous - A plant that does not develop persistent woody tissue above the ground (annual, biennial, or perennial.) Herbaceous vegetation includes grasses and grass-like vegetation, and broadleaved forbs.
Herbicide - A chemical preparation designed to kill plants, especially weeds, or to otherwise inhibit their growth.
Humus - Organic portion of the soil remaining after prolonged microbial decomposition.
Tribal and Treaty Rights - Native American treaty and other rights or interests recognized by treaties, statutes, laws, executive orders, or other government action, or federal court decisions.
Indian Tribe - Any American Indian or Alaska Native tribe, band, nation, pueblo, community, rancheria, colony, or group meeting the provisions of the Code of Federal Regulations Title 25, Section 83.7 (25 FR 83.7), or those recognized in statutes or treaties with the United States.
Indigenous - An indigenous species is any which were or are native or inherent to an area. (See also, *native*.)
Inerts - Anything other than the active ingredient in a pesticide product; not having pesticide properties.
Infested area - A contiguous area of land occupied by, in this case, invasive plant species. An infested area of land is defined by drawing a line around the actual perimeter of the infestation as defined by the canopy cover of the plants, excluding areas not infested. Generally, the smallest area of infestation mapped will be 1/10th (0.10) of an acre or 0.04 hectares.
Integrated Weed Management (IWM) - An interdisciplinary weed management approach for selecting methods for preventing, containing, and controlling noxious weeds in coordination with other

resource management activities to achieve optimum management goals and objectives.
Interdisciplinary Team (IDT) - A group of individuals with varying areas of specialty assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately analyze the problem and propose action.
Introduced species - An alien or exotic species that has been intentionally or unintentionally released into an area as a result of human activity. (See also *exotic, invasive, and noxious*.)
Introduction - “The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity” (Executive Order 13122, 2/3/99).
Invasive plant species - An alien plant species whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13122, 2/3/99). (See also *exotic* and *introduced species*.)
Irreversible effect - Effect characterized by the inability of the body to partially or fully repair injury caused by a toxic agent.
Irritant - Non-corrosive material that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact as a function of concentration or duration of exposure.
LC_{50} (Lethal Concentration$_{50}$) - A calculated concentration of a chemical in air or water to which exposure for a specific length of time is expected to cause death in 50 percent of a defined experimental animal population.
LD_{50} (Lethal Dose$_{50}$) - The dose of a chemical calculated to cause death in 50 percent of a defined experimental animal population over a specified observation period. The observation period is typically 14 days.
Label - All printed material attached to, or part of, the pesticide container.
Land allocation - Commitment of a given area of land or a resource to one or more specific uses (e.g. wilderness). In the Northwest Forest Plan, one of the seven allocations of Congressionally Withdrawn Areas, Late-Successional Reserves, Adaptive Management Areas, Managed Late-Successional Areas, Administratively Withdrawn Areas, Riparian Reserves, or Matrix.
Landscape - An area composed of interacting ecosystems that are repeated because of geology, land form, soils, climate, biota, and human influences throughout the area. Landscapes are generally of a size, shape, and pattern which is determined by interacting ecosystems.
Landscape Character - Particular attributes, qualities, and traits of a landscape that give it an image and make it identifiable or unique.
Landscape Setting - The context and environment in which a landscape is set; a landscape backdrop. It is the combination of land use, landform, and vegetation patterns that distinguish an area in appearance and character from other areas.
Leachate - Water that collects chemicals as it trickles through soil or other porous media containing the chemicals.
Leaching - The process by which chemicals on or in soil or other porous media are dissolved and carried away by water, or are moved into a lower layer of soil.
Level of Concern (LOC) - The concentration in media or some other estimate of exposure above which there may be effects.
Lichens - Complex thallophytic plants comprised of an alga and a fungus growing in symbiotic association on a solid surface (such as a rock.)
Littoral zone - (1) That portion of a body of fresh water extending from the shoreline lakeward to the limit of occupancy of rooted plants. (2) The strip of land along the shoreline between the high and low water levels.
Lowest-Observed-Adverse-Effect Level (LOAEL) - The lowest dose of a chemical in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed and control populations.

Manual Control - The use of any non-mechanized approach to control or eliminate invasive plants (i.e. hand-pulling, grubbing.)
Material Safety Data Sheet (MSDS) - A compilation of information required under the OSHA Communication Standard on the identity of hazardous chemicals, health and physical hazards, exposure limits, and precautions.
Mechanical Control - The use of any mechanized approach to control or eliminate invasive plants (i.e. mowing, weed whipping, hot foam.)
Microorganisms - A generic term for all organisms consisting only of a single cell, such as bacteria, viruses, protozoa and some fungi.
Minimum tool - Use of a weed treatment alternative that would accomplish management objectives and have the least impact on resources.
Mitigation measures - Modifications of actions taken to:

(1) avoid impacts by not taking a certain action or parts of an action;
(2) minimize impacts by limiting the degree or magnitude of the action and its implementation;
(3) rectify impacts by repairing, rehabilitating, or restoring the affected environment;
(4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or,
(5) compensate for impacts by replacing or providing substitute resources or environments.

Modification - A visual quality objective meaning human activities may dominate the characteristic landscape but must, at the same time, utilize naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.
Mollusks - Invertebrate animals (such as slugs, snails, clams, or squids) that have a soft, un-segmented body, usually enclosed in a calcareous shell; representatives found on National Forest System land include snails, slugs, and clams.
Monitoring - A process of collecting information to evaluate if objectives and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned.
Morbidity - Rate of disease, injury or illness.
Mowing - Invasive plant treatment method which is limited to level/gently-sloping smooth-surface terrain. Treatment timing is critical, and must be conducted for several consecutive years.
National Environmental Policy Act (NEPA) - An Act passed in 1969 to declare a national policy that encourages productive and enjoyable harmony between humankind and the environment, promotes efforts that prevent or eliminate damage to the environment and biosphere, stimulates the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and establishes a Council on Environmental Quality.
National Forest Management Act (NFMA) - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring preparation of Forest Plans and the preparation of regulations to guide that development.
National Marine Fisheries Service (NMFS) - The federal agency that is the listing authority for marine mammals and anadromous fish under the ESA.
National Pollutant Discharge Elimination System (NPDES) - As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.
National Visitor Use Monitoring (NVUM) - A permanent, ongoing sampling system which measures national forest visitor demographics, experiences, preferences, and impressions. A stratified random

sample is done for 25% of the National Forest system each year according to a national research protocol. NVUM responds to the need to better understand the use and importance of, and satisfaction with, national forest system recreation opportunities.

National Wilderness Preservation System (NWPS) - The Wilderness Act of 1964 established the national Wilderness Preservation System to ensure that certain federally owned areas in the United States would be preserved and protected in their natural condition. The Act defines a wilderness area, in part, as an area which generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable. Areas included in the system are administered for the use and enjoyment of the American people in such manner as to leave them unimpaired for future use and enjoyment as wilderness.

Native species - With respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem (Executive Order 13122, 2/3/99).

Naturalized - Applied to a species that originally was imported from another country but that now behaves like a native in that it maintains itself without further human intervention and has invaded native populations.

Non-local native - This term has two meanings: (1) a population of a native plant species which does not occur naturally in the local ecosystem and/or (2) plant material of a native species that does not originate from genetically local sources.

Non-target species - Any plant or animal that is not the intended organism to be controlled by a pesticide treatment.

No-Observed-Adverse-Effect level (NOAEL) - Exposure level at which there are no statistically or biological significant differences in the frequency or severity of any adverse effect in the exposed or control populations.

No-Observed-Effect-Level (NOEL) - Exposure level at which there are no statistically or biological significant differences in the frequency or severity of any effect in the exposed or control populations.

Not Likely to Adversely Affect (NLAA) - Determinations are applied to those species that had very little habitat on National Forests in Region Six, were not in habitats susceptible to invasive plants, or were known to tolerate herbicide treatments without effects.

Noxious weed - "Any living stage (including but not limited to, seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the United States, and can directly or indirectly injure crops, other useful plants, livestock, or poultry or other interests of agriculture, including irrigation, or navigation or the fish and wildlife resources of the United States or the public health" (Public Law 93-629, January 3, 1975, Federal Noxious Weed Act of 1974).

Outstandingly Remarkable Value (ORV) - A characteristic of rivers or sections of rivers in the national Wild and Scenic River System. In order for a river to be included in the system, it must possess at least one "outstandingly remarkable" value, such as scenic, recreational, geologic, fish, wildlife, historic, cultural, or other similar features. ORV's are values or opportunities in a river corridor which are directly related to the river and which are rare, unique, or exemplary from a regional or national perspective.

Partial Retention - A visual quality objective which in general means human activities may be evident but must remain subordinate to the characteristic landscape.

Pathogen - A living organism, typically a bacteria or virus, that causes adverse effects in another organism.

Percolation - Downward flow or filtering of water through pores or spaces in rock or soil.

Perennial - A plant species having a life span of more than two years.

Periphyton - Microscopic plants and animals that are firmly attached to solid surfaces under water such

as rocks, logs, pilings and other structures.
Persistence - Refers to the length of time a compound, once introduced into the environment, stays there.
Personal Protective Equipment (PPE) - Clothing and equipment worn by pesticide mixers, loaders and applicators and re-entry workers, hazmat emergency responders, workers cleaning up Superfund sites, et. al., which is worn to reduce their exposure to potentially hazardous chemicals and other pollutants.
Pest - An insect, rodent, nematode, fungus, weed or other form of terrestrial or aquatic plant or animal life that is classified as undesirable because it is injurious to health or the environment.
Pesticide - Any substance used for controlling, preventing, destroying, repelling, or mitigating any pest. Includes fungicides, herbicides, fumigants, insecticides, nematicides, rodenticides, desiccants, defoliants, plant growth regulators, etc.
Pesticide tolerance - The amount of pesticide residue allowed by law to remain in or on a harvested crop.
pH - The negative log of the hydrogen ion concentration. A high pH (greater than seven) is alkaline or basic and a low pH (less than seven) is acidic.
Population - A group of individuals of the same species in an area.
Population at Risk - A population subgroup that is more likely to be exposed to a chemical, or is more sensitive to the chemical, than is the general population.
Porosity - Degree to which soil, gravel, sediment, or rock is permeated with pores or cavities through which water or air can move.
Potable Water - Water that is considered safe for drinking and cooking.
Project Design Features/Features (PDC, PDF) - A set of implementation Design Features/features applied to projects to ensure that the project is done according to environmental standards and adverse effects are within the scope of those predicted in this Environmental Impact Statement.
Proposed species - Any plant or animal species that is proposed by the Fish and Wildlife Service or NOAA Fisheries in a *Federal Register* notice to be listed as threatened or endangered.
Potential Vegetation Type (PVT) - The term Potential Vegetation Type is used to represent the combination of species that could occupy the site in the absence of disturbance.
Protozoa - Single-celled, microorganisms without cell walls containing visibly evident nuclei and organelles. Most protozoa are free-living although many are parasitic.
Recreational Rivers - A classification within the national Wild and Scenic River System. Recreational rivers are those rivers, or sections of rivers, that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.
Reference Dose (RfD) - The RfD is a numerical estimate of a daily exposure to the human population, including sensitive subgroups such as children, that is not likely to cause harmful effects during a lifetime. RfDs are generally used for health effects that are thought to have a threshold or minimum dose for producing effects.
Registered Pesticides - Pesticide products which have been approved for the uses listed on the label.
Registration - Formal licensing with EPA of a new pesticide before it can be sold or distributed. Under the Federal Insecticide, Fungicide, and Rodenticide Act, EPA is responsible for registration (pre-market licensing) of pesticides on the basis of data demonstrating no unreasonable adverse effects on human health or the environment when applied according to approved label directions.
Restoration - Ecological restoration is the process of assisting the recovery and management of ecological integrity. Ecological integrity includes a critical range of variability in biodiversity, ecological processes and structures, regional and historical context, and sustainable cultural practices.

Retention - A visual quality objective which in general means human activities are not evident to the casual forest visitor.
Revegetation - The re-establishment of plants on a site. The term does not imply native or nonnative; does not imply that the site can ever support any other types of plants or species and is not at all concerned with how the site 'functions' as an ecosystem.
Riparian Area - A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it.
Riparian Reserves - Areas along live and intermittent streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving as dispersal habitat for certain terrestrial species.
Risk Assessment - An analytic process that is firmly based on scientific considerations, but also requires judgments to be made when the available information is incomplete. These judgments inevitably draw on both scientific and policy considerations.
Risk - The chance of an adverse or undesirable effect, often measured as a percentage.
Risk assessment - The qualitative and quantitative evaluation performed in an effort to estimate the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or biological agents.
Saturated zone - A subsurface area in which all pores and cracks are filled with water under pressure equal to or greater than that of the atmosphere.
Scenery Management - The art and science of arranging, planning, and designing landscape attributes relative to the appearance of places and expanses in outdoor settings.
Scenic - Of or relating to landscape scenery; pertaining to natural or natural-appearing scenery; constituting or affording pleasant views of natural landscape attributes or positive cultural elements.
Scenic Integrity - State of naturalness or, conversely, the state of disturbance created by human activities or alteration. Integrity is stated in degrees of deviation from the existing landscape character in a national forest.
Scenic Quality - The essential attributes of landscape that when viewed by people, elicit psychological and physiological benefits to individuals and to society in general.
Scenic Rivers - A classification within the national Wild and Scenic River System. Scenic rivers are those rivers, or sections of rivers, that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
Seen Area - The total landscape area observed based upon landform screening. Seen-areas may be divided into zones of immediate foreground, foreground, middleground, and background. Some landscapes are seldom seen by the public.
Sensitive species - Species identified by the Regional Forester for which population variability is a concern, as evidenced by significant current or predicted downward trend in population numbers or density; or significant current or predicted downward trends in habitat capability that would reduce a species existing distribution.
Sensitivity Level - A particular degree or measure of viewer interest in the scenic qualities of the landscape.
Species of Local Interest (SOLI) - Threatened, endangered and proposed species; Regional Forester's Sensitive species, management indicator species, and other rare or endemic species of concern.
Species - "A group of organisms, all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms." (Executive Order 13122, 2/3/99).
Spot application - Herbicide treatment involving use of a backpack sprayer or other means. Application is aimed at specific target species, with methods of prevention (such as barriers,) to control

damage to non-target species.
Standards and guidelines - The rules and limits governing actions, as well as the principles specifying the environmental conditions or levels to be achieved and maintained.
Sub-chronic exposure - An exposure duration that can last for different periods of time (5 to 90 days), with 90 days being the most common test duration for mammals. The sub-chronic study is usually performed in two species (rat and dog) by the route of intended use or exposure.
Sub-chronic toxicity - The ability of one or more substances to cause effects over periods from about 90 days but substantially less than the lifetime of the exposed organism. Sub-chronic toxicity only applies to relatively long-lived organisms such as mammals.
Submerged Aquatic Vegetation (SAV) - Vegetation that lives at or below the water surface; an important habitat for young fish and other aquatic organisms. In contrast to "emergent vegetation," which is growing out of or standing in water.
Substrate - With reference to enzymes, the chemical that the enzyme acts upon.
Surface water - All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors which are directly influenced by surface water.
Surfactant - A surface active agent; usually an organic compound whose molecules contain a hydrophilic group at one end and a lipophilic group at the other. Promotes solubility of a chemical, or lathering, or reduces surface tension of a solution.
Survey and Manage - Mitigation measure adopted as a set of standards and guidelines within the Northwest Forest Plan Record of Decision and replaced with standards and guidelines in 2001 (Record of Decision) intended to mitigate impacts of land management efforts on those species that are closely associated with Late-Successional or old-growth forests whose long-term persistence is a concern. This mitigation measure applies to all land allocations and requires land managers to take certain actions relative to species of plants and animals, particularly some amphibians, bryophytes, lichens, mollusks, vascular plants, fungi, and arthropods, which are rare or about which little is known. These actions include: (1) manage known sites; (2) survey prior to habitat-disturbing activities; and, (3) conduct extensive and general regional (strategic) surveys.
Synergistic effect - Situation in which the combined effects of exposure to two chemicals simultaneously is much greater than the sum of the effect of exposure to each chemical given alone.
Take - "The term 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." (Title 16, Chapter 35, Section 1532, Endangered Species Act of 1973)
Threatened species - Plant or animal species likely to become endangered throughout all, or a significant portion of, its range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.
Threshold - The maximum dose or concentration level of a chemical or biological agent that will not cause an effect in the organism.
Tolerances - Permissible residue levels for pesticides in raw agricultural produce and processed foods. Whenever a pesticide is registered for use on a food or a feed crop, a tolerance (or exemption from the tolerance requirement) must be established. EPA establishes the tolerance levels, which are enforced by the Food and Drug Administration and the Department of Agriculture.
Toxicity - The inherent ability of an agent to affect living organisms adversely. Toxicity is the degree to which a substance or mixture of substances can harm humans or animals.
Toxicology - The study of the nature, effects, and detection of poisons in living organisms. Also, substances that are otherwise harmless but prove toxic under particular conditions. The basic assumption of toxicology is that there is a relationship among the dose (amount), the concentration at the affected site, and the resulting effects.

Treatment Area - An infested area where weeds have been treated or retreated by an acceptable method for the specific objective of controlling their spread or reducing their density.

U.S. Fish and Wildlife Service (US FWS) - The federal agency that is the listing authority for species other than marine mammals and anadromous fish under the ESA.

U.S. Forest Service (USDA FS or USFS) - The federal agency responsible for management of the nation's National Forest lands.

Variety Class - A particular level of visual variety or diversity of landscape character.

Viability - Ability of a wildlife or plant population to maintain sufficient size to persist over time in spite of normal fluctuations in numbers, usually expressed as a probability of maintaining a specific population for a specified period.

Viable Population - A wildlife or plant population that contains an adequate number of reproductive individuals appropriately distributed on the planning area to ensure the long-term existence of the species.

Viewshed - Total visible area from a single observer position, or the total visible area from multiple observer position. Viewsheds are accumulated seen-areas from highways, trails, campgrounds, towns, cities, or other viewer locations. Examples are corridor, feature, or basin viewsheds.

Visual Absorption Capability - A classification system used to denote relative ability of a landscape to accept human alterations without loss of character of scenic quality.

Visual Quality Objective - A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

Well-distributed - Distribution sufficient to permit normal biological function and species interactions, considering life history characteristics of the species and the habitats for which it is specifically adapted.

Wetland - An area that is regularly saturated by surface or ground water and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include swamps, bogs, fens, marshes, and estuaries.

Wild and Scenic River System - The Wild and Scenic Rivers Act of 1968 established a system of selected rivers in the United States, which possess outstandingly remarkable values, to be preserved in free-flowing condition. Within the national system of rivers, three classifications define the general character of designated rivers: Wild, Scenic, and Recreational. Classifications reflect levels of development and natural conditions along a stretch of river. Classifications are used to help develop management goals for the river.

Wilderness - Areas designated by Congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or for a primitive and confined type of recreation; include at least 5,000 acres, or are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, educational, scenic, or historical value as well as ecological and geologic interest.

Wild Rivers - A classification within the national Wild and Scenic River System. Wild rivers are those rivers, or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted.