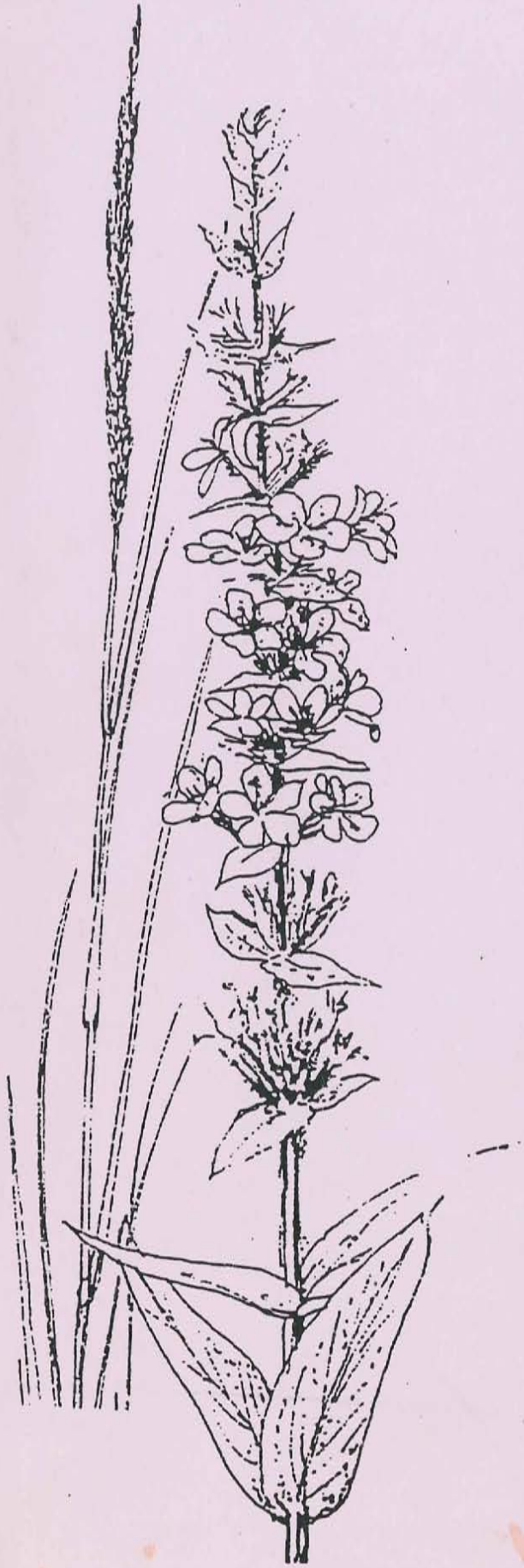

Final

NOXIOUS EMERGENT PLANT MANAGEMENT

ENVIRONMENTAL IMPACT STATEMENT

CO-LEAD AGENCIES:

Washington State Department of Agriculture
Washington State Department of Ecology
Washington State Department of Natural Resources
Washington State Department of Fisheries
Washington State Department of Wildlife
Washington State Noxious Weed Control Board

November 1993

NOXIOUS EMERGENT PLANT MANAGEMENT EIS

Agriculture • Ecology • Fisheries • Natural Resources • Wildlife • Noxious Weed Board

November 1993

Dear Reader:

Enclosed please find the Noxious Emergent Plant Management Environmental Impact Statement (EIS). Recognizing the potential for damage to wetland ecosystems from *Spartina*, purple loosestrife, and other noxious emergent plants, several agencies agreed to work together as co-leads to develop this EIS. As co-leads, the Washington State Departments of Agriculture, Ecology, Fisheries, Natural Resources, Wildlife, and the State Noxious Weed Control Board are responsible for its content.

Co-lead agency decisions related to noxious emergent vegetation will be guided by this document. Ecology, Fisheries, and Wildlife will use the EIS to decide if permits required for weed management activities should be issued, issued with conditions, or denied. Fisheries, Natural Resources, and Wildlife will refer to this EIS when managing noxious weeds on public lands. The EIS will also support Agriculture and the State Noxious Weed Control Board as they carry out their responsibilities for Washington State's Noxious Weed Program. Citizens participating in these efforts and local, federal, and other state agencies may also benefit from the information provided.

The EIS evaluates different alternatives for managing vegetation that is both "noxious" and "emergent"; its findings do not apply to other plants. Noxious is a legal designation for any plant that has been placed on the Washington State Noxious Weed List. Emergent refers to the type of plants commonly found in wetlands; they are rooted below water, but a portion of the plant extends above the water's surface.

Alternatives include Integrated Management (the preferred alternative), No Action, and exclusive use of either mechanical, physical, biological or chemical methods. Among the most important EIS findings are that impacts and effectiveness are highly variable depending on both the size of the area to be managed and site-specific characteristics, and that exclusive use of one method may not address this variability.

Integrated Management was determined to be the best alternative because it allows a manager to determine which method will cause the least environmental impacts, while providing the most effective control on a specific site. Specific information on many alternatives is limited, and control plans will need to be monitored as they are implemented. Control of noxious vegetation will involve a long-term commitment of time and resources with few quick fixes.

Given the inherent variability among sites and control methods, a programmatic EIS for all noxious emergent plants cannot provide the site-specific level of detail required for managing localized infestations. Therefore, the co-lead agencies believe that the most effective plans for managing these plants will be developed and implemented at the local level.

The EIS incorporates several appendices: a responsiveness summary of comments on the draft EIS; possible permit conditions in the form of mitigation measures proposed by Ecology, Fisheries and Wildlife; hypothetical plant management scenarios; a funding proposal for noxious emergent plant control; and a draft *Spartina* Work Plan. Additional appendices include the public comment letters and 12 technical reports on specific noxious weeds and management alternatives. These volumes should not be viewed as "stand alone" documents, because information in one document may modify information in another.

We, the Responsible Officials for this document, hope you find the EIS useful and informative.

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FACT SHEET

Project Title:	State of Washington Noxious Emergent Vegetation Management
Proposed Action:	Manage noxious emergent plant species, such as various species of cordgrass (*Spartina patens*, *Spartina alterniflora*, and *Spartina anglica*) and purple loosestrife (*Lythrum salicaria* and *Lythrum virgatum*). Garden loosestrife (*Lysimachia vulgaris*), giant hogweed (*Heracleum mantegazzianum*), and indigobush (*Amorpha fruticosa*) are also addressed, but to a lesser extent than the species noted above. The preference is to determine which alternative, or combination of alternatives, will be the most effective with the least environmental impacts. Also included in the proposed action are criteria for addressing infestations of other existing noxious species and new invaders.
Lead Agencies:	Washington State Departments of Agriculture, Ecology (nominal lead agency), Fisheries, Natural Resources, and Wildlife; and the Washington State Noxious Weed Control Board.
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Contact Person:	Mr. Steve Saunders, Washington State Department of Ecology, Water Quality Program

Licenses, Permits, and Approvals:

This list reflects approvals required by various plant management alternatives discussed in this document. Not all approvals listed below are required for all activities discussed herein. Requirements may change, so please check with resource agencies to determine requirements for a particular project.

Agriculture:
Pesticide applicator's license including an aquatics category endorsement, release permit for biological control organisms.

Ecology:
Temporary Modification of Water Quality Standards.

Fisheries:
Hydraulics Project Approval

Wildlife:
Hydraulics Project Approval; fish planting permit; access approval

Local:
Substantial Development Permit; Burning approval; approvals through local codes such as sensitive areas ordinances

Federal:
Section 10, Section 404 Corps of Engineers Permits; Permits to comply with the Coastal Zone Management Act; Approval from USFWS for compliance with the Endangered Species Act; coordination with the National Historic Preservation Act; Approvals from U.S. Department of Agriculture for biological control agents; compliance with the National Environmental Policy Act (NEPA);

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U.S. Fish and Wildlife Service: Fred Paveglio and Kevin Kilbride

Documents Incorporated by Reference:

1992, Washington State Department of Ecology, Final Supplemental Environmental Impact Statement and Responsiveness Summary, Aquatic Plants Management Program for Washington State, Mitigation Section. This document is housed at Department of Ecology Headquarters and Regional Offices and several libraries throughout Washington State. Contact Ms. Kari Rokstad, Ecology at (206) 407-6483, for more information.

Date of issue of EIS:

November 1993

EIS Availability:	Department of Ecology, Regional Libraries
Location of Background Data:	Department of Ecology, 300 Desmond Drive, Lacy, Washington, 98503
Cost:	No charge for document while copies are in stock. Once stock is depleted, a fee will be charged to cover copying costs.

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Included in bound EIS:

1. Agency Mitigation Measures
2. Simulated IWM Scenarios
3. Draft *Spartina* Work Plan
4. EPA Watershed Restoration Grant Proposal
5. Responsiveness Summary

Under separate cover:

A. *Spartina*: Distribution, Biology, and Ecology
B. Purple Loosestrife: Distribution, Biology, and Ecology
C. No Action: Efficacy and Impacts
D. Physical Control Methods: Efficacy and Impacts
E. Chemical Methods Only: Pesticide Characterization; and
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F. Chemical Methods Only: Human Health Effects of Glyphosate
G. Chemical Methods Only: Human Health Effects of 2,4-D
H. Biological Control Methods: Efficacy and Impacts
I. Integrated Weed Management Alternative for Managing Noxious Emergent Plants
J. Dotted and Garden Loosestrife, Giant Hogweed, and Indigobush: Distribution, Biology, and Ecology
K. Emergent Noxious Weed Control Final Reports:
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EXECUTIVE SUMMARY

The Washington State Departments of Agriculture, Ecology, Fisheries, Natural Resources, and Wildlife, along with the Washington State Noxious Weed Control Board, acting as co-lead agencies, have collaborated to explore management options and related environmental and social concerns for noxious emergent plant species in the State of Washington. Species of concern include three species of cordgrass or *Spartina* (*S. patens, S. alterniflora,* and *S. anglica*), purple loosestrife (*Lythrum salicaria*), garden loosestrife (*Lysimachia vulgaris)*, giant hogweed (*Heracleum mantegazzianum*), and indigobush (*Amorpha fruticosa*). These species are included on the Washington State Noxious Weed List (Chapter 16-750 WAC) because they are considered detrimental to the agricultural and/or natural environments of the state. Species were chosen to represent the variety of noxious emergent plants in Washington and any management plan for their control would also apply to most other emergent species not directly addressed here. The lead agencies seek to determine which management alternative or combination of alternatives would provide the most effective management of noxious emergent plants with the least environmental impacts. The information in this Environmental Impact Statement is extracted from technical reports (included as Appendices A-K) that are available for those wishing more detailed information. Some information has become available since the technical reports were written, and information sources are cited in the text of the document.

The co-lead agencies have determined that management of these noxious emergent plant species could have probable significant adverse impacts on the environment. Thus, an environmental impact statement (EIS) is required under RCW (Revised Code of Washington) 43.21C.030(2)(c). Six potential management alternatives are evaluated in this EIS: (1) No Action, (2) Physical Methods Only, (3) Mechanical Methods Only, (4) Biological Methods Only, (5) Chemical Methods Only, and (6) Integrated Weed Management (the Preferred Alternative). Potential efficacy, impacts, and mitigation measures are discussed for each alternative.

Little is known about efficacy, potential impacts, and mitigation opportunities associated with several of the control methods discussed in this EIS. Much of the available information is anecdotal or relates to limited studies, sometimes without adequate experimental design. Critical information needs have been identified for each alternative.

Under the **No Action Alternative**, noxious plant infestations would not be actively managed. Distribution and spread of noxious species would be governed by natural processes. Under this alternative, the agencies would continue to monitor noxious weeds on a regional basis and to participate in public outreach activities. Species would continue to be listed as noxious weeds, as required by state law. No action would violate state law in areas where control is required. The No Action Alternative would not regionally stabilize or decrease *Spartina* distributions within the next several decades. For example, aerial inventories conducted in Willapa Bay in the fall of 1992 show that there is now 36 percent more acreage covered by *Spartina* clones of at least 3 feet in diameter than there was in 1989. Clones less than 3 feet in diameter are not included in this estimate. Extensive *Spartina* infestations would significantly affect the physical, chemical, and biotic characteristics of estuarine environments. Potential negative impacts include colonization of large areas of tidal flats, accretion of sediments and topographic changes, displacement of native vegetation, and degradation of available habitat for many fish, wildlife, shellfish, shorebirds, waterfowl, and Endangered, Threatened, and sensitive plant and animal species. Positive impacts of the No Action Alternative include increased cover, foraging habitat, and nesting habitat for some animal species, and in a few areas, shoreline stabilization and reduction of nutrient input to estuaries. These potential benefits are relatively minor in comparison with possible adverse impacts.

Under the No Action Alternative, purple loosestrife would continue to spread, intensifying adverse impacts to the natural, agricultural, and built environments. Elements of the environment potentially affected include biota (including rare flora and fauna), sedimentation rates, water flows, agricultural irrigation, and economies of private and public sectors. These adverse impacts appear to outweigh the few apparent beneficial effects of infestations, which include aesthetics and honey production.

Similarly, there is no evidence that this alternative would result in the containment or stabilization of Washington infestations of garden loosestrife, giant hogweed, or indigobush. Despite lack of information on the biology and ecology of these species, infestations elsewhere in the world suggest these species might adversely affect physical, chemical, and biotic characteristics of wetland and riverine environments in Washington. Specific adverse impacts could include displacement of native plant and animal communities, increased threats to human health, increased rates of erosion and possible localized decreases in water quality or water quantity.

The **Physical Control Only Alternative** includes methods that primarily use hand labor or, in the cases of flooding or draining, control plants by changing the area's hydrology. Physical methods evaluated in this EIS include: digging, covering, dewatering/draining, flooding/inundating, and burning/flaming. Most physical control methods are labor intensive but are practical and effective in some situations, particularly with small isolated infestations or to prevent seed production and spread. Control methods vary in application practicality, depending on size of infestation, age of plants, topography, and proximity to agricultural, aquacultural, or built environments. Environmental impacts associated with physical methods include soil erosion, sediment mobilization, non-target species mortality, noxious plant dispersal, soil compaction, disruption of aquatic food webs, and safety of laborers. The severity of impacts is dependent both on the specific physical method chosen and size of area treated. For example, hand digging has few environmental impacts, while dewatering or flooding may result in significant impacts. Impacts associated with all physical methods would be expected to increase with the size of area treated. Depending on treatment method, many impacts can be mitigated by using appropriate procedures and materials and by carefully timing treatments. Two methods that may cause significant impacts that cannot be mitigated are de-watering or large-scale flooding.

The **Mechanical Methods Only Alternative** includes methods of eradicating or containing colonies, or suppressing seed production, using machines. Machines include tools with power sources other than human and range from hand-held brush cutters to tractors and barge-mounted dredges. Some methods that primarily use manual labor, such as crushing by foot, are also considered under this alternative. Mechanical control methods evaluated in this EIS include dredging, digging, plowing, rotovating, crushing, mowing, and harvesting. Significant impacts include noxious plant dispersal, soil compaction, sediment mobilization, non-target plant and animal mortality, increased water turbidity, and disruption of aquatic food webs. The extent of these impacts varies with treatment method and size of treatment area. Many impacts can be mitigated by using appropriate procedures and materials, and by carefully timing treatments. Plowing and rotovating are ineffective at killing plants and would likely result in enlargement of infestations, which cannot be practically mitigated. Harvesting does not halt infestation spread and requires a market for plant products, but could be beneficial as a method of controlling seed production. Digging, crushing, and/or mowing would be applicable in some situations for some species.

The **Biological Methods Only Alternative** involves the use of biologically based controls, such as pathogens, insects, livestock, genetic engineering, and competitive plant species to manage infestations of noxious species. A realistic goal of a biological control program is to reduce noxious species abundance to an acceptable level, rather than eradicate the species completely. The planthopper, *Prokelisia marginata*, holds promise for large-scale control of seed production in *Spartina alterniflora*, but 8 to 12 years might be necessary to complete testing and gain regulatory approvals. Potential insect agents for control of *S. anglica* and *S. patens* have not been investigated. Several insect species have been released in Washington for control of purple loosestrife. Direct grazing by domestic livestock could affect the health and vigor of *Spartina* and purple loosestrife infestations. However, sediments/soils, water quality, and non-target biota would all be negatively affected by livestock grazing. Although grazing with livestock could be an effective control method in monospecific stands of *Spartina*, it is not recommended because of associated adverse impacts that cannot be mitigated. Little information was found describing or evaluating potential biologically based controls for the other noxious plant species of concern.

The **Chemical Methods Only Alternative** focuses on the use of two herbicides: glyphosate and 2,4-dichlorophenoxyacetic acid (2,4-D). Rodeo® and Pondmaster®, manufactured by Monsanto Agricultural Company, are the only glyphosate formulations commercially available and registered for aquatic use in Washington state. In this document, glyphosate will refer to Rodeo® unless otherwise stated. Rodeo® must be used with a nonionic surfactant to help cover the plant and reduce the surface tension of spray droplets.

Glyphosate can be used for control of both *Spartina* and purple loosestrife. In several studies, glyphosate applications have had mixed effectiveness (0 to 100 percent) in controlling *Spartina*. The effect of tides washing glyphosate off of plants has been implicated as a main limiting factor in its efficacy in controlling *Spartina*. A recent study in Willapa Bay found no significant reduction in *Spartina* stem density when applied by helicopter using a 5 percent solution. However, the same concentration of Rodeo® (5 percent Rodeo®, 95 percent water/surfactant) applied with a hand-held wand resulted in an 84 percent reduction in *Spartina* stem density. Rodeo® is also the most effective herbicide for controlling purple loosestrife that has DOE approval for use in waters of Washington State.

Six formulations of 2,4-D are registered for use in freshwater systems in Washington State. Depending on the specific formulation, an adjuvant could be used with 2,4-D. 2,4-D has

been demonstrated as an effective tool to control purple loosestrife in wetland areas, but it is not used for *Spartina*. However, the Department of Ecology does not currently grant permits for use of 2,4-D formulations in waters of Washington State.

The potential impacts from use of glyphosate or 2,4-D result from the toxicity of the herbicides or from other factors, such as loss of vegetation, algal blooms, loss of oxygen in water, and erosion and sediment instability from loss of plant cover.

The magnitude of the toxic impacts depends on the concentration of the herbicide in the environment, the toxicity of the herbicide, and the extent to which humans, wildlife, and non-target plants could be exposed to the herbicide. Although no significant impacts from glyphosate are expected for wildlife and humans, there could be toxic effects on eelgrass and algae. Biodegradation and toxicity studies in fish, invertebrates, and mammals of the surfactants approved for use in Washington and chemicals similar to the surfactants indicate that the environmental concentrations of surfactants that would result from spraying are not expected to have significant adverse impacts to human health or the environment. If the herbicides are not applied appropriately, they could affect non-target vegetation. Furthermore, 2,4-D could have toxic effects on some mammals, birds, fish, and aquatic invertebrates, and the trace impurities in some 2,4-D formulations could have toxic impacts on human health and the environment. EPA is expected to decide this fall whether a special review of 2,4-D is warranted because some studies suggest a possible link between 2,4-D and cancer in humans. However, results of human health risk assessments indicate that the concentrations of glyphosate or 2,4-D to which the public could be exposed are expected to be below levels of concern.

The **Integrated Weed Management Alternative (IWM)**, which is the Preferred Alternative, focuses on the coordinated use of multiple preventive, biological, mechanical/physical, and chemical treatment methods to control, contain, reduce, and/or eradicate noxious plant species. IWM has been chosen as the Preferred Alternative because it is a comprehensive approach that combines a management process with the best components of the other alternatives. IWM is the most promising approach to regionally stabilize and decrease noxious weed distributions. IWM involves the deliberate selection, integration, and directed use of plant population suppression measures on the basis of predicted economic, environmental, and sociological consequences. When these measures are successfully applied, plant populations are prevented from attaining economically and/or environmentally

damaging densities. Management program activity is guided by appraisals of plant invasive status and damage potential. Preventing establishment of potentially new invaders is the top management priority. Prevention of seed production, containment, and reduction or eventual eradication of new invader and established invader populations are second and third priorities.

A generalized IWM program, including information acquisition, damage and action threshold establishment and use, treatment methods selection and implementation, and monitoring/evaluation, is presented. Site-specific management plan strategies, objectives, and treatment methods for potentially new, new, and established invaders are also discussed. Public participation in integrated management program development and implementation is an integral part of the IWM approach. In general, impacts due to implementation of IWM control methods would combine types of impacts from implementation of the individual methods, although some combinations of methods could have additional effects. By using a combination of methods, plants would be exposed to multiple stresses, and each control method could be used less frequently, resulting in a reduction in environmental impacts.

1.0 INTRODUCTION

This EIS is a result of six agencies working together to develop a statewide strategy for managing noxious emergent vegetation. The agencies that share co-lead status for this EIS are the State Departments of Agriculture, Ecology, Fisheries, Natural Resources, and Wildlife; and the State Noxious Weed Control Board. As co-leads, each of these agencies is responsible for the information presented in this EIS.

This chapter contains four main sections. In Section 1.1, the EIS scope is discussed. Various considerations regarding the implementation of this EIS are presented in Section 1.2. In Section 1.3, an overview of the responsibilities of the co-lead agencies is provided. In Section 1.4, a description of the organization of this document is presented.

1.1 EIS SCOPE

This EIS focuses on "noxious emergent" vegetation. The term "noxious weed" has legal definitions established by the federal government and by the State of Washington. In the amended federal Noxious Weed Act (Public Law 93-629), a noxious weed is defined as "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 or wildlife resources of the United States or the public health." In Washington, a noxious weed is defined as "any plant which when established is highly destructive, competitive, or difficult to control by cultural or chemical practices" (Chapter 17.10 RCW). Emergent plants are defined as plants that are "temporarily to permanently flooded at the base but do not tolerate prolonged inundation of the entire plant" (Cowardin, 1979) and plants adapted to grow with most of their leaf and stem tissue above the water surface (Kurtz 1989).

Noxious species appearing on the state list are categorized as either Class A, B, or C species, depending on their distribution within Washington. Class A species are of very limited distribution or are unrecorded in the state and pose a serious threat to the state. Class B species are of limited distribution or are unrecorded in a region of the state and pose a serious threat to that region. These may be too abundant in other regions for control to be

practical or realistic. In these regions where they do pose a serious threat, Class B species are designated for control. Class C species are any other noxious weeds, typically those that are widely established in the state and of special concern to a segment of the agricultural industry.

Washington State law (Chapter 17.10 RCW, Chapter 16-750 WAC) requires control of all Class A species in the counties where they occur, while the Washington State Noxious Weed Control Board (WSNWCB) mandates control of Class B species in designated regions (Class B-designate). County weed control boards/ districts may select and add to their noxious weed lists Class B species not designated by the WSNWCB for control in their counties. The weed control boards/districts also may include Class C species on their lists. When Class B non-designate and C species are included on county lists, control is required by state statutes.

Noxious emergent species specifically addressed in this EIS include various species of cordgrass (*Spartina patens, Spartina alterniflora,* and *Spartina anglica*) and purple loosestrife (*Lythrum salicaria* and *Lythrum virgatum*). Garden loosestrife (*Lysimachia vulgaris*), giant hogweed (*Heracleum mantegazzianum*), and indigobush (*Amorpha fruticosa*) are also specifically addressed, but to a lesser extent than cordgrass and purple loosestrife.

These species were chosen as representative of a range of noxious emergent species found in this state. *Spartina* and purple loosestrife are examples of noxious emergents with extensive infestations that currently pose serious and complex management problems. The other species are examples of noxious emergents that could, if not immediately and appropriately managed, eventually present problems similar to those presented by purple loosestrife and cordgrass. Our ultimate goal is to develop an overall management plan that will help us deal with infestations of existing extensive populations of noxious species and those that are relatively new invaders.

This EIS does not address other exotic invasives, such as salt cedar, russian olive, and reed canarygrass. Though these plants may cause problems in wetlands, they have not yet been officially designated as noxious. WSNWCB's listing process provides an opportunity, through a public hearing, for any person to ask that a plant be placed on the Noxious Weed List (only non-native plants may be formally designated as noxious).

The "Table of Contents" or "scope" of this EIS was determined both by the co-lead agencies and through a public scoping process. In addition to mailing the draft scope to interested parties, three public scoping meetings were held. Valuable input was provided by people attending meetings in Moses Lake, Bellevue, and South Bend, and by people who submitted written comments. Most comments received were incorporated into the Final Scope, which dictated the contents of this EIS.

Agencies have determined that the Preferred Alternative is Integrated Weed Management (IWM). Other alternatives evaluated include: No Action, Physical Methods Only, Mechanical Methods Only, Chemical Methods Only, and Biological Methods Only. IWM allows selection from among treatment methods included in the other alternatives to match the management requirements of a specific site. Treatment methods are chosen to maximize efficacy and to minimize negative environmental, economic, and social impacts. At an individual site, they can also be used in combinations not possible under other alternatives, permitting variation in environmental sensitivity within the site to be appropriately addressed. Unlike other alternatives, IWM includes a systematic process for establishing management goals and prioritizing activities on the basis of infestation type; prevention of weed introduction or infestation enlargement; determination of weed abundance thresholds used to dictate when management activities are required; infestation monitoring; and public involvement. IWM has been chosen as the Preferred Alternative because it is a comprehensive approach that combines a management process with the best components of the other alternatives.

1.2 IMPLEMENTATION

This section presents summary information regarding the implementation of this EIS. First, an explanation of how this SEPA document may be used to comply with SEPA requirements for localized planning efforts is provided. Next, economic considerations are briefly mentioned, recognizing that as plans become more specific and localized, economics will require further evaluation. A discussion of the rationale used to decide which of the more than 200 adjuvants would be addressed in this EIS is also provided, along with the Washington State Department of Ecology's position regarding the permitting of adjuvants that were not addressed in this EIS. Lastly, a description of the additional implementation information contained in Appendices 1 through 5 is presented.

1.2.1 State Environmental Policy Act (SEPA) Compliance

Any of the multiple SEPA options available are not precluded by this EIS, so the choice about how to proceed with SEPA compliance will be up to the SEPA lead agency. Possible SEPA actions include: taking no additional action; issuing an adopting, addendum, or supplemental; or making a new SEPA threshold determination. Deciding which avenue to take, given the number available, will require:

- Defining the proposal (what exactly is it that will be done?)
- Developing a good understanding of site specific characteristics
- Evaluating the needs of the public and implementing agencies
- Determining if the proposed action is different than that addressed in this EIS.

Because this EIS is designed to be used for actual implementation, agencies could choose to proceed without taking additional SEPA actions. This would not be legitimate if the proposed activity is different than those assessed in this EIS.

Though not necessarily essential, agencies may choose to adopt this EIS to satisfy SEPA requirements, public information needs, and/or other considerations. Other available choices include:

- Issuing a Supplemental EIS (particularly if the proposal or new information related to alternatives and/or impacts is significantly different than that addressed in this EIS)
- Making a new threshold determination independent of this EIS
- Issuing an addendum (addendums might be useful for providing information to interested parties about site specific characteristics)

The Washington State Department of Ecology (Ecology) has been using the 1980 Aquatic Plant Management EIS as supplemented in 1992, which is similar to this EIS, as the basis for permit decisions related to use of herbicides for aquatic plant control. Prior to making

decisions about issuing permits allowing herbicide use, Ecology adopts this Aquatic Plant Management EIS. Ecology has selected to use this mechanism for two reasons. If there is uncertainty about a requirement, we would rather err on the conservative site. Additionally, each adoption is noted in the SEPA register, which is one way to keep the public informed about our pending permit decisions. The Washington State Department of Natural Resources (DNR) follows the same adoption process as Ecology for all programmatic EISs.

Consistent with past practices, Ecology and DNR will most likely adopt this EIS for requests for permits allowing use of Rodeo® or 2,4-D to control noxious emergent vegetation. Other co-lead agencies are continuing to evaluate available options. Other agencies trying to decide how to fulfill SEPA requirements should review the SEPA rules (particularly WAC 197-11-600). Additional help with these decisions is available through Ecology's Environmental Review Section.

1.2.2 Economic Considerations

The co-lead agencies recognize that it is essential to factor cost into decisions. However, given the variables involved and that comparative costs need to be assessed at a local or site-specific level, a discussion of economic considerations was determined to be beyond the scope of this document. Obvious factors, such as equipment (including safety equipment), labor, and transportation should be included in any economic assessment. Less obvious, but just as important, are considerations such as cost of mitigation measures and/or monitoring, training, and values associated with resource damage or enhancement. It may also be important to recognize that labor costs may be offset by new employment opportunities offered by management alternatives, or special fund (grants or loans) available, especially in economically depressed counties.

1.2.3 Permitting of Adjuvants

Adjuvants (which include surfactants) may be used in conjunction with either 2,4-D or glyphosate. Due to time and money constraints, as well as difficulty in finding information regarding adjuvant use, only three non-ionic surfactants are evaluated in this EIS. As defined by WAC 15.58.030(37) "a spray adjuvant means any wetting agent, spreading agent, deposit builder, adhesive, emulsifying agent, deflocculating agent, water modifier, or similar agent with or without toxic properties of its own, intended to be used with any other

pesticide as an aid to the application or to the effect of the pesticide, and [that] is in a package or container separate from that of the pesticide with which it is to be used."

The Department of Agriculture has registered over 200 adjuvants. This process does not include an evaluation of toxicity, but does include a review to ensure that the principal functioning agent in the adjuvant is exempt from any food tolerance. Because adjuvants are not federally registered as pesticides, they do not normally undergo federal toxicity review as adjuvants. The pesticide and adjuvant label serves as the primary source for determination by the State Department of Agriculture of legal uses. Most adjuvant labels do not prohibit use in water. Although use in water may be consistent with the label, however, not all adjuvants would be allowed to be used in water. Adjuvant use would depend upon purpose/function, adjuvant and pesticide label recommendations, compatibility, and other considerations.

As noted elsewhere in this document, the Rodeo® label requires use of a non-ionic surfactant, but we do not know at this time if other adjuvants have been or might be proposed for use with Rodeo®. We have even less information about adjuvants used in conjunction with 2,4-D in aquatic situations. A brief review of 2,4-D labels for formulations allowed for use in or near water indicates that at least two types of adjuvants, thickeners and surfactants, are recommended. Fuel oil is among adjuvants recommended on some 2,4-D registration labels. However, WAC 16-230-635 limits use of oil-type carriers, emulsifiers and spreader stickers to use when not in excess of one pint per acre, provided that oil-type carriers in excess of one pint per acre may be used with invert systems and that invert systems may be used on aircraft by written permit only.

Ecology will continue to pursue information regarding use patterns and toxicity of adjuvants related to aquatic use of Rodeo® and 2,4-D. Until more information is available, only the three non-ionic surfactant evaluated in this document will be considered for permitting for use in conjunction with Rodeo® in aquatic situations. Decisions regarding additional requests for use of adjuvants will be made case by case based on available information.

Additional information may be available from product manufacturers, existing data bases, or other literature. For example, the Registry of Toxic Effects of Toxic Substances may contain toxicity data and references for, and/or the regulatory status of, the principal functioning agents contained in adjuvants. The Environmental Protection Agency's review of

inert toxicity may also be an information source, because some adjuvant functioning agents may also be used as inerts. Both of these examples, however, present labor intensive efforts that will most likely provide neither full-formulation or chronic toxicity information. Currently, funds and staff available for finding and analyzing additional information are limited, and these practical constraints may limit Ecology's ability to permit use of adjuvants not addressed in this EIS.

1.2.4 Additional Information

Additional information regarding the EIS implementation process is presented in Appendices 1 through 5, which are contained within this document.

Appendix 1 presents very specific mitigation language that agencies anticipate incorporating into permits as conditions, where appropriate and necessary. While this is a draft and partial description of possible permit conditions, it should help decision-makers incorporate logistical and/or monetary considerations into decisions.

Hypothetical scenarios that present simulated plant problems, along with IWM plans designed to manage these problems, are presented in Appendix 2. These scenarios may give people faced with real management problems a feel for IWM in action, allowing people to envision how the philosophy of IWM could be implemented.

A draft *Spartina* Work Plan (Appendix 3) suggests priorities and basic premises upon which more site specific plans could be based. Technical staff and local citizens may want to use this as a starting point for local plan development.

Appendix 4 is a project proposal for EPA watershed restoration grants. This proposal presents some very useful information about how to reduce costs of noxious weed control by employing the services of the Washington State Conservation Corps (WCC). WCC is well suited and organized to handle the hiring, supervision, and general administration associated with getting crews out into the field. Alternatively, crews can be hired directly through local job services offices and the implementing entity can assume responsibility for crew coordination and supervision.

Appendix 5 contains the public comments on the draft EIS and the responses of the authors to those comments. Attachment 1 to this appendix contains information on the status of 2,4-D reregistration studies. For those who want more information on noxious weed control, addresses and phone numbers of county extension agencies and noxious weed boards in Washington state are included in Attachment 2.

1.3 OVERVIEW OF AGENCY RESPONSIBILITY

A multi-agency alliance in Washington State was formed because of mutual interests in issues related to noxious emergent plant management. All agencies involved are concerned about the potential environmental and economic consequences of unmanaged emergent noxious weed populations. Agencies also want to ensure that the most effective and least environmentally damaging management alternative(s) will be used. In addition to these broad interests, each agency has specific regulatory or land management responsibilities related to various aspects of plant management, as discussed below.

The Department of Agriculture (Agriculture) is involved in quarantines to prevent noxious weed introductions, regulating and directly managing noxious weeds activities, and providing technical assistance and administering grants to others interested in noxious plant control. Agriculture is also responsible for licensing and training pesticide users; registering and reviewing pesticide labels; and enforcing laws and rules designed to prevent pesticide related environmental damage, crop damage, food contamination, public health problems, and other possible negative effects of mishandling pesticides.

Ecology is responsible for issuing short-term modifications (STMs) to the water quality standards. These would be required for management activities such as use of pesticides, or mechanical or other control methods that might cause excess turbidity or violate other provisions of the water quality standards. Ecology is also responsible for ensuring consistency of proposals with rules and regulations designed to protect groundwater, shorelands, wetlands, air quality, and other elements of the environment. As managers of the Padilla Bay National Estuary Research Reserve, Ecology is responsible for protecting natural estuarine ecosystems and preventing invasion of noxious weeds.

The Departments of Fisheries and Wildlife (Fisheries) share authority for administration of the State Hydraulic Code. Hydraulic Project Approval (HPA) is required for most

mechanical control methods (e.g., mowing, crushing, etc.), burning, bottom barriers, etc., used for control of noxious emergent vegetation. The use of chemicals, hand pulling, and small-scale hand-digging will generally not require an HPA. Driving on tidelands and other wetland areas to conduct operations, including chemical applications, will require an HPA. Fisheries also has substantive comment authority to other agencies for projects affecting aquatic resources. Wildlife regulates use of fish as biological control agents for plant management. Additionally, Wildlife may also directly participate in noxious emergent plant control on state-owned lands.

The Department of Natural Resources (Natural Resources) manages state owned beds and intertidal areas as a proprietor and natural resources trustee. Natural Resources is directed by the legislature to manage these lands and to provide a balance of public benefits. The responsibilities of the Department include the native biodiversity of the state, native wetland plant communities, important aquatic habitats such as kelp and eelgrass beds, non-vegetated tidal and mudflat systems, and Endangered, Threatened and Sensitive plant and animal species. To protect public lands and meet its legislative mandate, Natural Resources is interested in preventing aquatic lands from colonization by noxious plants.

The Washington State Noxious Weed Control Board (WSNWCB) determines, classifies, and adopts by rule the noxious weeds of the state. It also has other rule making authority under the state noxious weed law, including determining the monetary penalties for infractions of the state noxious weed law and defining management options for noxious weeds such as controlling, containing, eradicating, and preventing the spread of noxious weeds. Additionally, the WSNWCB conducts educational activities and coordinates weed control activities among agencies.

More specific information about the regulatory, advisory, and land management functions of the co-lead agencies relative to noxious weeds is provided in the Regulatory Authority section of this EIS (Chapter 5). This section also provides information about the functions of other state agencies, local governments, and federal agencies relative to noxious emergent plant management.

1.4 REPORT ORGANIZATION

Reviewed in this EIS, from a statewide perspective, are alternatives, impacts, and permit requirements related to noxious emergent plant management. The EIS is not designed to provide problem-specific management plans, but to establish a framework for local plan development and provide a basis for making informed decisions. When developing a noxious weed management strategy for a localized area, information in this document should be reviewed with site specific characteristics in mind. The remainder of this EIS is organized into four sections plus appendices.

The Existing Conditions section (Chapter 2) describes the existing natural environment and current distribution and status of *Spartina*, purple loosestrife, and miscellaneous species of concern in Washington State.

The Alternatives section (Chapter 3) provides a general description of the methods available for managing noxious emergent plants, with a focus on two major noxious weeds in the state: *Spartina* and purple loosestrife. Key to this section is a comprehensive discussion of Integrated Weed Management that includes an overview of the basic premises of this preferred alternative. Additional useful information, such as situations in which specific methods would have the greatest utility, and factors to consider when making decisions, is also provided.

Analysis of potential environmental impacts, and suggested methods for mitigating these impacts, can be found in the Impacts section (Chapter 4) of this EIS. Site specific characteristics, plant density, management-site size, and other factors will dictate the potential for and/or severity of impacts. A comparison must be made between area-specific management problems and the discussion of impacts provided in this section.

The Regulatory Authority section (Chapter 5) explains the conditions under which local, state, and federal laws may apply to alternatives assessed in this EIS. This discussion should help define which permits would be required for management alternative(s) being considered.

Two sets of appendices are also provided as part of this EIS. The first set of appendices are labeled numerically and are provided within this document. These appendices are intended

to help bridge general EIS guidance with development of site-specific Integrated Weed Management Plans.

The second set of appendices for this EIS are labeled alphabetically (Appendices A through L) and are published under separate cover. These appendices provide the detailed technical information upon which the majority of this EIS is based.

2.0 EXISTING CONDITIONS

This section describes the existing natural environment and current distribution and status of *Spartina* species, purple loosestrife, and miscellaneous species of concern (garden loosestrife, giant hogweed, and indigobush) in Washington State. The discussion of the natural environment in Washington is included to provide background on the environmental elements that are relevant to the efficacy, implementation, or impacts of various alternatives. Information for section 2.1 was summarized from Emergent Noxious Weed Control Final Reports (Appendix K). The characterizations of the species of concern are summarized from technical reports, which are included as Appendices A, B, and J.

2.1 SUMMARY OF THE NATURAL ENVIRONMENT IN WASHINGTON STATE

2.1.1 Climate

Because Washington is located on the windward coast in mid-latitudes, climatic elements combine to produce a predominantly marine-type climate west of the Cascades, and a combination of continental- and marine-type climate on the east side. Considering its northerly latitude, the climate of Washington is mild. The Pacific Ocean has a modifying effect on the climate, especially in western Washington, which results in less severe winters and cooler summers. Semipermanent pressure systems create a seasonal summer drought/winter rain precipitation regime, with the majority of the rainfall occurring between November and April. In western Washington, precipitation is usually in the form of rain, except at the higher elevations. East of the Cascade Mountains, winters are colder, summers are warmer, and there is generally less precipitation than in western Washington. However, some of the same elements that moderate the climate in western Washington keep most of eastern Washington from experiencing the extremes of a truly continental climate. As with western Washington, precipitation occurs mostly during the winter.

The varied terrain, the Pacific Ocean, and the semipermanent high and low pressure regions over the North Pacific have a strong influence on Washington's climate. The western and eastern slopes of the Olympic and Cascade mountain ranges create dramatic "rain shadow" effects where the uplift of air masses, induced by the presence of mountains, results in significant precipitation on the western slopes. The average annual precipitation on the

western slopes of the Olympic Mountains is well over 2.5 meters (m) (100 in.); on the eastern slopes the average annual precipitation is 50 centimeters (cm) (20 in.) or less. A similar pattern is found in the Cascades, where annual precipitation on the western slopes is about 2.5 m (100 in.), compared to less than 25 cm (10 in.) per year on the eastern slopes. The rain shadow of the Cascades results in the desert conditions of the Columbia Basin.

2.1.2 Geology/Topography

Washington state has a complex geology that has been strongly shaped by two major forces—volcanism (including seismic activity) and glaciation. Additionally, several distinctive landscape features (such as the Potholes and Channel Scablands) in the Columbia Plateau in eastern Washington have been formed by recurring floods. These floods were caused by repeated breaching of ice dams on the large glacial lakes that dominated the interior of the western United States during the glacial episodes. Although glaciation and volcanic activity have been the dominant factors in forming the Washington landscape, sedimentary and metamorphic rock are also abundant. The Coast Ranges and the Willapa Hills have extensive areas of sandstone/siltstone deposits and shale, as well as areas of basalt. Additionally, the North Cascades mountains are largely sedimentary. Landforms vary from high mountains to river valleys to lava plains, with elevation ranging from sea level to over 4200 m (14,000 feet [ft]).

2.1.3 Soils

The diverse development of soils in Washington is related to the geologic complexity of the state. Many of the soils are relatively young, and, therefore, poorly developed, due to the comparatively recent episodes of glaciation and volcanism. Soils are poorly developed in some mountainous parts of Washington. In these steep mountainous areas, soils are constantly moving downslope in response to gravity. Consequently, many steep slopes have only a thin soil horizon over bedrock or parent materials.

Many of the soils of Washington have developed in volcanic ejecta (i.e., lava, ash, pumice) or contain at least some ash and/or pumice. The level of volcanic influence is proportionate to the proximity of a site to volcanic activity, and, in the case of aerial-born ejecta, the distance from the source and the prevailing wind direction during eruption.

2.1.4 Hydric Soils

Hydric soils are those soils that are saturated, flooded, or ponded long enough in the growing season to develop anaerobic (reduced oxygen) conditions in the upper part of the soil profile. Anaerobic conditions affect the production, growth, and survival of plants. Hydric soils can form in areas of both glacial and volcanic origin and in any substrate type—from very fine to very coarse materials. Hydric soils can also consist of organic soils (peat and muck). Hydric soils are found in virtually every landscape within the state.

2.1.5 Wetlands

Wetlands are found throughout the Washington landscape in a variety of shapes and forms. Wetlands are relatively new features in the landscape. Perhaps the oldest existing wetlands are the peat systems (bogs and fens), which can date back to the last retreat of the glaciers (approximately 14,000 years ago). Wetlands in Washington contain native species that are adapted to the natural environment, including natural disturbances such as fire, floods, and seasonal and long-term drought. However, Washington wetlands are also vulnerable to invasion by non-native species. These non-native species are able to colonize wetlands that are unvegetated or only sparsely vegetated by native species and often displace native plants. Many soil types can support invasive hydrophytic ("water-loving") plant species. The hydrologic regime of a given wetland, rather than the substrate, is more critical in determining the susceptibility of a wetland to invasion.

2.1.6 Surface Water Movement

The variable terrain, combined with wet winters and summer drought, causes a highly variable regime of surface water movement. The surface water movement is also characterized by occasional catastrophic events such as scour, deposition, and flooding. The total annual discharge of small streams exceeds that of the larger river systems transecting Washington—a condition unusual among the physiographic regions of the United States. This condition can be attributed to: (1) diversion and pumping of surface and groundwater for agricultural and industrial uses, (2) extensive dam and catchment systems that have disrupted almost all of the larger streams and rivers, (3) increased evaporation by the creation of artificial impoundments in the dam and catchment systems, and (4) abundance of small coastal and lowland streams that are hydrologically isolated from large river systems.

2.1.7 Groundwater

Groundwater levels and movement vary widely in western Washington and are, therefore, difficult to characterize. Groundwater in eastern Washington is sometimes at or above the surface in irrigation influenced areas (such as the Potholes and wasteway areas) or as deep as hundreds of feet below ground surface. Many areas in eastern Washington that were formerly desert have become wetlands because of extensive irrigation. The hydrology regime of these wetlands is largely influenced by groundwater.

2.1.8 Water Quality

Water quality sampling in Washington indicates that streams and lakes east of the Cascades have higher pH and alkalinity values than streams and lakes west of the Cascades. Dissolved solids concentrations are lowest during high stream flows and highest during low flows in summer. Rivers in general have fecal coliform/fecal streptococci (intestinal bacteria) counts within the acceptable range. The Yakima and Puyallup rivers, however, have extremely high counts for these bacteria. In many parts of the state, waterbodies in agricultural areas have relatively high levels of nitrogen, phosphorus, and a variety of pesticides, including insecticides and herbicides. Western Washington rivers generally have higher sediment loadings than rivers in the eastern part of the state. Rivers in eastern Washington have greater water temperature variations.

Tidally influenced and marine waters have more static water quality parameters than do rivers and lakes. In Puget Sound, the surface temperature ranges from 7 to 13°C (45 to 55°F), whereas the deep water stays about 6°C (43°F) year-round. Temperature ranges along the Pacific Coast of Washington are similar to those of Puget Sound. Salinity in Puget Sound ranges from 20 to 30 parts per thousand (ppt). In brackish, tidally influenced estuaries, the salinity ranges from 20 to 30 ppt at the mouth to 0 ppt at the limit of the saltwater intrusion. Marine salinities range from 30 to 35 ppt. The tidal regime along the west coast of the United States is mixed semi-diurnal, which typically gives two high tides of unequal height and two low tides of unequal height per day. The time between high and low tides averages about 6 hours, with longer times for transitions between very high and very low tides. The lowest low daytime tides typically occur in the summer.

2.1.9 Air Quality

Air quality in Washington is highly variable depending upon the location and weather conditions. In the urbanized areas of Puget Sound, many areas are "nonattainment" areas (areas where the ambient air conditions do not meet or attain the standards set for a particular pollutant) for carbon monoxide, ozone, or particulates. The urbanized areas of eastern Washington are mainly in river valleys and are subject to seasonal inversions, resulting in nonattainment for several pollutants.

2.2 CHARACTERIZATION OF *SPARTINA* IN WASHINGTON

Where the noxious species of *Spartina* grasses occur in Washington, they are dominant members of the intertidal salt marsh community and usually form dense, monospecific stands. *Spartina* is well known for its aggressive abilities as a colonizer and the absence of natural biological controls has contributed to its rapid spread in Washington. Except *S.* x *townsendii*, the noxious species of *Spartina* present in Washington are capable of reproducing sexually. However, reproduction by seed has been documented only for populations of *S. alterniflora* in Willapa Bay and populations of *S. anglica* in Port Susan Bay. The formation of viable seeds can have profound implications for management of these noxious weeds, because seeds are more readily and widely dispersed than the plant fragments (underground stems) that are capable of establishing new plants. Prevention of seed set is typically achieved by treating plants before or during flowering, before seeds have formed. These species have been introduced by chance or intentionally into intertidal areas of Washington (Figure 1). In addition to noxious species of *Spartina*, there are two native species, *S. gracilis* and *S. pectinata*, in Washington. Both of these species occur in eastern Washington; *S. gracilis* in alkaline areas and *S. pectinata* in freshwater impounded and riparian wetlands. *Spartina pectinata* is a state-listed Sensitive plant species (WNHP 1990). In this EIS, references to *Spartina* are only the noxious, non-native species of the genus.

Spartina alterniflora was introduced into Willapa Bay in the late 1800s, presumably from its use as packing material in oyster shipments from the East Coast. Because Willapa Bay has extensive mud flats that are suitable for supporting *Spartina*, and because *S. alterniflora* is a better competitor than native salt marsh species in parts of the intertidal zone, this species has become well established in the area (Figure 1). *Spartina* in Willapa Bay represents the largest infestation of cordgrass in Washington. Current areal estimates range between 1,100

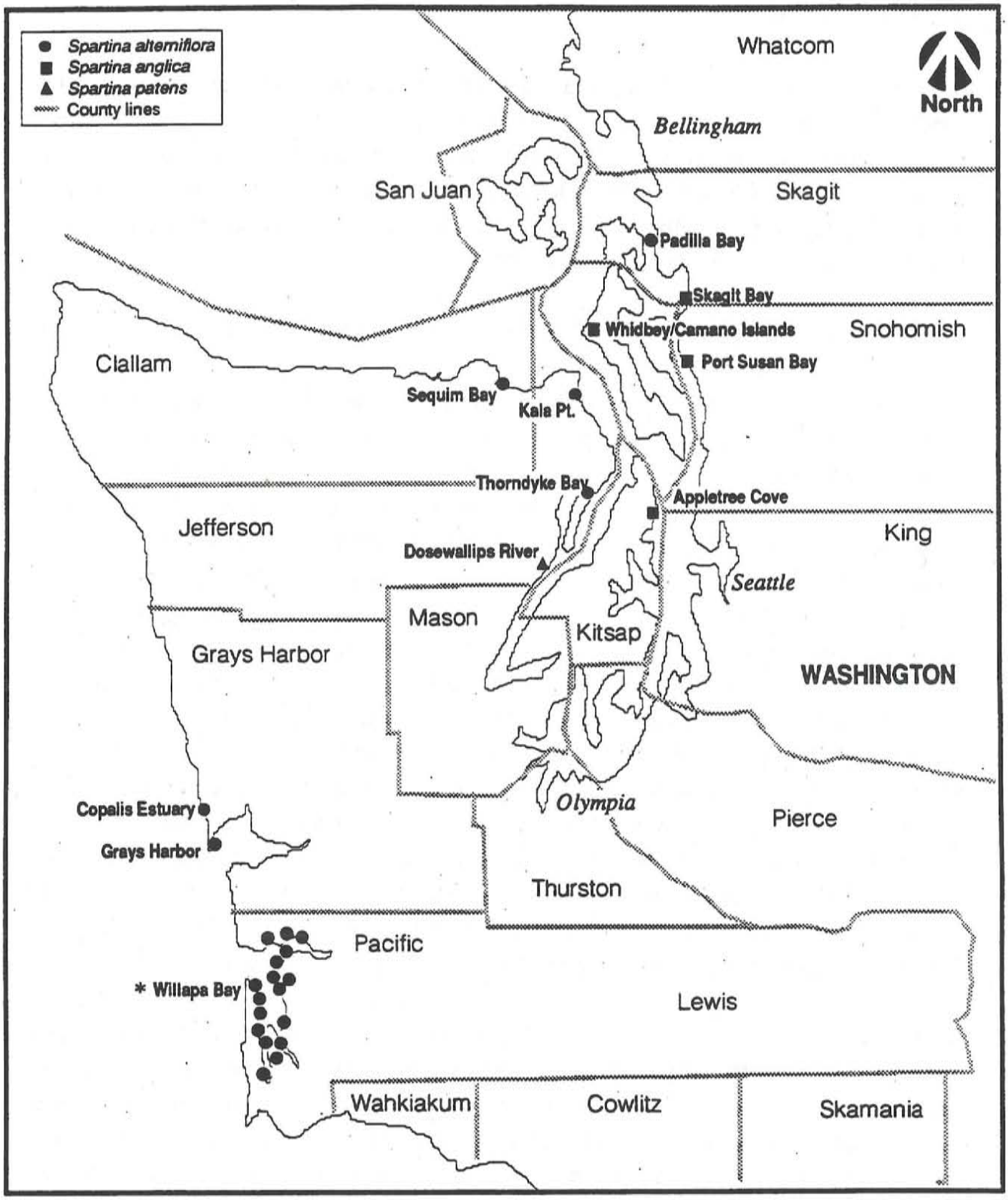

Figure 1. General locations of *Spartina* infestations in Washington. Areal estimates of infestations, if available, are given in text. Redrawn from Aberle (1990).

**Spartina alterniflora* is present throughout Willapa Bay.

acres (450 hectares [ha]) and 2,000 to 2,500 acres (810 to 1000 ha) (Sayce 1990). Substantially smaller populations of *S. alterniflora* are found in Padilla Bay, Grays Harbor, Copalis River Estuary, Thorndyke Bay, Kala Point, and Gibson Spit (Sequim Bay) Washington. *Spartina alterniflora* is listed as a Class B noxious weed in Washington. *Spartina* x *townsendii* is a sterile hybrid of *S. alterniflora* and *S. maritima*. *Spartina anglica* is the fertile form of the hybrid. These two species are often discussed collectively because they are practically indistinguishable in the field. It is uncertain which species, *S. anglica* or *S.* x *townsendii*, was originally planted in Washington. The original planting, which was intended to provide forage for cattle, occurred in 1961 on the east shore of Port Susan Bay (3 miles south of Stanwood). Although the original planting died back, the grass has since spread to other areas of Port Susan Bay and north into Skagit Bay. *Spartina anglica* or *S.* x *townsendii* is well established in Livingston Harbor, Washington. One or both of these species are also present at Camano Island, Deer Lagoon on Whidbey Island, Appletree Cove, and Skagit Bay. In Washington, *S. anglica* is listed as a Class B noxious weed.

The only occurrence of *S. patens* in Washington is a small infestation at Dosewallips State Park, at the mouth of the Dosewallips River where the river enters Hood Canal. This single patch has become the subject of recent eradication efforts. The only other known location of this species in the Pacific Northwest is in the Siuslaw Estuary of Oregon. This species is listed as a Class A noxious weed in Washington.

2.3 CHARACTERIZATION OF PURPLE LOOSESTRIFE IN WASHINGTON

First reports of purple loosestrife (*Lythrum salicaria*) establishment in the Pacific Northwest were from estuaries, suggesting that marine commerce was a primary factor in its introduction and spread. Purple loosestrife was first identified and documented in Washington in 1929 from the boggy margins of Lake Washington near the University of Washington campus and along the shores of Lake Sammamish. This species is now present throughout the state, including the Everett area, at the mouth of the Skagit River, Cowlitz County, Clarke Wahkiakum, and Pacific Counties along the Columbia River west of Bonneville Dam, and is particularly abundant in Grant and neighboring eastern Washington counties. Based on a tentative inventory, purple loosestrife occurs in at least 31 of 39 Washington counties. *Lythrum virgatum* (wand loosestrife) is another purple-flowered loosestrife that is morphologically similar to *L. salicaria*; both species have been referred to as purple loosestrife. However, it is uncertain if *L. virgatum* has naturalized in Washington.

These closely related species are both listed as noxious weeds in Washington because of their similar habitat requirements and because they are not easily distinguished from each other in the field. These species are listed as Class B noxious weeds in Washington.

Purple loosestrife appears to have no preference to substrate, provided that hydrology is adequate. Purple loosestrife is found in very course-grained sediments (sands and gravels); very fine-grained, dense mineral soils; and in organic soils. It appears to be colonizing more slowly in western Washington than in eastern Washington. This differential rate of spread could be due to the presence of more competitive and/or more abundant woody wetland species in western Washington, climatic differences, fertility of waters, or intraspecific variation.

The extensive irrigation canal system in eastern Washington (Winchester and Frenchman Hill Wasteways) has also facilitated this species' rapid spread. Wetlands of the Columbia River Basin were created in the 1950s by the Bureau of Reclamation irrigation project. These wetlands formed in ditches and along leaking irrigation canals. Wetlands also formed where the water table was significantly elevated (especially around the Potholes Reservoir). Wetland species were probably barely established in these newly created wetlands when purple loosestrife was first introduced to the Winchester Wasteway area in the 1960s, thereby providing the opportunity for relatively rapid invasion of purple loosestrife. Canals are currently being lined in some areas for purposes of water conservation, and this should result in elimination of created wetlands and purple loosestrife plants that inhabit them.

Monospecific stands of purple loosestrife occur in both eastern and western Washington, but appear to be more abundant in eastern Washington. This difference might be a function of the circumstances of the establishment of this plant in eastern Washington. The invasive populations in Washington's freshwater wetlands are likely to expand, primarily due to seed dispersal to suitable habitats via stormwater/surface water drainage systems and waterways.

2.4 MISCELLANEOUS SPECIES

In addition to the primary species of concern (*Spartina* spp. and purple loosestrife), three species of secondary concern were also considered during the EIS process: garden loosestrife, giant hogweed, and indigobush.

Garden loosestrife is native to Eurasia but has been cultivated occasionally in North America. In Washington, garden loosestrife has been observed in King County on the north, east, and west shores of Lake Sammamish and the north and south ends of Lake Washington. Garden loosestrife is currently listed as a Class B noxious weed in Washington.

Giant hogweed has been cultivated as an ornamental plant for many years. Its introduction into botanical gardens and other gardens throughout the world has presumably contributed to its increasing range. In Washington, the species is thought to have been introduced in the early 1950s. Giant hogweed has apparently been growing on Phantom Lake (Bellevue, Washington) for more than 40 years and was originally brought to that location by German emigrants. The species is now reported from Clallam, Clark, Island, King, Kitsap, Mason, Skagit, Thurston, and Whatcom counties. Single populations are known from Sequim, Clallam County; Potlatch, Mason County; Vancouver, Clark County; Coupeville, Island County; and Mt. Vernon, Skagit County. Multiple infestations are located in King County (Seattle area) and Thurston County (Olympia and Rainier). This species is classified as a Class A noxious weed in Washington.

Indigobush was not reported in the Pacific Northwest until the 1980s. In Washington, indigobush is invading native plant communities along the Columbia and Snake rivers and some of their tributaries from just above Central Ferry, Garfield County, to the western part of the Columbia River Gorge. This species is also present on both sides of the Columbia and Snake rivers, downstream of Central Ferry. It has been observed along Deadman and Meadow creeks near Central Ferry and upstream from Starbuck on the Tucannon River in Columbia County. It is also known from Mill Creek near Walla Walla, Walla Walla County. Other reports indicate it is located on Columbia River shores throughout the Columbia River Gorge and on the Columbia River from the Hanford Reach to the mouth of the Willamette River on the Oregon shore and to Wahkiakum County on the Washington shore. The species probably extends along the entire southern length of the Columbia River.

Indigobush is listed a Class B noxious weed because it spreads from planted areas into native plant communities.

3.0 ALTERNATIVES

To develop a management plan for noxious emergent plant species, it is necessary to determine which management alternative or combination of alternatives would provide the most effective management of these species with the fewest adverse environmental impacts. The management alternatives evaluated in this environmental impact statement (EIS) are: (1) No Action, (2) Physical Methods Only, (3) Mechanical Methods Only, (4) Biological Methods Only, (5) Chemical Methods Only, and (6) Integrated Weed Management (Preferred Alternative). Complete discussions of each alternative and extensive technical references can be found in the Technical Reports for each alternative. These technical reports are included in this EIS as Appendices A through K. The following section provides a brief description of the alternatives and the efficacy and impacts associated with each alternative. Tables summarizing the most practical applications, use constraints, and significant environmental impacts associated with each alternative are provided. A detailed discussion of impacts associated with the different alternatives and mitigation measures for these impacts is presented in Section 4.0 (Impacts Analysis).

3.1 NO ACTION ALTERNATIVE

3.1.1 Description of Alternative

Under the No Action Alternative, noxious plant infestations would not be actively managed—that is, there would be no organized intervention to control, contain, reduce, or eradicate infestations. Rather, the distribution and spread of noxious species would be controlled by natural processes. The efficacy of this alternative is closely tied to the efficacy of these natural processes. A complete discussion of the efficacy and impacts of this alternative is provided in Appendix C. Under this alternative, interested agencies would continue to monitor infestations of noxious weeds and participate in public outreach activities. Species would continue to be listed as noxious weeds, as required under state law. Public and private landowners who knowingly fail to control noxious weeds on their lands, where control is required, would be in noncompliance with state law (Chapter 17.10 RCW) and, in these cases, the No Action Alternative would not be an option.

3.1.2 *Spartina*

Spartina species are colonizing tidal flats and, in some areas, are displacing salt marsh and eelgrass communities. Potential impacts of *Spartina* colonization of native habitats are described in Section 4.1.1. It is unlikely that the No Action Alternative would result in the natural stabilization of *S. alterniflora*, *S. anglica*, or *S. patens* populations or distribution in Washington within the next several decades. Aerial inventories conducted in Willapa Bay in the fall of 1992 show that there is now 36 percent more acreage covered by *Spartina* clones of at least 3 feet in diameter than there was in 1989 (J. Civille, pers. comm. 1993). Since clones less than 3 feet in diameter were not included in the inventory, the actual increase in *Spartina* acreage could be larger.

It appears that the natural processes of dieback, plant competition, insect or animal herbivory, or plant pathogens would not stabilize or decrease populations of *Spartina* species. Even if these natural processes stabilize the vegetative spread of *Spartina* in some instances, the spread of these species to new locations by the transport of seed or vegetative propagule (a vegetative fragment capable of producing a new individual) would probably continue to occur. Although successful seedling establishment of *Spartina* has been shown to be variable in both natural and non-native populations, one successful reproductive season could increase *Spartina* distribution within a water body and contribute its spread to new locations.

As noted in Section 2.2, *S. alterniflora* extent in Willapa Bay represents the largest infestation of cordgrass in Washington. Current areal estimates range between 1,100 acres (450 ha) and 2,000 to 2,500 acres (810 to 1000 ha). One early estimate indicated that, if *Spartina* continued to spread unchecked, it would potentially cover 30,000 acres in Willapa Bay by the year 2030 (Sayce, 1988). Sayce now believes that potential habitat for the species is considerably more extensive, and that all of the intertidal zone in Willapa Bay is probably under threat (K. Sayce, pers. comm. 1993). The habitat suitable for *S. alterniflora*, *S. patens*, and *S. anglica* is abundant in intertidal areas throughout Washington, and includes the entire intertidal zone in many areas. Adoption of the No Action Alternative would result in the establishment of extensive colonies of these species.

Widespread *Spartina* infestations could significantly affect the physical, chemical, and biotic characteristics of estuarine environments. Potential impacts include colonization of large areas of tidal flats, displacement of native vegetation, changes in the topography and

elevation of intertidal areas due to sediment accretion, and changes in available habitat for fish, wildlife, and commercial and noncommercial shellfish.

3.1.3 Purple Loosestrife

Purple loosestrife is infesting natural, disturbed, and constructed freshwater wetland communities throughout Washington. Potential impacts of purple loosestrife infestation are described in Section 4.1.2. Under the No Action Alternative, it is unlikely that natural processes—such as natural dieback, insect or animal herbivory, or plant pathogens—would effectively stabilize or decrease purple loosestrife populations or distribution in Washington. At the local level, the areal extent of individual infestations would stabilize once all suitable habitat has been exploited. However, stabilized infestations can apparently undergo large population explosions if subjected to natural or human disturbance. Purple loosestrife's prolific production of seeds and vegetative propagules, combined with many opportunities for dispersal (natural or artificial drainage canals, highway corridors, riverine systems, boats, people, wildlife), would result in the spread of purple loosestrife to currently uninfested areas. The rate of spread of purple loosestrife in North America between 1940 and 1980 has been estimated to be relatively slow—approximately 1,160 km^2/year (381 mi^2/yr). Based on available information, the rate of spread would probably continue under the No Action Alternative.

The continued spread of purple loosestrife could adversely affect components of the natural and built (residential and commercial properties, parks, and public works developments) environments such as biota (including rare fauna and flora), sedimentation rates, water flows and hydrologic regimes, agricultural irrigation, and economies of private and public sectors.

3.1.4 Miscellaneous Species

There is scant information regarding the potential for natural stabilization and/or dieback of garden loosestrife, giant hogweed, and indigobush in Washington. The extent that natural processes stabilize or decrease existing infestations of these species at the local and regional levels in Washington has not been investigated. Potential impacts of colonization by these species are described in Section 4.1.3. Instances of dieback for giant hogweed or the other species are not mentioned in existing literature. For some of these species, the nature of the threat of infestation in Washington is unknown. These species have invaded wetland and/or

riparian plant communities in Washington and other parts of the world with temperate climates. Each of these species has colonized these habitats aggressively via seed and/or asexual reproduction. Abundant suitable habitat exists for each of these species in Washington, which suggests—if not managed—these species could become more widely distributed in the future. Infestations of these species could adversely affect native plant and animal communities, pose increased threats to human health (giant hogweed), increase erosional rates, and possibly cause localized decreases in water quality or quantity.

3.2 PHYSICAL METHODS ONLY

3.2.1 Description of Alternative

Physical control methods primarily include hand labor or hydrological alterations such as flooding or draining (see Appendix D). Physical control methods evaluated here include:

- Hand removal (hand digging and pulling)
- Covering
- Dewatering/draining
- Flooding/inundating
- Burning/flaming

Other physical methods were also considered, but rejected because of the high likelihood of adverse impacts that could not be mitigated. For example, the use of explosives for controlling *Spartina* and purple loosestrife infestations was considered to have unacceptably high potential for plant dispersal to new sites.

The listed control methods can be used singly or in combination with other methods. For example, covering is sometimes preceded by mowing to reduce biomass under the plastic fabric. Choice of treatment method might vary depending on management objectives. Some techniques, such as flaming, are used to control seed production, whereas others (e.g., covering) are designed to eradicate clumps or colonies of plants.

Physical control methods are discussed below. Methods and use limitations common to all species are discussed first, followed by discussions of issues specific to each species. The

most practical applications, use limitations, and significant environmental impacts of each control method are summarized for *Spartina* and purple loosestrife in Tables 1 and 2.

Hand removal: Hand removal by pulling or digging requires limited equipment, including shovels, hand clippers, and protective clothing. Hand pulling can also be done from boats. Bags, shoulder bags, wheelbarrows, hand carts, boats, barges, sleds and/or motorized vehicles might be required for transporting plants away from the treatment site. Many noxious emergent weeds are able to regrow from underground rhizomes and roots. Because of this, eradication efforts for these species require that all underground plant portions be removed. Disruption of soil and exposing bare soil through the digging process would open the site for seed germination for some species and could enhance the site for continued noxious weed infestation. Hand removal is a labor-intensive method that might be practical for eradicating small, young plants, but might be impractical for controlling larger plants with extensive root systems.

Covering: Plants cannot tolerate covering that blocks light from reaching their photosynthetic parts. In addition to light deprivation, covering can subject plants to toxic compounds because it alters soil chemistry by limiting oxygen availability to the surface of the soil. Covering methods typically use black geotextile fabric or black plastic to block light and smother plants. Cut vegetation and vegetable fiber mats, which eventually degrade, might also be used. Covering with soil could be effective, but would not be permitted in most areas.

Large black plastic sheets or geotextile fabric mats are easily made and are also used under highways, for lining landfills, and for landscaping projects. A typical geotextile fabric used for covering noxious weeds is Mirafi 700x, which is made of woven polypropylene and is sold in rolls that are 3.7 m (12 ft) wide. Covering is often preceded by mowing or burning to reduce biomass. Treatment areas should be monitored to ensure that tears in covers can be detected and repaired. At the conclusion of the treatment period, the covers must be removed (unless biodegraded) from all sites and disposed. The amount of time a site must remain covered to effect containment or eradication could vary and might need to be experimentally determined.

Dewatering/draining: There are few documented instances of dewatering/draining being used in areas occupied by the noxious species discussed here. Drainage of wet sites prevents

Table 1. Applications and major environmental impacts associated with physical methods for controlling *Spartina*. (Mitigation opportunities for impacts are described in Table 15).

Physical Control Method	Most Practical Applications	Use Constraints	Significant Environmental Impacts
Hand pulling or digging	Eradication of small, isolated clumps, seedlings, or sparse infestations	Labor-intensive; multiple treatments may be required; plants must be accessible by foot; pulling limited to seedlings small enought to pull	Loss of substrate affixed to roots; soil compaction
Covering	Eradication of small colonies	Labor-intensive over a large area; wind or waves may dislodge covers; monitoring during treatment required; biodegradable materials are preferred; non-biodegradable materials will require removal after use; covers may be buried by sediment	Desirable plants and infauna beneath covers impacted; soil compaction; cover fragments may entrap or be ingested by mammals and birds; hydrogen sulfide buildup may impact fauna; covers may be impossible to remove after burial by sediment
Dewatering/draining	Eradication of medium-sized colonies	Not practical for large areas or gradual slopes near sea level; difficulty in obtaining permits; efficacy unknown	Non-target plant and animal mortality; disruption of aquatic food webs; sediment mobilization; water turbidity increases; disturbances associated with construction
Flooding/inundating	Eradication of medium-sized colonies	Not practical; shoreline topography must be amenable; difficulty in obtaining permits	Mortality of most plants and animals in the treatment area; changes in sediment dynamics; disturbances associated with dike construction

Table 1. Continued.

Mechanical Control Method	Most Practical Applications	Use Constraints	Significant Environmental Impacts
Harvesting	Prevention or reduction of seed set	Requires market for products; could only be done where colony spread would not be problematic; should be conducted to augment control efforts and not to maximize yield.	Continued colony enlargement; dispersal of rhizomes and seeds (if done after seed set); non-target plant and animal mortality; soil and water resource degradation

Table 2. Applications and major environmental impacts associated with physical methods for controlling purple loosestrife. (Mitigation opportunities for impacts are described in Table 15).

Physical Control Method	Most Practical Applications	Use Constraints	Significant Environmental Impacts
Hand pulling or digging	Eradication of isolated plants or small, sparse infestations	Labor-intensive; multiple treatments might be required; plants must be readily accessible and old enough to be identified	Loss of substrate affixed to roots; increased potential for soil erosion; soil compaction; seed dispersal; exposure of bare soil where seeds could generate
Covering	Eradication of seedlings and reduction of older plant vigor in small, monospecific areas	Labor-intensive over a large area; treatment sites must be mowed or burned initially; wind or waves might dislodge covers	Non-target plant and animal mortality; soil compaction
Dewatering/draining	Eradication or reduction of young plant vigor in sparse infestations	Efficacy unknown; best during summer; not recommended for heavy infestations	Non-target plant and animal mortality; disruption of aquatic food webs; seed dispersal to new sites; enhanced seed germination; disturbances associated with dike construction
Flooding/inundating	Eradication of young plants	Not feasible in croplands or pastures; spring flooding most effective; several years might be necessary to kill older plants	Non-target plant and animal mortality; disturbances associated with dike construction; opportunities for purple loosestrife spread into flooded and disturbed soil sites
Burning/flaming	Controlled burning: large, continuous infestations; removal of accumulated biomass to prepare site for other control methods; Flaming: isolated plants, discontinuous patches; prevention or reduction of seed set	Spring burning most effective; effective only in drier sites	Non-target plant and animal mortality; temporary degradation of air quality; increased potential for soil erosion; enhanced conditions for seed germination

continued growth and survival of many wetland plants, particularly shallow-rooted species. Dewatering/draining control methods involve excavation of ditches and/or construction of dikes to exclude water from infested areas. Construction is typically done with heavy equipment. Water might also be diverted away from a site via drainage ditches or dikes. The amount of time a site must remain drained might vary from site to site. Dewatering/draining should be done during the summer, when plants would be subjected to greater water stress. The feasibility of this control method would depend greatly on the topography and hydrology of the treatment site.

Flooding/inundating: The noxious species discussed here cannot tolerate permanent inundation due to decreased oxygen availability to plant tissues. Dikes can be used to create impoundment areas and flood noxious weed infestations. An adequate water supply is required to maintain a flooded area at a depth damaging to the plant population; natural water sources can be supplemented with pumped water if necessary. Dikes should be constructed to be impermeable to water, to withstand storms and water movement, and to be readily removed once the treatment is completed. Polyvinyl chloride (plastic) liner, which is also used to line artificial ponds and some waste disposal sites, can be stretched along the slope of the earthen or rock dike to make the dike impermeable to water. The plastic must form a water-tight seal at the base of the dike, possibly by burying its lower edge in the mud or sand. A water control structure, such as a weir, could be used to regulate flows of water exiting the impoundment.

Burning/flaming: Burning uses fire to incinerate entire above-ground portions of plants or groups of plants in a self-sustaining fire. Burning is most appropriate for prevention or reduction of seed set. It also reduces biomass and could be used in conjunction with other control methods, such as covering. Burning is accomplished by igniting colonies. The most appropriate fuel for use in wetlands is propane. Other fuels, such as diesel, gasoline, or fuel oil might pollute the soil and water if not burned completely. During colony ignition, workers walk along the edge of the stand with a propane flamer, creating a line of fire. If sufficiently dry, stems and leaves of the noxious emergent weeds fuel the fire. Hay might be used to sustain burning between clumps of plants.

Flaming scorches or burns individual plants, and does not result in a self-sustaining fire. It is done with flamers that use propane fuel. Flaming is most appropriate for use on flowering

or pre-flowering plants to prevent seed production. Flames are directed at the upper portions of the mature plants, or it can also be used to kill or stress seedlings near the ground surface.

3.2.2 *Spartina*

Spartina species grow in saltmarshes located in the intertidal zone in several areas of Washington. The intertidal zone presents several challenges to controlling or eradicating these plants. *Spartina* species often grow on soft soils, which inhibits walking or using vehicles during implementation of control measures. They often occur in large infestations on nearly flat (shallow gradient) areas, making dewatering/draining or flooding/inundating impractical because of the large areas that would need to be treated. Daily tidal fluctuations wet the plants, making them difficult to burn, and the wave action can dislodge covering materials.

Hand removal: The efficacy of hand removal depends to a great degree on the diligence of the people implementing the method. Any portion of rhizome or root of *Spartina* left behind can potentially sprout and re-establish the clone. The amount of soil that would need to be dug out along with the plants to ensure complete removal of propagules increases dramatically with age and size of the plant. Seedlings, for example, can be pulled easily without taking much soil. Larger plants, however, can have underground parts extending as much as 1.2 m (4 ft) below the soil surface, and removing a one-square meter (10.8 ft^2) patch of *S. alterniflora* by digging might require removal of wet mud weighing more than 1 metric ton (1.1 ton).

Workers walking on soft substrates in *Spartina* marshes might use "mudluks," made from tire innertubes attached to a support, to increase surface area contact with the substrate. These make walking easier and minimize soil compaction. A canoe or hovercraft can also be used to avoid disturbing the soil.

Covering: Covering can be used as an effective method for eradicating small- to medium-sized patches of *Spartina*. Covers might need to remain in place for two growing seasons to eradicate plants. A frequent cause for covering attempts to fail is inadequate anchoring of the material. Torn or improperly sealed seams might allow plants to grow through the covers. Mowing to reduce biomass would not be necessary if covers are placed early in the growing season.

Dewatering/draining: Adequate drainage levels for plant eradication or control might need to be experimentally determined on a site-specific basis. Dewatering *Spartina* colonies would be impractical when they occur in large, flat intertidal areas. Effectiveness of this control method for *Spartina* eradication is not known. Dikes can be used to exclude water from an area.

Flooding/inundating: *Spartina* plants cannot tolerate permanent flooding and must be exposed for part of the day. In areas that are nearly flat, it would not be practical to flood *Spartina* colonies. However, small colonies can be flooded by sinking open-ended cylinders into fine sediments surrounding the plants. Water levels would be replenished at high tides. Care should be taken to ensure that *Spartina* plants do not colonize the margins of the inundated area and perpetuate the infestation.

Burning/flaming: Burning and flaming can stress *Spartina* plants and reduce chances of colony spread. However, effects may be temporary, and regrown *S. alterniflora* plants have greater stem density following burning. Burning does not kill *Spartina* because plants can resprout from rhizomes and roots buried in the sediment. *Spartina* stands are often resistant to sustaining a burn because of the daily wetting of vegetation and the presence of dried salt on above-ground parts. Dry litter for fueling the fire is generally not present. Thus, this control method might be feasible only at higher tidal elevations and at warm and dry times of the year, when plants would dry more thoroughly between tidal cycles. Wetting would not interfere with flaming, which could be a useful method for preventing seed production.

3.2.3 Purple Loosestrife

Purple loosestrife grows primarily in moist or saturated soils, but occasionally is found in drier sites. It grows in cattail marshes, sedge meadows, bogs, and along stream and river banks, lake shores, and on alluvial floodplains. Because of the broad range of hydrological, ecological, and topographical settings it can infest, suitable control measures vary widely from site to site. Methods that result in plant fragmentation or seed dispersal might contribute to spreading the infestation and have a net negative impact.

Hand removal: Hand extraction of purple loosestrife in isolated, newly or lightly infested sites is feasible; however, it is not cost effective in heavily infested sites. It is highly unlikely that a single pulling would completely remove purple loosestrife from a site. The

entire rootstock must be pulled because regeneration from root or stem fragments is possible. Plants older than one year are usually firmly rooted and are, thus, unlikely to be hand pulled successfully. Hand pulling operations might be more effective after mid-July or early August, when seedlings are large enough to be detected amongst other vegetation.

Covering: The utility of this technique for managing purple loosestrife has not been fully ascertained. Monospecific stands of seedlings are probably most amenable to control by this method. Covering plants with black plastic for 5 months would kill seedlings and diminish regrowth from established rootstocks, but most older plants would not be killed. Seeds occurring in the soil probably would not be adversely affected by covering. Once exposed to light and moisture, germination would occur, and in the absence of competition from other vegetation, dense stands of purple loosestrife seedlings might develop. To preclude purple loosestrife seedling development, sites should be covered with plastic during early spring (April to May). To kill standing vegetation, covering should be established in the spring, before plants get too large, and be continuous for one to two years. Alternatively, covering plants during July and August would achieve some control of seedlings and established plants.

Dewatering/draining: There are no documented instances of this method being used against purple loosestrife. Bottom sediments laden with purple loosestrife seeds would become exposed and germination, seedling development, and establishment of a dense infestation would occur. This has been observed where natural water reductions or human-generated drawdowns of wetland sites occur. Consequently, drainage should not be used in sites already heavily infested by purple loosestrife. In addition, not all purple loosestrife plants might succumb to dewatering, especially larger plants. If this method is employed, drainage should be conducted during the summer, when temperatures are high and rainfall is diminished.

Flooding/inundating: The efficacy of flooding to reduce purple loosestrife density would depend upon the amount of time a site is flooded and the age structure of the population. First-year plants would be most susceptible to flooding treatments. The water depth necessary to kill most established purple loosestrife plants has not been determined. Purple loosestrife seeds are relatively unaffected by submersion and might even be dispersed to new sites by flood water. Spring flooding of a purple loosestrife-infested site is preferable

because seed germination would be inhibited and shoot regrowth from established rootstocks would be diminished or possibly prevented.

Burning/flaming: Fire might be of some value in the management of purple loosestrife, although its roots occur several centimeters beneath the soil surface and are protected from the heat generated by a surface fire. Thus, burning would not eradicate an infestation although it may stress plants or prevent seed production. Flaming individual, actively growing plants might achieve a control level comparable to that produced by mowing. Fire can be used to remove the dried, woody stems that remain attached to the perennial root crown to enhance habitat utilization by other wetland plants and animals. However, burning or flaming might stimulate shoot regrowth from root crowns of established plants. In addition, blackened soils in burned areas warm earlier in the season and purple loosestrife seed germination might be improved at such sites. Purple loosestrife is negatively affected by fire only if it is burned during the spring. Further assessment of the technique is required.

3.2.4 Miscellaneous Species

Physical methods for controlling or eradicating garden loosestrife, indigobush, and giant hogweed are poorly understood. Many of the physical control methods discussed above for *Spartina* and purple loosestrife would be appropriate and effective in control or eradication efforts, but few specific data are available for their use on these species. No information is available on physical control methods for use on indigobush or garden loosestrife.

Some physical control methods have been used on giant hogweed. Digging might destroy the plant, but care must be taken to remove much of the rootstalk. To kill giant hogweed, it must be cut at 8 to 10 cm (3.2 to 4 in.) below ground level and removed. Control by digging is most effective early in the spring, when plants are actively growing and are still small. Seed longevity in the field is not known, however, seeds do survive in the soil for some length of time. Following eradication of growing plants, seeds could germinate and reinfest the area.

3.3 Mechanical Methods Only

3.3.1 Description of Alternative

The Mechanical Control Only Alternative includes methods of eradicating or containing colonies, or suppressing seed production, using machines. Machines include tools with power sources other than human and range from hand-held brush cutters to tractors and barge-mounted dredges. Some methods that are primarily manual, such as crushing by foot, are considered under this alternative. For a complete discussion of the efficacy and impacts associated with this alternative, see Appendix K. Mechanical control methods evaluated here include:

- Dredging
- Digging
- Plowing
- Rotovating
- Crushing
- Mowing
- Harvesting

Mechanical control methods are discussed below. Methods and use limitations common to all species are discussed first, followed by discussions of issues specific to each species. The most practical applications, use limitations, and significant environmental impacts of each control method are summarized for *Spartina* and purple loosestrife in Tables 3 and 4.

Dredging: Dredging is a large scale operation that alters underwater topography. Dredging could be used to remove entire plants and accreted sediments, in or along navigable waterways. Two types of dredges, the suction/pipeline dredge and the clamshell bucket dredge, would be effective for removing noxious emergent weeds. The suction/pipeline dredge has a cutting head that chews up the weeds, their root mass, and surrounding sediments, which are then suctioned up and transported through a pipeline to a disposal area. The diked disposal area acts as a settling pond and could be located on nearby uplands. Sediment and some plant material settles out and floating plant fragments can be trapped at the outlet weir where water returns to the waterway. Placement and design of a diked disposal area involves many steps requiring studies of material to be dredged and conditions

Table 3. Applications and major environmental impacts associated with mechanical methods for controlling *Spartina*. (Mitigation opportunities for impacts are described in Table 15.)

Mechanical Control Method	Most Practical Applications	Use Constraints	Significant Environmental Impacts
Dredging	Eradication of large monotypic infestations where sediment accretion has destroyed navigable channels	Must be accessible from water	Infauna and benthic organism mortality; sediment mobilization; increase in water turbidity; rhizome dispersal
Digging	Eradication of small monotypic colonies where sediment has accreted	Must be accessible from shore; might not be possible on soft sediments	Infauna and benthic organism mortality; sediment mobilization; increase in water turbidity; soil compaction; rhizome dispersal
Plowing	Not recommended	Not recommended	Dispersal of rhizomes and seeds
Rotovating	Not recommended	Not recommended	Dispersal of rhizomes and seeds
Crushing	Prevention or reduction of seed set; delay of expansion of small to large monotypic colonies	Multiple treatments required for eradication; crushing by foot should be limited to small clones, whereas mechanical crushers can be used for large clones; heavy machinery not appropriated for use in soft substrates;labor intensive if done by foot; treatment should be done early in the growing season	Soil compaction; sediment mobilization; non-target plant and animal mortality; seed (if done after seed set) dispersal
Mowing	Prevention or reduction of seed set; delay of expansion of small to large monotypic colonies	Multiple treatments required to kill plants; labor intensive if hand-held equipment used; treatment before seed set	Soil compaction; sediment mobilization; non-target plant and animal mortality; rhizome or seed (if done after seed set) dispersal
Harvesting	Prevention or reduction of seed set	Requires market for products; could only be done where colony spread would not be problematic; should be conducted to augment control efforts and not to maximize yield.	Continued colony enlargement; dispersal of rhizomes and seeds (if done after seed set); non-target plant and animal mortality; soil and water resource degradation

Table 4. Applications and major environmental impacts associated with mechanical methods for controlling purple loosestrife. (Mitigation opportunities for impacts are summarized in Table 15).

Mechanical Control Method	Most Practical Applications	Use Constraints	Significant Environmental Impacts
Dredging	Not possible or not recommended	Not recommended	Not recommended
Digging	Not recommended	Not recommended	Dispersal of seeds and vegetative propagules; infauna and benthic organism mortality; sediment mobilization; increase in water turbidity; soil compaction
Plowing	Not recommended	Not recommended	Dispersal of seeds and vegetative propagules; not effective
Rotovating	Not recommended	Not recommended	Dispersal of seeds and vegetative propagules; not effective
Crushing	Prevention or reduction of seed set; delay of infestation expansion	Multiple treatments required for eradication and possibly for prevention of seed set; stem fragments might be difficult to remove	Dispersal of seeds and vegetative propagules; soil compaction; non-target plant and animal mortality
Mowing	Prevention or reduction of seed set; delay of infestation expansion	Multiple treatments required for eradication and possibly for prevention of seed set; labor intensive if hand-held equipment used; stem fragments might be difficult to remove	Dispersal of seeds and vegetative propagules; soil compaction; sediment mobilization; non-target plant and animal mortality
Harvesting	Not recommended	Not recommended, no known market	Not recommended

at the disposal site. Clamshell dredges are mounted on barges that can be maneuvered in relatively shallow water. The clamshell is suspended from a crane and consists of a two-sided, hinged bucket that bites into the material to be dredged. The dredged material is released into another floating vessel and transported away from the site. This material might subsequently be transported by truck to an upland disposal site. Clamshell dredges have seals that minimize the amount of dredged material that escapes into the water column as the bucket is pulled to the surface.

Digging: Digging machines considered here are heavy equipment vehicles: backhoes and bulldozers in combination with a front loader. These can only be used in areas that can be approached from adjacent uplands. Temporary roads (which could be removed following treatment) could be built to provide access to treatment sites. This treatment method would not be practical in some areas with soft soils.

Plowing: Plowing severely damages plants but leaves plant fragments and sediments in place. A tractor and plow would be used to turn over plants and soil to a depth dependent on the size of the plow. A plow would cut up stems and roots, expose some of the root structure, partially bury the above-ground portions of the weeds and disturb the sediments, leaving mounds and furrows.

Rotovating: Rotovation is the process of using a large machine to till up to approximately 20 cm (8 in.) below the surface of bottom sediments, dislodging stems and roots of target plants. The sediment is thoroughly broken up and mixed by a multibladed cutter head. Floatmounted rotovators work effectively in waters 1 to 4 m (3.3 to 13.2 ft) deep and can, in some cases, be used in water 7 m (23 ft) deep. In water less than 1 m (3.3 ft) deep, the rotovator head tends to "walk" ineffectively across the bottom, rather than digging into it. Rotovating is specifically designed to removed non-woody rooted aquatic plants and their roots, and is not applicable to most emergent wetland plants.

Crushing: Noxious weeds can be mechanically crushed by tractor or all-terrain vehicle or trampled by foot. Crushing does not necessarily separate the above-ground portion of noxious weeds from their roots. This method is designed to interrupt above-ground growth and seed production. Repeated crushing stresses the root systems and might kill the plants.

Mowing: Mowing involves cutting plants at or near the soil surface. Mowing tools considered in this EIS include hand-held non-motorized tools, such as scythes, and mechanical tools, such as hand-held brush cutters, power mowers, tractor-mounted mowers, and articulated tractors with large rotary cutting heads mounted on arms. An example of the latter machine is the Kaiser Spyder, which is designed to work on multiple types of terrain and might be fitted with pontoons for working in soft sediment.

Harvesting: Mechanical harvesting of noxious weeds is defined as the cutting and removal of the bulk of the plant prior to seed formation. Mechanical harvesting might use one of many machines, including hand-held brush cutters, tractor-mounted harvesters, and floating aquatic harvesters. These machines can access harvesting sites either from land or water and might remove cut plants or leave them on site for later removal. The intention of harvesting should be to augment control efforts as part of a mowing program and not to encourage continued growth of the plants for additional harvests. The harvesting method would be at least partially effective in controlling the spread of noxious weeds by preventing production and dispersal of seeds.

3.3.2 *Spartina*

The intertidal zone, in which *Spartina* grows, presents several challenges to controlling or eradicating these plants. In many infested areas, soils are soft and inaccessible to vehicles. Likewise, many colonies occur in the upper intertidal zone, which might not be accessible to floating machinery or barges.

Dredging: Dredging could control and possibly eradicate some *Spartina* infestations. Unlike most control options, dredging could remove accreted sediments as well as plant material and thus could be used to restore the pre-infestation topography of the site. In many areas, however, the final elevation might be lower than that of the surrounding unvegetated tideflats. Dredging is a large scale, costly process that would alter substantial portions of intertidal areas. Because of the large-scale nature of dredging, it would only be practical for eradication of large, monotypic infestations. Most dredges could not reach *Spartina* plants in upper intertidal areas.

A suction/pipeline dredge could be used only when *Spartina* was submerged, and disposal sites would need to be within a reasonable pumping distance from the site. To eradicate the

plant, all viable roots would have to be removed. The outlet weir of the disposal site would need to be modified to keep as much root and rhizome material as possible from returning to the estuary.

Clamshell dredge operation would likely result in rhizome dispersal, due to inadequately sealed buckets or improper delivery to vessels used to transport dredged material. Unlike the suction/pipeline dredge, the clamshell dredge can continue operation at low tide.

Digging: Using mechanical equipment for digging is only feasible for *Spartina* beds approachable from the upland. Digging would remove the entire plant and root system. Digging could be used for control of either small or large monotypic clumps. Digging would not be efficient for individual plants or areas where *Spartina* is interspersed with native salt marsh plants. A dragline bucket can be used with a land-based crane, although its open bucket would increase the possibility of dispersing viable rhizomes. Digging would be most practical at low tide. Temporary roads providing access would have to be built to access some *Spartina* infestations, especially ones surrounded by areas with soft soils, and this may not be permitted in some areas.

Plowing: There is no evidence that plowing could effectively control *Spartina*. Plowing could only be accomplished on *Spartina* infestations on firm sediments that are approachable from the upland, and only during low tide. Plowing *Spartina* meadows would break up roots and rhizomes. After tidal flooding, rhizome fragments would be transported by currents and waves to infest new areas in an estuary. In addition, viable rhizomes that remain in place could sprout and reestablish. The predicted result of plowing *Spartina* would be a decrease in seed production at the treated sites for one season, with a subsequent increase in vegetative spread throughout an estuary and possibly beyond.

Rotovating: Viable *Spartina* roots are found from the sediment surface to one meter (3.3 ft) or more beneath the surface. Underwater rotovation would cut up and dislodge some plant material capable of regeneration, and leave some undisturbed. Rotovation would decrease stem density of a *Spartina* marsh only temporarily, because remaining roots and root fragments could sprout and reestablish the infestation. Viable root fragments would continually be released into the water column during rotovation for dispersal by tides, currents, and waves. Therefore, rotovation would not be effective in controlling *Spartina*.

Crushing: Trampling and crushing of *Spartina* have two immediate impacts. Oxygen diffusion to the roots is interrupted by pinching off air passages extending through the stem and into the roots. Oxygen supplied to the roots through these air passages allows them to survive in anaerobic soils. Trampling also pushes plants into the mud, which buries photosynthetic surfaces and further limits oxygen intake. Trampling or crushing *Spartina* generally reduces plant vigor and, if repeated, would eventually kill plants.

Crushing might be an effective control measure for *Spartina,* under certain conditions. Trampling by foot could be attempted on small monotypic clones or patches, even where the patches are interspersed with native vegetation. Mechanical crushing as a short-term control method could be used on large monotypic marshes and on individual patches, but would not be appropriate for scattered plants, in areas where *Spartina* is mixed with native vegetation, or where soft sediments make it impractical.

Various methods of crushing have been tried, using tractors, three-wheel all terrain vehicles (ATVs), and by foot. Crushing by foot might not provide enough pressure to be effective, although this has been reported to be successful in some attempts. Tests using a tractor and an ATV on experimental plots of *Spartina* indicate that repeated crushings might reduce stem density, reduce new shoot initiation, and eliminate seed production. In some cases, crushing once using a tractor might be effective in halting regrowth.

Crushing should be done when the growing shoots are still brittle, and seed production has not begun. Trampling/crushing would not be practical in lower parts of the intertidal zone or on soft substrates because of difficulties in walking and using heavy equipment in these areas. The number of treatments necessary to provide control is uncertain and probably variable.

Mowing: Mowing must be repeated to kill *Spartina*, although a single mowing appears to reduce seed production and weaken the plants. However, increased plant vigor has been found in single- and twice-mowed plots of *S. alterniflora* in Willapa Bay. Repeated mowing eventually weakens rhizomes of *Spartina* and reduces below-ground energy reserves. Mowing should be done either at the sediment surface or just below it to deny roots the photosynthetic products from the above-ground portion of the plant. Mowing using hand-held tools is a selective method, and native vegetation can usually be avoided. It also allows work to be done on difficult, uneven topography. Mowing to control flowering could take

place just once per season, while eradication would probably require 4 to 6 repetitions each growing season for at least 2 seasons (J. Civille, pers. comm. 1993). Mowing should be started well before the grass reaches its full height. Mowing more often, and earlier in the spring, is not only easier, but also reduces the total amount of litter dispersed at any one time (J. Civille, pers. comm. 1993).

Repeated hand mowing using brush cutters, followed by hand pulling of individual plants, has been successful in at least one *Spartina* eradication experiment. Mowing is being evaluated as a control method in state natural areas where protection of native salt marsh is the highest priority (J. Civille, pers. comm. 1993). Research on repetitive mowing of *Spartina alterniflora* is underway on two preserves in Willapa Bay managed by the Department of Natural Resources. In one study, 100 ft by 200 ft plots were mowed three times during the growing season using blade equipped brush cutters. Mowing effects on both *Spartina* and native salt marsh plants are being monitored on permanent transects. Preliminary observations indicate the elimination of *Spartina* seed set, dramatic reduction of stem density, and native plant recolonization in mowed areas.

A second mowing control program was initiated in 1992 with the goal of *Spartina* eradication in a discrete area (J. Civille, pers. comm. 1993). All *Spartina* within a large area of marsh was mowed five times in 1992. Field observations at the end of 1992, and spring 1993 indicate that this mowing intensity speeds the decline and mortality of *Spartina alterniflora*. April - September monthly mowing will continue in 1993. Results on both research and control efforts are projected to be available in late 1994.

<u>Harvesting</u>: Mechanical harvesting of *Spartina* could be used as a method of inhibiting seed production. However, harvesting would not control lateral vegetative spread. A stem segment about 10 to 15 cm (4 to 6 in.) in length would normally be left to grow a new crop. *Spartina* could be successfully harvested twice a year, in June and September. Harvesting of the crop should be done during low tides if land-based techniques are used to prevent the clippings from floating away. A tractor/mower could be equipped with a conveyor attachment to load the clippings onto a receiving apparatus (track or wagon) at the time of mowing. It has been demonstrated that, after using a brush cutter, clippings can be caught by a strategically placed containment boom such as those used to contain oil.

A floating plant harvester, such as the mudcat Aquatic Plant Harvester, would access a site from water and can operate in water as shallow as 61 cm (24 in.). Once cut, *Spartina* plants would be conveyed to a hopper on the harvester. In shallow water, the cutter blades occasionally hit the bottom and the paddle wheels stir up the bottom sediments. This might release pieces of rhizomes to infest new areas.

Use of harvesting as a control method requires that a market for the plant material be secured. Potential products include paper, mats for erosion control, room dividers, flooring, and baskets.

3.3.3 Purple Loosestrife

Purple loosestrife grows primarily in moist or saturated soils, although it occasionally might be found in drier sites. It grows in cattail marshes, sedge meadows, and bogs, along stream and river banks, on lake shores, and on alluvial floodplains. Because of the broad range of hydrological, ecological, and topographical settings it can infest, suitable control measures vary widely from site to site.

Dredging: Most purple loosestrife infestations in Washington are associated with shallow or seasonally flooded wetland systems that are too shallow or otherwise inaccessible for dredging. In areas where dredging is feasible, the process would severely disturb wetland soils, and any native/naturalized flora or fauna present. This resulting disturbance provides ideal habitat for reinfestation by purple loosestrife (from seed banks or remnant vegetative propagules). In addition, large numbers of seeds would be released to float to new locations and spread the infestation. The limited number of sites suitable for dredging, the adverse impacts associated with dredging, and its ineffectiveness in controlling the spread of purple loosestrife limits its potential for use as an effective control option.

Digging: Digging would remove the entire plant and root system of the target species and would be most effective on large, monotypic stands of purple loosestrife. However, the use of bulldozers or backhoes would greatly disturb wetland soils in and/or around purple loosestrife stands. The major impact of this disturbance would be the germination of the dormant seed bank, with subsequent sprouting and re-establishment of the infestation. Improper disposal of dug material could spread infestations to new locations. The probability that mechanical digging would eliminate and prohibit the spread of purple

loosestrife is low. This, in conjunction with a high potential for exacerbating the spread of propagules by opening up more disturbed habitat, eliminates digging as a feasible option for control of purple loosestrife.

Plowing: Purple loosestrife does not thrive under constant cultivation, as occurs in fields that produce annual crops. However, less frequent plowing stands of purple loosestrife has not proven to be an effective control method, because most pieces of root stalks and stems would remain to sprout in the overturned soil. The seed bank could also easily re-establish seedlings and spread the infestation. The major impact of plowing would be the germination of the dormant seed bank, with subsequent sprouting and re-establishment of the infestation. Stems and roots have a high probability of being transported to wetland environments where new infestations might occur.

Rotovating: Purple loosestrife is usually found in emergent wetlands, thus rotovating is not an option.

Crushing: Crushing might be achieved by driving a vehicle over the plants or stomping them by foot. Injured plants regrow less vigorously or die. There are no published reports of crushing being used against purple loosestrife. Purple loosestrife is very brittle and would likely break into several pieces if crushed, resulting in the release of plant fragments that could resprout and be dispersed to new sites, thus increasing the infestation area. Heavy crushing vehicles would compact the soils, causing hydrological and biological changes in sensitive wetland environments. In addition, soil disturbances are known to allow loosestrife seedlings to sprout from the dormant seed banks.

Mowing: Aerial biomass of purple loosestrife can be reduced by various hand-cutting instruments such as rotary or sickle bar mowers, filament and blade brush cutters, scythes, and shears, and by large mechanical instruments such as tractors with rotary mowers. Hand cutting of purple loosestrife stems can effectively prevent seed formation and deplete carbohydrate reserves within the roots. However, multiple cuttings might be required to prevent production of a seed crop.

Purple loosestrife should be cut in summer, at a time when plants are in the pre-bloom or early bloom stage because this is when energy reserves are lowest in the roots. Cutting

during hot weather would hasten desiccation of chopped leaves and stems and reduce the chances of vegetative reproduction from cut stems.

Attempts at controlling loosestrife by mowing alone have not been successful. Documented negative effects of mowing include the release of seeds from the soil seed bank as the surface soil layer is disturbed. Seeds and pieces of cut stems can be transported to new areas and become established as new infestations.

Mowing can result in temporary control of seed production without spreading the infestation if: (1) the loosestrife stand is monotypic and no more than 3 years old; (2) the surface of the soil is covered with the organic debris that prevents stems from contacting and rooting in bare soil; (3) the soil is not severely compacted or otherwise disturbed; (4) the tractor is not taken across areas that are potential loosestrife habitat; (5) treatments are done with a rotary mower during dry weather; and (6) treatments are repeated as necessary to keep the plants from going to seed. Under these conditions, research has found that the number of new shoots decreases, and the mulching action of the rotary mower lowers the viability of cut stems by making them small and damaged, which prevents sprouting.

Harvesting: Commercial or other public uses for purple loosestrife have not been developed and are not currently being pursued.

3.3.4 Miscellaneous Species

The miscellaneous species addressed here (garden loosestrife, giant hogweed, and indigobush) typically occur in relatively small patches and not in the large, monotypic stands that are characteristic of many *Spartina* and purple loosestrife infestations. The mechanical methods discussed in this EIS are generally inappropriate for treating small patches of plants, because they are either not cost-effective, or are not selective enough to be used at that scale. Furthermore, although some of the methods discussed above might be effective in controlling or eradicating infestations of the miscellaneous species, few have been attempted. There is practical information available on potential control methods only for giant hogweed. Very little is known about the use of mechanical controls to control giant hogweed, although some information is available:

- Trampling by cattle knocks down leaves and stems and crushes the crowns of the rootstocks, preventing further growth. Crushing with mechanical devices might be effective in some circumstances, but has not been tested.

- A single mowing stimulates budding on the rootstock and does not kill giant hogweed. To kill the plant by cutting, it must be cut 8 to 10 cm (3 to 4 in.) below ground level and removed. Repeatedly mowing shoots and leaves, however, reduces below-ground energy reserves and might prevent seed production or eventually starve the rootstock.

3.4 BIOLOGICAL METHODS ONLY

3.4.1 Description of Alternative

This alternative, which is based on principles of population ecology, involves using various biologically based controls for managing infestations of the noxious emergent plant species of concern in Washington. Biological control involves the introduction of a biological agent, such as a predator, parasite, or pathogen, to maintain another organism's population density at a lower average level than would occur in the absence of the biocontrol agent. For a complete discussion of this alternative see Appendix H. A realistic goal of a biological control program is to reduce noxious species abundance to an acceptable level, rather than eradicate the species completely. Some biological control methods, such as use of new microbial pathogens, insects, or genetic engineering, can require several years to be researched, complete the approval process, and, after introduction, can take several additional years to affect plant viability. Tables summarizing the most practical applications, use constraints, and significant environmental impacts associated with the Biological Methods Only Alternative are provided for *Spartina* (Table 5) and purple loosestrife (Table 6). Five categories of biological agents/controls were considered:

- Microbial pathogens
- Insects
- Grazing
- Genetic engineering
- Plant competition and forced succession

Table 5. Applications and major environmental impacts associated with biologically based methods for controlling *Spartina*. (Mitigation measures for impacts are summarized in Table 16.)

Ecological Control Method	Most Practical Applications	Use Constraints	Significant Environmental Impacts
Microbial pathogens (seed fungi)	Prevention or reduction of seed set	Specificity to *Spartina* species not known; 8 to 12 years might be necessary to complete testing and gain regulatory approvals	Possible death or injury of native species or agricultural grasses; fungal infestations may reduce palatability of *Spartina* to livestock, or other animals; ergot is toxic to many organisms
Insects (*Prokelisia marginata*)	Prevention or reduction of seed set	Specificity to noxious *Spartina* species not known; 8 to 12 years might be necessary to complete testing and gain regulatory approvals	Possible death or injury of native species or agricultural grasses; high arthropod densities might reduce plant palatability to livestock
Grazing (livestock)	Not recommended	Animal acquisition and care, fencing, and associated human labor costs high; intensive grazing probably required to effect control; not allowed in environmentaly sensitive areas (nearly all wetlands); some areas not accessible to cattle; not recommended	Soil compaction; nutrient, sediment, and fecal coliform bacteria input to surrounding waters; death or injury of non-target plants and animals possible

Table 5. Continued.

Ecological Control Method	Most Practical Applications	Use Constraints	Significant Environmental Impacts
Genetic engineering	None	---	---
Plant competition and forced succession	Limitation of landward *Spartina* spread in small areas	Labor intensive; unknown success or feasibility	Conversion of low salt marsh areas to high salt marsh

Table 6. Applications and major environmental impacts associated with biologically based methods for controlling purple loosestrife. (Mitigation measures for impacts are summarized in Table 17.)

Biological Control Method	Most Practical Applications	Use Constraints	Significant Environmental Impacts
Microbial pathogens	None	---	---
Insects	Reduction of seed set; reduction of plant vigor	Releases of several insect species will be necessary to effect control	Honey production in managed apiaries might be affected
Grazing (livestock)	Seedling mortality or reduction of seedling vigor	Older, woody plants not highly palatable; intensive grazing probably required to effect control; not allowed in environmentally sensitive areas	Soil compaction; nutrient, sediment, and fecal coliform bacteria input to surrounding waters; death or injury to non-target plants and animals possible
Genetic engineering	None	---	---
Plant competition and forced succession	Undetermined	No acceptable perennials known, except tall woody vegetation (which are inappropriate for some sites); annuals only effective for short-term competition against seedlings; labor intensive; treatment sites must be burned, mowed, etc. before planting/seeding; multiple plantings/seedings might be required	Non-target plants and animals might be affected

Microbial pathogens: Disease-inducing microscopic organisms, such as viruses and fungi, can be used to manage infestations of noxious plant species. For example, naturally occurring fungal infestations can prevent seed production in grasses, thereby eventually reducing the density of the infected plant population. Once identified as specific to the target plant, the destructive microbial pathogen must be tested and approved prior to release as a biocontrol agent.

Insects: To control or contain noxious plant species with insects, destructive natural enemies are obtained from the plant's native home. These insects must be tested thoroughly to ensure that they damage only the noxious species and not any ecologically, economically, or aesthetically important plants. Once this has been determined by federal and state regulatory agencies (see below), the insects are released into the infested area. Following successful establishment of the insects, oscillations in the populations of noxious species and their insect controls would occur over time in response to environmental conditions and the normal interactions between the target plants and insects. Ideally, the released insects build up large populations in time and reduce the noxious plant population.

Procedures developed by scientists of the United States Department of Agriculture's (USDA) Agricultural Research Service govern the introduction into the United States of biological control agents (including both microbial pathogens and insects) for noxious plant species. These procedures specifically address requirements for introducing bioagents non-native to the United States, but are also applicable to those microbial or insect agents native to the eastern United States or California being considered for introduction in Washington. The USDA in conjunction with the Washington State Department of Agriculture (WSDA) is the federal agency responsible for approving release of microbial or insect agents in Washington for noxious weed control. A survey of biological control projects in the United States involving insects found that, in general, 8 to 12 years elapsed between the initiation of the biological control project and the release of the agents in the field.

Grazing: Vertebrate animals such as cattle, horses, goats, and sheep have often been used for weed control. Exotic wildlife species could also be introduced for noxious plant management. Unlike insect bioagents, animal numbers are not dependent on plant densities and lack the high degree of host specificity exhibited by many insect herbivores.

Genetic Engineering: Biotechnology, especially new techniques of molecular and cellular biology, hold great promise for the development of genetically engineered organisms that might benefit humans in various ways. At this point in time however, no biotechnological discoveries have been made that would be of immediate value in controlling noxious plant species.

Plant Competition and Forced Succession: Competition can be defined as an interaction between individuals brought about by a shared requirement for a resource in limited supply, such as nutrients, water, or light. If one species is able to deplete the site resources more efficiently, then it might be able to replace existing vegetation. Noxious weed control might be effected by using plants that possess competitive superiority—that is, plants that are better able to utilize available resources.

Additionally, the processes involved in natural succession can be applied in resource management situations. To manage succession, three components are required: designed disturbance, controlled colonization, and controlled species performance. Designed disturbance includes activities initiated to create or eliminate site availability (such as burning, flooding, draining, herbicide application). Controlled colonization includes methods used to decrease or increase availability and establishment of specific plant species (such as seeding, direct planting, water manipulation, herbivory). Controlled species performance includes methods used to increase or decrease growth and reproduction of selected plant species (such as burning, mowing, herbicide application). All components result in changes in resource availability (light, water, nutrients) that influence plant survival during the successional process. A substantial investment of labor and money might be required to initiate and maintain forced succession.

3.4.2 *Spartina*

Microbial Pathogens:

Based on available information, seed fungi appear most promising as a microbial control of *Spartina* seed production. However, seed fungi would not prevent spread by rhizomes, and the feasibility of large-scale control efforts involving these fungi has not been researched. Several factors need to be investigated to make this determination, including verification of microbe specificity to each noxious *Spartina* species, efficacy, and appropriate method(s),

timing, frequency, and environmental conditions for fungal applications. These studies might require several years and considerable funding to complete.

Insects:

Herbivorous insects have been shown to affect growth and seed production in eastern populations of *S. alterniflora* and *S. patens*. However, none of these insect species are present in Washington. One species, *Prokelisia marginata*, or a subspecies, is also associated with *S. foliosa* and *S. alterniflora* in California. This planthopper has potential as a biological control candidate to limit the spread of *S. alterniflora* in Washington because it appears to reduce or prevent seed production. However, tests would need to determine threats to any native plant species and the insect density required to effect control. Additionally, the susceptibility of *S. patens* and *S. anglica* or other species to *P. marginata* has not been examined. As with the release of seed fungi, studies requiring several years and considerable funding to complete would be necessary before this agent could be released in Washington.

Grazing:

Grazing by domestic livestock could affect *Spartina* in several ways: grazing or trampling living plants could impact the health and vigor of individual plants, and soil compaction from livestock trampling could prevent seed germination or vegetative propagation. Seedlings and young shoots would be particularly vulnerable to grazing pressure. Grazing might also produce effects similar to those observed after cutting or mowing *Spartina*, specifically reduction or prevention of seed set. Trampling by livestock might kill individual plants or affect *Spartina* spread in an area. However, sediments/soils, water quality, and non-target biota would all be negatively affected by livestock grazing. The introduction of exotic wildlife species (such as nutria) is not recommended because of potential negative impacts to desirable vegetation.

Genetic Engineering:

Because no information about the application of genetic engineering to control *Spartina* species was found, this control method is not currently viewed as a viable approach.

Plant Competition and Forced Succession:

All three noxious species of *Spartina* appear to be superior competitors where they occur in Washington. It would seem unlikely that a native plant species could out-compete any of these species without first altering the environment in which they occur. The effectiveness of plant competition and forced succession would be limited to the landward spread of *Spartina* and would lead to the conversion of low salt marsh to high salt marsh. This method is labor-intensive.

3.4.3 Purple Loosestrife

Microbial Pathogens:

The use of exotic phytopathogenic organisms (organisms that cause disease in plants) for the biological control of purple loosestrife is not currently viewed as a viable approach. There are no reports in the American and European literature of significant pathogens being recovered from purple loosestrife and field surveys conducted in Europe and in Washington did not reveal any damaging pathogens attacking this plant.

Insects:

There is great potential for the use of herbivorous insects for biological control of purple loosestrife in Washington. Based on surveys conducted by the USDA Beneficial Insects Laboratory and the Commonwealth Institute of Biological Control (CIBC), six species of insects have shown promise. Three beetle species, *Hylobius transversovittatus, Galerucella calmariensis*, and *G. pusilla*, were approved for release by federal and state regulatory agencies in 1992 and limited releases have begun in Washington. It is not known when the remaining bioagents will be available for release. The three insects authorized for release are highly specific to purple loosestrife and are expected to be very effective and reliable in controlling populations of this species. Based on previous successes, it might be necessary to establish four to six insect species on purple loosestrife before control is achieved. The amount of time required for the control of purple loosestrife to be effected is not known and cannot be readily predicted. Based on similar programs, 5 to 10 years might be required before significant plant population density reductions are realized. It is likely that a 90

percent reduction in the purple loosestrife stand density would eventually be realized upon the successful establishment of these insects in North America.

Barring unanticipated events that might result in the localized decimation of bioagent populations (e.g., insecticides applied for insect pest control or weed elimination by herbicides), a single release of each natural enemy at a site should be sufficient to effect permanent establishment. Insects are self-perpetuating and would remain in an area year after year as long as the target plant is present in sufficient densities. The only labor requirements associated with the use of insects involve their initial release and some redistribution to other sites within an infested region to expedite further colonization.

Grazing:

There are no published studies available that indicate that livestock grazing can effectively control purple loosestrife. Although animals would consume the plant during the early growth stages, it apparently is not a highly palatable plant. Forced browsing on purple loosestrife seedlings or shoot regrowth during the spring might adversely affect survival or seed production potential. Effective suppression of purple loosestrife could possibly result from short-duration high-intensity grazing of seedling plants during the spring and/or early summer. It is not known, however, what kinds of livestock might most efficiently graze the plant in wetland sites. Sediments/soils, water quality, and non-target biota could be negatively affected by livestock grazing.

Genetic Engineering:

Because no information about the application of genetic engineering to control purple loosestrife was found, this control method is not currently viewed as a viable approach.

Plant Competition and Forced Succession:

The use of competing vegetation to manage purple loosestrife has been attempted in several wildlife refuges. No acceptable perennial vegetation is known that can out-compete purple loosestrife, except tall woody plants, which may not always be wanted or adapted to infestation sites. Annuals, including Japanese millet (*Echinochloa crus-galli* var. *frumentacea*), pale smartweed (*Polygonum lapathifolium*), (both of which are non-native

species), and certain other early germinating species can out-compete purple loosestrife seedlings in some situations. However, these species would only be effective against seedlings, and surviving purple loosestrife seedlings would continue to grow in subsequent years. The Washington Department of Wildlife is investigating the abilities of several woody plants (cottonwood and willow species) to shade out or suppress purple loosestrife. Further research on purple loosestrife replacement control plants is needed before the technique can be extensively used in succession management programs. A substantial investment of labor and money might be required to initiate and maintain forced succession in a purple loosestrife-infested waterbody. Intentional disturbances (burning, flooding, cutting, herbicides) would be required to initiate the successional pathway at the control site. As a result of these practices, non-target plants and animals might be affected.

3.4.4 Miscellaneous Species

Little information is available on the potential for insect biocontrol of garden loosestrife, giant hogweed, and indigobush in Washington. Insects associated with these species outside of Washington have been found, but the insects' specificity and effectiveness as control agents is unknown.

In Europe, effective control of giant hogweed has been obtained by allowing cattle to graze where plants are growing. Trampling by livestock knocks down leaves and stems and crushes crowns or rootstocks of plants, preventing further growth. Goats, however, might be sensitive to the toxins produced by giant hogweed. No information is available on the efficacy of livestock for control of garden loosestrife. Indigobush is reportedly used as forage for cattle and sheep in Italy, although no information is available on the efficacy of grazing for control of the plant.

No information about the application of genetic engineering or plant competition and forced succession to control these species was found. These methods are not currently viewed as a viable approaches for the control of these species.

3.5 CHEMICAL METHODS ONLY

3.5.1 Description of Alternative

Two chemical methods have been considered in this alternative to control noxious emergent vegetation in Washington state: glyphosate and 2,4-dichlorophenoxyacetic acid (2,4-D). A third chemical, triclopyr, is under consideration by the EPA but is not yet approved for aquatic use (see Appendix E, Pesticide Characterization). Although other herbicides were suggested through the scoping process, they were dismissed on the basis of EPA label restrictions, limitations in efficacy, and/or unacceptable impacts to beneficial uses of waters of the State. This section describes each method and its potential effectiveness in controlling *Spartina* and purple loosestrife in Washington. Unless specifically noted otherwise, the information presented in this section was obtained from Pesticide Characterization, provided as Appendix E of this EIS. References are included only for those studies that were not available in Appendix E. Use of product names in this EIS is only for the purpose of illustration and does not constitute an endorsement of the product.

Three main aspects of this alternative are discussed in this section. First, some of the major physical and chemical characteristics of the two herbicides are summarized. Next, general application instructions and application methods for glyphosate and 2,4-D are discussed. Third, the potential efficacy of these herbicides in controlling *Spartina* or purple loosestrife is presented. A summary of this alternative is presented in Table 7.

Glyphosate: Glyphosate is an herbicide that has been used worldwide in both the agricultural and forestry industries. The primary mechanism for uptake of glyphosate through the plant is from the point of foliage contact and into the root system. Glyphosate inhibits the synthesis of essential amino acids in plant tissue. Rodeo® and Pondmaster®, manufactured by Monsanto Agricultural Company, are the only glyphosate formulations commercially available and registered for aquatic use in Washington state (D. Dolstad, pers. comm., 1993). When the term "glyphosate" is used in this EIS, it specifically refers to Rodeo®, unless otherwise stated.

Rodeo® does not contain a surfactant, but the EPA registration label requires that Rodeo® be used with a nonionic surfactant. Surfactants provide an even coverage of the herbicide on the surface of the plant, reduce the surface tension of spray droplets, and can improve

Table 7. Summary description of chemical methods only alternative[1/].

Physico-Chemical Characteristic	Glyphosate	2,4-D
Adjuvant Necessary	Yes. Most common in WA State are R-11, X-77, LI-700.	Depends on brand and application method.
Mobility in Soils/Sediments	Practically nonmobile; unlikely to migrate to groundwater.	Relatively mobile but groundwater contamination infrequently reported.
Bioconcentration Factors	Low.	DMA salt low; 2,4-D acid low; BEE high in invertebrates, otherwise moderate.
Biodegradation Half-Life	Soil: <1-249 days; avg. 60 days. Freshwater Sediments: 7-70 days. Estuarine Sediments: 30 days. Freshwater: 1.5-70 days. Estuarine Water: <2 days.	Soil: 1.5-25 days; BEE 1-2 days . Freshwater Sediment: <1 month. Freshwater: DMA 2.2-11 days; BEE 0.11-2.3 days; 2,4-D acid 0-28 days.
Persistence	Soil, Freshwater and Estuarine Sediment: 1 year. Freshwater: 129 days. Estuarine Water: no information found. Marine Water: 27% up to one day after treatment. Marine Sediment: 43% after 4 months at Willapa Bay.	Soil: 25 days or more. Freshwater Sediment: 2,4-D 182 days; BEE 300 days. Freshwater: 59 days.
Efficacy of Application Methods	Helicopter: quick for large area; spray ball can minimize drift and overspray. Boat, Truck, ATV Spraying: more control than helicopter; reduced possibility of drift or overspray; more time and labor than helicoptor.	Same as glyphosate.

Table 7. Continued.

Physico-Chemical Characteristic	Glyphosate	2,4-D
Efficacy of Application Methods	Wicking: may require less herbicide for control; no possibility of overspray; may require several passes across plant; labor intensive. Back-pack Spray: almost twice as rapid application as wicking; easier than wicking; some drift or overspray could occur.	Same as glyphosate.
Efficacy in Spartina Control	Mixed effectiveness: 0-100% reported.	NA
Efficacy in Purple Loosestrife Control	Generally good success.	Generally good success.
Potential Impacts[2]	Soil and sediment erosion. Algal blooms. Decrease in oxygen in the water. Effects to non-target plants. Mammalian habitat degradation. Potential interactions with other chemicals. Some surfactants moderately toxic to fish and slightly to highly toxic to aquatic invertebrates.	Soil and sediment erosion. Algal blooms. Decrease in oxygen in the water. Effects on non-target plants. Mammalian habitat degradation. Potential toxic effects on some mammals, avian species, fish, and aquatic invertebrates. Potential interactions with other chemicals. Inconclusive evidence for causing cancer in animals and humans.

[1] Summary information for this table obtained from the technical reports provided in Appendix E, F, and G.
[2] Potential impacts presented in this table for summary purposes only; all impacts listed here are not expected to occur in every spraying instance. Rather, they represent the range of possible short-term and/or long-term impacts. Some of these impacts are only expected under a distinct set of circumstances or may not occur at all. Refer to Section 4.5 for a detailed description of the potential magnitude and duration of impacts and any associated mitigation and minimization measures.

herbicide penetration. Over 95 percent of Rodeo® applications in Washington state are in combination with X-77® Spreader, R-11® Spreader Activator, or LI-700® Penetrating Surfactant. R-11® is manufactured by Wilbur Ellis Company, the sole distributer of Rodeo® in Washington state. Therefore, R-11® and Rodeo® are commonly sold together.

Glyphosate has negligible vapor pressure and low bioconcentration factors ,ranging from 0.03 to 1.6 in fish. (Bioconcentration is the degree to which a chemical can be concentrated in the tissues of an organism. Bioconcentration factors less than 10 indicate that the pesticide does not accumulate in exposed organisms.) Glyphosate is considered practically nonmobile in soils and sediments because it rapidly and strongly adheres to soil particles. Groundwater contamination by glyphosate has rarely been reported and is unlikely to occur because glyphosate generally has a low ability to migrate through the soil to groundwater.

The primary method of glyphosate degradation is biodegradation (breakdown by microorganisms). Biodegradation is dependent upon a number of factors, such as Ph, temperature, and soil type. Thus, the length of time needed for glyphosate to decay varies according to the specific characteristics of the noxious weed infestation site. The half-life and persistence data are summarized in Tables 7 and 8. (Half-life is the length of the time required after application for the chemical concentration to decrease to one-half its original concentration. Persistence is the length of time required for a chemical to degrade to the point where it can no longer be detected. In many cases, chemicals can be detected at levels much lower than those expected to cause harm to biological systems.) For a more detailed discussion of glyphosate persistence, consult Appendix E.

No product-specific biodegradation studies have been conducted using the surfactants R-11®, LI-700®, or X-77®. LI-700® is made from a naturally occurring lipid and likely biodegrades, but no general information concerning biodegradation of this lipid was found. Data for surfactants similar to R-11® and X-77® indicate that degradation to the extent that the surfactant characteristics are no longer evident is fairly complete but the time for biodegradation was highly variable. However, studies show that the breakdown of all components of the surfactants is slow and may not be complete.

<u>2,4-D</u>: The chlorinated phenoxyacetic acids and their derivatives, which include the herbicide 2,4-dichlorophenoxyacetic acid (2,4-D), are among the most widely used pesticides in the world. 2,4-D is a systemic herbicide that functions as a plant growth regulator by

Table 8. Summary of persistence data for Glyphosate and 2,4-D.

Medium	Glyphosate	2,4-D
Soils	**Half-Life** Range of half-lives: <1-249 days; avg. = 60 days (Reinert and Rodgers 1987) Sandy loam: < 1.5 weeks; aerobic w/ microflora < 1 day (EPA 1992) Silty-loam: 1-3 days (EPA 1992; Rueppel *et al.* 1977) Silt-clay-loam: < 21-27 days (EPA 1992; Rueppel *et al.* 1977) Silt: approx. 249 days (agricultural fields) (Muller *et al.* 1981) Forest: 45-60 days (Feng and Thompson 1990); <14 days; <1 day; 5-13 days (Newton *et al.* 1984) Biologically active w/ microbial degradation: 2-10 weeks (Tooby 1985) Various soil types: 3-27 days (Sacher 1978) **Persistence** Loam: 10% persistence after 249 days (agricultural fields) (Muller *et al.* 1981) Silt loam: 10% persistence after 14 days (Rueppel *et al.* 1977) Silt-clay-loam: 10% persistence after 80 days (Rueppel *et al.* 1977) Forest: 13-18% persistence in 360 days (Feng and Thompson 1990) Various soil types: Persistence approx. 112 days (Sacher 1978)	**Half-Life** Agricultural soils: 1-2 days for 2,4-D BEE ester and 1.5-7 days for 2,4-D (Grover 1973; Smith 1972,78) Unspecified soil: 1.5-8.5 days (McCall *et al.* 1981) Clay: 25 days under upland conditions; 50 days in flooded conditions (Kuwatsuka and Miwa 1989); w/ previous treatments: 1-9 days (Smith and Aubin 1991) Sandy loam w/ previous treatments: 7 days (Smith and Aubin 1991) **Persistence** Unspecified soil: 10% persistence after 5.9-25 days (McCall *et al.* 1981)
Estuarine/ Marine Sediment	**Half-Life** Saline mudflat: 30 days (O'Keefe 1985) **Persistence** Tidal marsh sediment: highly variable, < 91 days (Kroll 1991) Estuarine sediment: < 90 days in most studies; up to 1 year (O'Keefe 1985) Marine sediment: 43% persisted after 4 months (Paveglio et al. 1993)	No data; 2,4-D not registered for marine use.
Freshwater Sediment	**Half-Life** Aerobic, silty clay-loam: 7 days (EPA 1992) Anaerobic: 5-7 weeks (EPA 1992)	**Half-Life** Artificial pond sediments: < 1 month (Birmingham and Colman 1985)

Table 8. Continued.

Medium	Glyphosate	2,4-D
Freshwater Sediment	**Persistence** Stream sediments: persistence 196-364 days (Feng et al. 1990); persistence >54 days (Newton *et al.* 1984) Pond sediment: persistence > 127 days (EPA 1992)	**Persistence** Persistence up to several months (Smith and Isom 1967; Frank and Comes 1967; Cope *et al.* 1970; Wojtalik *et al.* 1971; Schultz and Harman 1974; Watson 1977; MacKenzie 1979); Mount and Stephan 1967); persistence 14-161 days (Dynamac 1988; Schultz and Gangstad 1990) Artificial pond sediments: persistence up to 182 days; 2,4-D BEE up to 42 days (Birmingham and Coman 1985) Lake sediments: 2,4-D BEE persistence 86-300 days (Dynamac 1988)
Freshwater	**Half-Life** Field and lab studies: 1.5-15 days (Goldsborough and Beck 1989; Hunter *et al.* 1984; Sacher 1978) Nonflowing natural freshwater ponds and wetland systems: 7-10 weeks (Ghassemi *et al.* 1981) Pond water: 14-21 days (EPA 1992) **Persistence** Pond water: persistence up to 129 days (EPA 1992) Stream: persistence up to 7 days (ref); persistence up to 96 hours (Feng *et al.* 1990)	**Half-Life** Variable, few days to several months (EPA 1987) 2,4-D BEE lab and field studies: 0.11 to 2.3 days (Reinert and Rodgers 1987; Paris *et al.* 1981; Dodson and Mayfield 1979; Oklahoma Water Research 1975; Frank and Comes 1967) 2,4-D DMA: 2.2 to 11 days (Reinert and Rodgers 1987; Schultz 1973; Otto *et al.* 1983; Dynamac 1988) 2,4-D amine salt: 3.9 days (Robson 1968) **Persistence** Georgia ponds: persistence up to 28 days (Schultz and Gangstad 1990) Lakes: persistence 0-22 days; 2,4-D BEE persistence up to 59 days (Dynamac 1988; Hoeppel and Westerdahl 1983)
Estuarine/ Marine Water	**Half-Life** < 2 days (Kroll 1991) **Persistence** 27% persisted after 1 day (Paveglio et al. 1993)	Data not available; 2,4-D not registered for marine use.

stimulating nucleic acid and protein synthesis and affecting enzyme activity, respiration, and cell division. Unlike glyphosate, 2,4-D based herbicides are selective and do not harm monocot species (such as grasses, sedges, and rushes), which are the dominant species in most wetland areas.

Liquid 2,4-D formulations are used to control surface and immersed vegetation. Granular formulations are often used to control submersed vegetation. The following 2,4-D formulations are registered for aquatic use in Washington State:

- 2,4-D dimethylamine salt (2,4-D DMA)
- 2,4-D butoxyethyl ester (2,4-D BEE)
- 2,4-D isooctyl (2-octyl) ester
- 2,4-D isooctyl 2-ethylhexyl ester
- 2,4-D sodium salt
- 2,4-D alkyl amine C12.

The two most commonly used forms of 2,4-D include the dimethylamine (2,4-D DMA) salt and butoxyethyl ester (2,4-D BEE) compounds. The parent, acid compound is not typically formulated as an end-use product, but the ester and amine formulations commonly used in aquatic applications are rapidly converted to the acid form in the environment.

2,4-D is relatively mobile in soil because it is highly soluble and does not strongly adhere to soil. However, groundwater contamination with 2,4-D has not been widely reported and in most cases has been associated with point sources, such as spills. Bioaccumulation is low for 2,4-D DMA and 2,4-D acid. For 2,4-D BEE, bioaccumulation is high in invertebrates, but moderate in other organisms.

Like glyphosate, 2,4-D breaks down by a process known as biodegradation. An initial lag period in 2,4-D degradation that lasts for a few days to a few weeks can occur. During this time microorganisms acclimate to 2,4-D and achieve a sufficient population for measurable degradation to occur. Repeated application of 2,4-D results in shorter half-lives because the microorganisms become more acclimated to the herbicide. However, data indicate that after the initial lag period, biodegradation rates are similar for acclimated and previously unacclimated soils. In addition to the 2,4-D persistence data summarized in Table 7, more

detailed information is presented in Table 8, and a further description of 2,4-D persistence is provided in Chemical Characterization in Appendix E.

3.5.2 Application Instructions and Methods

The proper selection of herbicide formulation and application method are important factors in a herbicide's effectiveness and practicality. To ensure maximum effectiveness and to minimize potential adverse effects on non-target organisms, all forms of herbicides must be prepared, mixed, and applied as specified on the herbicide label and in accordance with Washington state rules and the permit issued to the applicator. For example, under Washington Administrative Code (WAC 16-230-640), the application of 2,4-D in temperatures above 85°F (29°C) is prohibited. Although the label might allow for application up to 95°F (35°C), the more stringent WAC guidelines must be followed. Some general use instructions and application methods for glyphosate and 2,4-D are discussed below.

General Use Instructions: Rodeo®, the form of glyphosate commercially available in Washington for aquatic use, should be applied to emergent vegetation that is actively growing. Rodeo® will not control plants that are completely submerged or that have a majority of their foliage under water. Visible effects occur on most annual plants within 2 to 4 days, but on most perennial brush species effects might not occur for 7 days or more. Extremely cool or cloudy weather following treatment might slow the activity of glyphosate and delay visual effects of control. Visible effects are a gradual wilting and yellowing of the plant that advances to complete browning of above-ground growth and deterioration of underground plant parts. In some cases, effects might not appear for up to 4 weeks depending on the physiological state of the plants. If an infestation is treated quickly, before the noxious plant is the dominant species, the relatively small "holes" in the vegetation following removal of the weeds would be quickly filled by other perennials, thereby precluding the establishment of noxious plant seedlings.

2,4-D herbicides should be applied in spring or early summer when young vegetation is actively growing, preferably in the bud and flowering stage of growth. Approximately 2 weeks is required for control of most vegetation; tissue damage should be evident within 2 to 4 days with liquid formulations and a week with granular formulations. Regrowth will be evident in 4 to 5 weeks if roots are not killed. 2,4-D is generally most efficacious when

used in conjunction with other herbicides (such as Rodeo®) and management tools to control noxious weeds. One of its chief advantages is that it is selective and kills sensitive dicots (most broad-leaved plants such as daisies and roses) but does not harm most monocots (grasses, sedges, rushes) which are important components of wetlands.

Application Methods: Herbicide application methods potentially available for controlling emergent vegetation include spraying with helicopter; boom or spot spraying with boat, truck, or ATV; backpack spraying; and wicking. The application methods would greatly influence the time and labor needs for each method of chemical control. It is anticipated that for a given application method, both glyphosate and 2,4-D would generally have similar time and labor constraints and similar efficacy. A major concern with all spraying which directly affects the choice of an application method is the likelihood of drift of the chemical to non-target areas.

Helicopter applications allow for a more controlled and directed spray than is possible using fixed-wing aircraft. The major advantages to helicopter application are the ability to quickly apply the herbicide to a large area. A typical spray apparatus consists of a boom with multiple nozzles for broadcast delivery of the herbicide. Different boom designs and nozzle configurations are available, and are selected as appropriate for the site to be sprayed. The number of nozzles appropriate for use in emergent weed control is determined by application method. Aerial applications normally use hollow cone or flat fan nozzles to improve coverage with the smaller volume of spray solution applied per acre. An alternative to a helicopter with a boom is a helicopter with a spray ball. Use of a spray ball rather than boom allows the potential for drift to be minimized. The ball apparatus, which contains a spray nozzle system, hangs from the helicopter on a stem. The helicopter can hover over an area and use the ball to spray a small clump of noxious plants. This technique might be particularly appropriate when a spray site is located near a sensitive ecological habitat or human population. In areas of Washington state in which nonattainment of applicable air quality standards exists, aerial spraying must follow local regulations or permit requirements.

Applications using boats, trucks, and ATVs mounted with a boom sprayer or spot spraying with a hose from these vehicles are also common. These methods are particularly appropriate when the areas surrounding the target plants make an aerial application difficult, either because of the ecological habitat or public sensitivity. These types of spray applications allow for a more specific application than most aerial applications, and reduce

the possibility of drift or overspray. When large areas need to be treated, boat, truck, or ATV applications take longer than aerial applications, necessitating additional time and labor.

Wicking or wiping is the direct application of herbicide onto the plant surface using rope, paint rollers, absorbent foam rubber, carpet, or any absorbent material that can transfer the herbicide onto the leaf surface. This technique is more labor intensive than spraying, but can be very effective and might require less herbicide to achieve control. Wicking minimizes the potential for impact on nontarget organisms, because of the preciseness of the herbicide application onto the noxious plant. There is no opportunity for overspray. Wicking also allows taller species to be selectively removed, while lower species are left undamaged. However, to achieve control in some species, it is necessary to cover the entire plant with herbicide, which might require several passes across the plants from different directions.

The use of back-pack spray herbicide applications is ideal for treatment of relatively small areas where controlled application is desired. Back-pack spraying is almost twice as rapid as wiping, and the application is easier. The hand pump sprayers are the most common type of back-pack sprayer. Spray drift is a disadvantage of this herbicide application method, because the herbicide could inadvertently affect desirable vegetation or sensitive ecosystems.

3.5.3 *Spartina* Control

In this section, the efficacy of glyphosate used to control *Spartina* is discussed. 2,4-D alone does not kill *Spartina* and is not registered for marine use in Washington State, and therefore 2,4-D may not be used to control *Spartina*.

Glyphosate applications have had mixed effectiveness in controlling *Spartina*. In studies conducted by Monsanto Company to simulate broadcast aerial and hand-held spray applications, there was nearly 100 percent control of *Spartina* with all rates and methods at 2 months after treatment. Wiping or wicking resulted in less consistent control than broadcast applications. This might be a function of failure to treat specific stems during wicking rather than a failure to achieve control of treated stems. Glyphosate/surfactant must be applied during dry weather for maximum efficacy. The type and amount of surfactant used are also important factors in the effectiveness of the herbicide.

The length of time that glyphosate is in contact with *Spartina* has been implicated as a main limiting factor in its efficacy in tidal areas. Application at, or just prior to, the maximum low tide is necessary to provide sufficient contact time before high tide. In the Pacific Northwest, two high tides and two low tides each day severely limit the time available for application of glyphosate for tidally influenced wetlands.

The studies of Rodeo® and X-77® in Willapa Bay (Paveglio *et al.*, 1993a; Fresh and Carr, 1993; Simenstad *et al.*, 1993) were designed to evaluate fate and persistence and effects on invertebrates, plankton, and eelgrass. All of these studies were conducted at three test sites in Willapa Bay that had been sprayed with Rodeo® and surfactant. These studies also evaluated effects on organisms up to four months after treatment. Effects on eelgrass will be studied one year after spraying. In addition, a one-year followup study of *Spartina* control after aerial spraying at all three Willapa Bay sites and hand-held wand spraying at one of the sites was recently completed (Paveglio *et al.*, 1993b).

For these four studies, Rodeo® and X-77® Spreader® were applied by helicopter at a rate of 4.7 liters per hectare (L/ha) and 0.9 L/ha, respectively to treatment plots at three sites in Willapa Bay on August 19, 1992. Test sites were exposed to the herbicide/surfactant mixture for 5.5 hours before tidal inundation. The recommended application rate on the Rodeo® label for aerial spraying of *Spartina* is 4 to 7.5 pints of Rodeo® in 10 gallons of spray solution per acre; therefore, these studies evaluated effects at the lowest recommended aerial application rate.

The study by Paveglio *et al.* (1993a) evaluated fate and persistence of glyphosate, its primary metabolite (aminomethylphosphonic acid [AMPA]), and nonylphenol polyethoxylates (NPEO), the measurable portion of the surfactant in sediment, off-site seawater, on-site seawater, and *Spartina* at two hours, and 1, 14, 28, and 119 days after treatment. The glyphosate concentration in sediment ranged from a mean value of 1.73 ppm on the day of treatment to 0.75 ppm at 119 days post treatment (DPT), a decrease of 57 percent. AMPA showed no decrease while NPEO levels declined over the first 14 days (from 0.181 ppm to 0.105 ppm), then remained stable. Glyphosate was not detected in treatment or control plots prior to treatment. Deposit rates of glyphosate after aerial spraying did not differ significantly among the three sites.

Chemical concentrations in off-site seawater were measured at the leading edge of the first high tide after treatment. The site with the highest concentrations had average concentrations of glyphosate, AMPA, and NPEO of 515 ppb, 32.2 ppb, and 16 ppb, respectively.

Glyphosate concentrations measured in on-site seawater samples from all locations combined decreased by 73 percent from the first tide to one DPT, from an initial average concentration of 9.77 ppb to 2.62 ppb. AMPA levels decreased 42 percent (from 1.3 ppb to 0.76 ppb) and NPEO was not detected in on-site seawater.

Glyphosate concentrations in *Spartina* decreased an average of 97 percent (from 36.2 to 1.25 ppm) between one and 28 DPT for all locations combined. AMPA concentrations declined 86 to 96 percent at different locations. No NPEO was detected in *Spartina*.

This study found that glyphosate persisted in sediments for over four months which is similar to the range found in previous studies from less than 90 days up to one year. Maximum concentrations of glyphosate found in seawater were 515 ppb. The EC 50 for inhibited algal growth was 640 ppb in a study sponsored by Monsanto. The inhibition in growth of algae in the Monsanto study occurred after seven days of exposure to a constant concentration of the herbicide. These conditions would not occur in the environment, so adverse effects on algae would be much less likely. Concentrations in *Spartina* decreased as expected since glyphosate rapidly enters the root system from the leaves.

Fresh and Carr (1993) studied the short-term effects of glyphosate on eelgrass, and found a statistically significant 44 to 48 percent decrease in above-ground biomass at both treatment sites and a significant 36 percent decrease in percent cover at one of the sites. Based on these results, the authors concluded that treatment with glyphosate adversely affected eelgrass. This August, one year after spraying, they plan to study the effects on eelgrass at the sites.

The results from the Willapa Bay study differ from those of Bulthius and Shaw (1993), who found no effect on eelgrass from glyphosate in Padilla Bay. A native salt marsh plant, *Atriplex patula*, did respond to applications of glyphosate at a rate of 1.7 quarts per acre. However, in the Padilla Bay study, Bulthius and Shaw (1993) applied the glyphosate earlier (July 1), at a lower application rate (1.7 L/ha), and to an environment with shorter contact

time (less than 3 hours). Thus, it is not surprising that less impact would be observed in the Padilla Bay study than the Willapa Bay study.

The objective of the Simenstad *et al.* (1993) study was to measure the impacts of treatment with glyphosate on organisms which are important in the mudflat community and as prey of fish and wildlife. For algae, benthic meiofauna (sediment organisms between 0.1 and 1 mm in size), and epibenthic organisms (organisms that occur both in sediment and the water column) which have generation times of days to weeks, this study measured both short-term and long-term impacts. For benthic macrofauna (sediment organisms larger than 1 mm) with generation times of weeks to months, this study measured only short-term effects. The study took place from late August to December and thus did not assess impacts that could result from glyphosate residues in other seasons.

At each of the three sites the authors evaluated one control and one treatment plot one hectare in size. Samples were taken from 15 points within each plot. The study measured effects at control and treatment plots before treatment, immediately after, and 1, 14, 28, and 119 days after treatment.

There was a significant amount of variability between the three study sites and between treatment and control plots at each site even prior to treatment. There was also a high degree of variability in organism abundance in both the treatment and control plots over time. The statistical analysis compared the average abundance of organisms for treatment plots and control plots for a short time frame (up to 2 days after treatment) and a long time frame (up to 119 days after treatment) and found no statistically significant effects from treatment at this application rate. Although the marked degree of variability over time in the treatment and control plots reduced the ability of the statistical methods to detect subtle treatment effects, a visual review of the data confirmed that there were no consistent noticeable effects. The high degree of variability between test plots and control plots makes it difficult to draw conclusions when comparing the two. This study only evaluated organism density rather than both density and diversity. In addition, it did not address impacts other than survival and did not evaluate the effects of various concentrations or repeat applications.

A followup study of *Spartina* control in Willapa Bay one year after treatment (Paveglio *et al.*, 1993b) found that there was no statistically significant reduction in *Spartina* density at any of the treated plots after aerial treatment with Rodeo® and X-77® Spreader® at the lowest

recommended aerial application rate (4.7 pints Rodeo® per 10 gallons or approximately 5 percent in solution). Although it was not a statistically significant decrease, the authors did find a reduction in *Spartina* stem density with the greatest reduction occurring at the study site which was located higher in the intertidal zone and therefore had more contact time with the herbicide before it was washed off by tides. Two weeks after the aerial application, the authors applied Rodeo® and X-77® Spreader® to previously untreated plots at one of the sites using a hand-held wand at the maximum application rate (a 5 percent Rodeo® solution and a 1 percent X-77® Spreader® solution). One year later, they found an 84 percent reduction in stem densities in treatment areas which was a statistically significant decrease when compared to control areas.

Studies in Great Britain also indicate variable success in using glyphosate to control cordgrass. The Nature Conservancy Council reported mortality from zero to 50 percent and that no herbicide effectively killed young cordgrass (seedlings to 3 years). Ineffective treatment of young cordgrass was attributed to the fact that the young plants grow close to the substrate, are exposed for shorter period between tides, and have a small leaf area.

There are many variables that can affect the success rates of studies using glyphosate for control of *Spartina*. The length of time from application to high tide, weather conditions, application method, and timing of application in the plant's life cycle are all important factors. The study of *Spartina* control (Paveglio *et al.*, 1993b) found that aerial spraying at a rate close to the lowest recommended aerial application rate (4.7 pints Rodeo® per 10 gallons or approximately 5 percent in solution) was not effective, but ground application with the a similar concentration (5 percent in solution) was effective in controlling *Spartina*. The study confirmed that the length of time from herbicide application to inundation of the plants by tides influenced the effect on *Spartina*.

3.5.4 Purple Loosestrife Control

Either glyphosate or 2,4-D can be used to control purple loosestrife. The efficacy of these herbicides is discussed below.

<u>Glyphosate</u>: In Washington State, Rodeo® is the most effective chemical method available for controlling mature purple loosestrife plants. Applications of Rodeo® are a major

component of management efforts in Washington (D. Dolstad and W. Brookreson, pers. comm., 1993).

Glyphosate has been used successfully for purple loosestrife control in the Northeast and Midwest. It has become an important tool in controlling the invasion of loosestrife into wetlands in Minnesota and Wisconsin. At the Montezuma National Wildlife Refuge in central New York, application during the late flowering stage resulted in nearly 100 percent shoot reduction, and was more effective than applications made during the vegetative or early flowering stages of the plant. In the following growing season, plots sprayed in the vegetative stage became reinfested, while those sprayed in the early or late flowering stages were free of purple loosestrife seedlings. Because seeds remain viable in soil, it is possible that new seedlings may arise after mature plants die. Thus, glyphosate use would be required until the seed bank is exhausted.

In very dense growths of purple loosestrife, "holes" in vegetation created when glyphosate kills purple loosestrife could be large. Follow-up treatment for at least one more season is usually necessary since some plants would be missed, seedlings of noxious weeds would sprout, and a few plants would survive the initial treatment. Also, improper mixtures and careless application could adversely affect more surrounding vegetation and lead to the establishment of more weed seedlings.

2,4-D: State resource agencies in Minnesota and Wisconsin use 2,4-D as an effective tool in the control of purple loosestrife in wetland areas. In Voyageurs National Park in Minnesota, individual purple loosestrife plants are spot-sprayed with 2,4-D twice between late June and early August. In mid-August, workers cut and bag any remaining flower stalks, remove them from the wetland, and burn them. Since using this approach, initiated in 1988, the density and age structure of the loosestrife stands in the park have dramatically declined.

3.6 INTEGRATED WEED MANAGEMENT (PREFERRED ALTERNATIVE)

3.6.1 Description of Alternative

Integrated weed management (IWM) is the deliberate selection, integration, and implementation of weed suppressive measures. It is the preferred alternative for noxious emergent weed control and co-lead agencies can be expected to support its implementation.

The approach is based on ecological principles and incorporates multidisciplinary methodologies in developing management strategies that are practical, effective, and protective of public health, while minimizing environmental impacts. The primary goal of IWM is to maintain the target species at noninjurious population levels or, as defined in this document, to eradicate the target species. Some definitions of IWM exclude eradication as a management strategy, but for the purpose of this EIS, a broader definition has been adopted.

Benefits of integrated weed management include:

- Continuous monitoring and evaluation of the weed-impacted managed resource, including on-going inventory of habitat
- Reduced adverse impacts to natural, agricultural, and built emergent wetland environments
- Minimization and localization of use of herbicides
- Attainment of long-term, reliable weed management or eradication

Constraints associated with the IWM approach include:

- Complex and time-consumptive processes associated with development and implementation of an effective integrated approach
- Insufficient labor and monetary investments that might preclude long-term program goal attainments
- Lack of information on noxious plant biology and ecology, damage and action thresholds, and management method efficacies that are needed for program implementation

Various terms used in IWM have definitions that relate to specific objectives of the management approach. These terms are defined as follows:

Control = prevent all seed production.

Contain	=	confine a noxious weed to an identified area of infestation.
Reduce	=	lower weed population density without the expectation of complete control or containment.
Eradicate	=	eliminate a noxious weed within an area of infestation.
Prevention	=	adoption of practices that reduce the potential of noxious weed introduction.

3.6.2 Noxious Emergent Plant Management Generic Plan Development

The first step in the development of an IWM program is to develop a generic plan. This requires prioritizing sites for management and developing plans on the basis of management objectives and biological and practical concerns.

Prioritization of Sites for Management: Management of a noxious weed at a particular site is determined by assessment of the target species' potential for damaging important resources at the particular site. The following priority levels should be used (terminology after Hoglund *et al.*, 1991):

Priority I, *Potential New Invaders*

Potential new invaders are noxious weeds that have not been recorded in a site that is very vulnerable to invasion. Management emphasis is detection and prevention, especially of Class A species.

Priority II, *New Invaders*

New invaders are noxious weeds whose population density and distribution are such that all seed production can be prevented within a specific site by appropriate management methods. Management emphasis is prevention, control, containment, and/or eradication, depending on the class status of the weed.

Priority III, *Established Invaders*

Established invaders are noxious weeds whose population density and distribution are such that all seed production cannot be prevented within a specific site. Damage/action thresholds (explained below) determine the management strategy selected. Management emphasis is placed on prevention of infestation spread, containment, and reduction; however, taking no action is also a possibility. Eradication is usually not feasible.

Plan Development: Certain general program guidelines are applicable to the management of all noxious emergent weeds, although development of a specific IWM plan depends on the class and biology of the target species, the resource to be protected, and economic, labor, and other constraints.

Information Acquisition

Information gathering is essential in the IWM approach. To develop a management plan, it is necessary to delineate the problem area, determine damage and management action levels, select the most effective and least environmentally damaging management options, schedule treatments, and monitor/evaluate the program upon its implementation. The information gathering process includes surveying, monitoring, and record keeping. Surveys are designed to provide information about noxious plant species composition, distribution, abundance, and importance within the resource area to be protected. The purpose of monitoring, or regular inspection of weed-infected or treatment areas, is to compile and record site-specific information on the infestation that can be used to select or modify management strategies.

Damage and Action Thresholds

An essential element of the IWM approach is the use of damage and action thresholds as a basis for management decisions. Thresholds provide weed managers with definitive ways of determining when noxious weed populations warrant manipulative actions or no action. It should be noted that, in the case of Class A and, in some areas, Class B species, state law requires that damage and action thresholds be one seed-producing plant.

A damage threshold is the plant population density or growth stage that results in intolerable damage to the affected resources. The potential for damage is estimated, based on aspects of

weed biology and ecology, propagule transport potential, habitat vulnerability, water quality impacts, the noxious weed's potential to become established and spread, and the extent and land use of geographic area susceptible to invasion.

The action threshold is the plant density level or population size at which suppressive techniques must be implemented in order to prevent the population from reaching the damage threshold. An action threshold is established to guide weed management treatment selection and implementation.

Weed Management Treatment and Method Selection and Implementation

Integrated weed management focuses on the complementary use of two or more methods to manage noxious weeds. In general, preventive measures, along with one or more intervention methods, should be used against invasive species. Many factors must be considered when deciding what management methods would be most feasible and practicable. Selection of these measures must be based on detailed knowledge of available options, the resource to be protected, and weed biology and ecology. Important consideration should be given to methods that interrupt weed propagule dispersal, reduce seed longevity, minimize habitat perturbations contributing to undesirable plant occupancy, and avoid or interrupt local and regional weed immigration and emigration. Management methods can be biological, mechanical, physical, chemical, or preventative.

Evaluation

Once an IWM plan has been formulated and implemented, the project must be regularly reviewed and evaluated. Monitoring the impacted ecosystem is essential. Information gathering and interpretation through time allows the weed management specialist to detect and respond to changes and new developments. Evaluation of monitoring results enters the management system at all levels and is used to refine and improve the system and to provide updated information for the subsequent rounds of decision-making.

3.6.3 Noxious Emergent Plant Management Site-Specific Plan Development

Development of an IWM program for a specific site involves defining the site, seeking public input, determining priorities and objectives, and formulating a site-specific management plan.

Defining a Site: A "site" can be characterized as either an area susceptible to infestation or an area infested by noxious emergent weed species. A site is defined by the weed species present, and occupied habitat characteristics, in relation to treatment strategies and methods. Sites are defined for each noxious species and therefore, a piece of land occupied by more than one noxious species would constitute more than one site. Each site is unique and consequently warrants development of an individualized management plan. Site-specific factors such as the noxious plant species and its invasive status, potential environmental impacts, and the resource management objectives dictate which techniques would be most appropriate. Environmental and human health concerns; accessibility; seasonal, weather-related and possible budgetary and/or labor constraints; and mitigation measures must also be considered while the management plan is being designed.

Public Involvement

An opportunity should be provided for interested and concerned citizens to participate in and comment on the development of a proposed management plan. This is particularly important for large-scale weed suppression programs where public understanding, acceptance, and support of the effort are indispensable. The public involvement effort, instituted during early IWM project planning stages, should be continued throughout the implementation and evaluation phases.

Integrated Weed Management Decision Matrix

By following a step-by-step decision-making process, a weed manager can develop and implement a functional, site-specific management plan. This process is described below. A flow diagram of the integrated weed management plan decision-making process for noxious emergent noxious plants is presented in Figure 2.

(1) Inventory each management site. Determine the legal status (Class A, B, and C) of all identified noxious emergent species and designate the species as new or established invaders (see definitions in Section 3.6.2). Develop or review/modify list of potential new invaders.

(2) Evaluate weed biology to determine potential for infestation growth and dispersal, and for potential environmental damage.

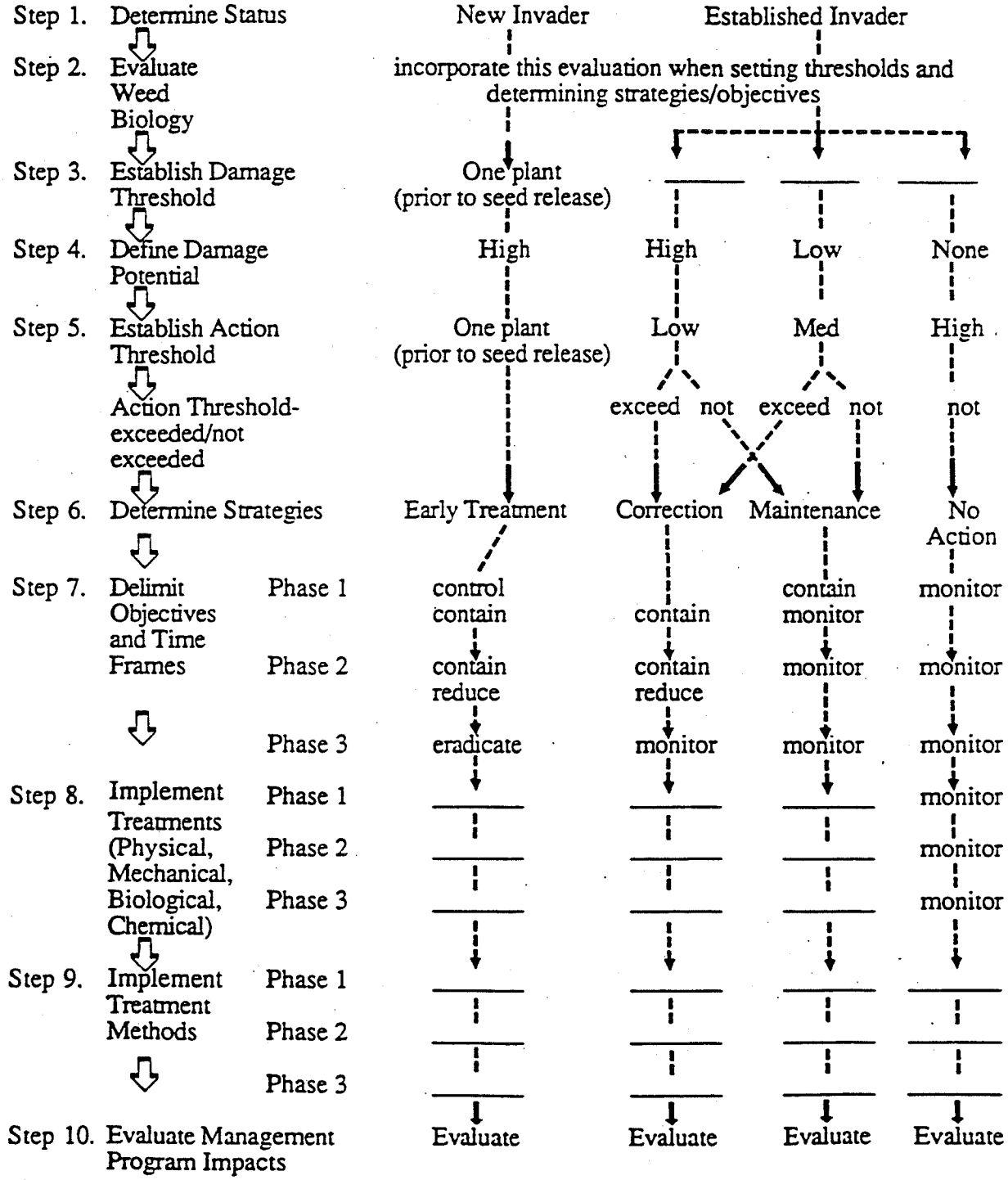

Figure 2. Flow diagram of the integrated management decision-making process for noxious emergent weeds (USFS, 1991).

(3-5) Determine the potential for damage to the site from noxious weed infestation. Determine the damage and action thresholds for each noxious plant species present.

(6) Develop site-specific weed management strategies based on noxious weed status (new or established invader) and damage and action thresholds. Strategies might include early treatment, correction, maintenance, and no action, as well as prevention.

(7) Determine specific objectives that can be attained within reasonable timeframes for each site. Objectives might include one or more of the following: control, containment, reduction, and eradication.

(8,9) Identify and implement appropriate preventive methods and treatments (that is, mechanical/physical, chemical, and/or biological) and specific methods (for example, hand removal, burning, insect bioagent release, etc.) based upon a knowledge of weed biology and ecology, potential treatment efficacy, site-specific characteristics, operational constraints, and mitigation needs. Ascertain costs involved in the implementation of the treatments.

(10) Monitor and evaluate treatments through time to identify the efficacy of the implemented strategies to gauge their effectiveness. Continue inventory for presence of noxious weeds. Identify any use-related constraints and adverse environmental impacts. Adjust management program as needed.

Priority I: *Potential New Invaders*: High priority is assigned to potential new invaders because, through early detection and prevention, the establishment of noxious weeds can be avoided.

Goal: Prevent or reduce the likelihood of invasion by noxious emergent weed species not yet recorded at a site.

Detection: Many species of noxious weeds are capable of invading and establishing in wetland environments throughout Washington. Potential new invaders require constant monitoring to prevent them from entering the state or expanding their currently known distributions.

The key to managing Priority I noxious weeds is to identify those species most likely to enter an area from adjacent counties, states, and Canada, and to take steps to prevent their entry. Likewise, early detection is of paramount importance in the management of these species. Once a potential new invader is discovered, it is reclassified as either a new invader or established invader.

Prevention Strategy and Methods

A preventive weed strategy should always precede and accompany the management effort. Prevention includes early detection procedures and measures taken to alleviate the conditions that cause and foster the spread of certain undesirable plants. Preventive programs might involve enactment and/or enforcement of federal and state laws and regulations restricting noxious weed movement (for example, quarantines such as WAC 16-752-400 through 420 for purple and wand loosestrife, WAC 16-752-500 through 525 for *Spartina*, and WAC 16-752-600 through 660 for giant hogweed and indigobush). Other preventive methods include:

- Revegetation of disturbed soils with desirable plant species immediately after disturbance to inhibit entry of potential invaders
- Evaluation of area management to detect practices that enhance the potential for introduction of noxious weeds
- Curtailment of noxious weed spread in wastelands or along transportation and utility line corridors
- Inventory of nearby sites that are favorable for plant establishment
- Inspection of and/or cleaning machinery, boats, and vehicles prior to their movement from noxious weed-infested sites to uninfested sites
- Management of livestock and wildlife feed and manure to prevent seed dissemination
- Restriction of weed propagule transport in fill earth and in irrigation water delivery systems

- Enhancement of educational awareness among resource managers and users concerning the identification of potential new invaders and new invaders and the detrimental, environmental impacts associated with their spread

Priority II: *New Invaders*: New invaders are given high priority for management action to prevent them from becoming established.

Goal: Control and ultimately eradicate noxious emergent weeds from a site.

Damage and Action Thresholds

One plant growing in the area of concern meets criteria for both damage and action thresholds of new invaders. In this situation, immediate action is required to prevent reproduction. The low damage and action thresholds reflect the potential of any new noxious weed to significantly impact natural resources. Additionally, treatment costs increase as plant populations spread.

New Invader Treatment Strategy Selection and Objectives

Development of objectives for new invaders is based on the strategy of Early Treatment. Early Treatment is characterized by the prevention of seed production when species' locations and numbers are few. The No Action strategy is not applicable to Class A and B-designate species but could be used against Class B-nondesignate and C species. Selected treatments and methods focus on immediate and continued prevention of seed production in the entire infestation. All appropriate treatment methods should be used to achieve the following Phase 1, 2, and 3 objectives.

Phase 1: Effect control and containment during the first treatment year, especially if the infestation is large, in order to prevent further on-site seed production and the enlargement or off-site spread of the infestation. During Phase 1, control efforts should first be directed against perimeter plants and then progress towards the infestation center.

Phase 2: Effect containment and reduction of the population within a specified time after the first year to prevent seed production, confine the infestation on-site, and begin to reduce

infestation size. During Phase 2, the short–and long-term goal of early treatment is the eradication of the noxious weed from the site.

Phase 3: Effect eradication. The first priority is to eliminate satellite (outlier) infestations within the treatment area because these contribute to the rapid and continued spread of the noxious weed species. Once the satellite infestations are eliminated, treatments should be directed against the perimeter of the primary infestation initially and then towards its core to eventually eradicate the plant. Outlier, perimeter, and core treatments must prevent seasonal seed production. A final priority should be the intensive suppression of populations of the target species near the designated eradication site in order to decrease the likelihood of reinfestation. Eradication is assumed to have been accomplished after the last reproducing plant has been observed, viable propagules are thought to have been depleted from the soil, and a safety factor of two or more years has passed.

Priority III: *Established Invaders*: Established invaders are noxious weeds for which all seed production cannot be prevented within a particular site.

Goal: Limit the spread of established noxious emergent weeds by emphasizing containment and reduction within a site.

Damage and Action Thresholds

The damage threshold is quantified in terms of population density (number of plants per unit of land or water surface area), rate of spread, or some other measurable factor. For Class A and, in some areas, Class B species, state law requires that damage and action thresholds be one seed-producing plant.

Determination of action thresholds takes into consideration the noxious weed's damage potential. If the damage potential is high (for example, purple loosestrife's potential to rapidly eliminate desirable food plants and cover essential to wetland wildlife inhabitants), the action threshold would be low (action must be taken at a low population level to prevent the damage threshold from being exceeded). Conversely, if the damage potential is low (for example, an emergent weed's population growth is effectively inhibited by competing plant species), the action level would be higher (action would not be initiated unless a substantial

increase in weed density occurred). When established action thresholds are exceeded, a Correction strategy (described below) must be implemented.

Treatment Strategy Selection and Objectives

Management objectives for established invaders are closely tied to the selection among four treatment strategies: Prevention of colony spread, Correction, Maintenance, or No Action. These strategies are described below:

Prevention: See discussion under Priority 1: Potential New Invaders.

The Prevention strategy is always applicable and should be utilized in combination with the other strategies.

Correction: The correction strategy includes use of treatments and methods to effect containment and reduction of noxious emergent plant species. Treatments and methods could include the following:

(a) Mechanical/physical
- (1) Hand removal/cutting (mowing)/mechanical harvesting
- (2) Covering (smothering)
- (3) Dewatering/draining
- (4) Flooding/inundating
- (5) Trampling/crushing
- (6) Burning/flaming
- (7) Dredging

(b) Chemical (application of selective and/or nonselective herbicides)

(c) Biological
- (1) Microbial pathogens
- (2) Release of insect bioagents
- (3) Forced grazing by livestock
- (4) Plant competition/forced succession

In the Correction strategy, the Phase 1 objective is containment. Eradication is usually an inappropriate objective for an established noxious weed infestation. Selected treatment methods should minimize continued seed production and confine the noxious weed to the treatment site. All appropriate methods might be used. Additional objectives would be defined based on site-specific conditions and management objectives for the area. Long-term, Phase 2, objectives would also include applying containment and reduction techniques to lower the population density below damage and action thresholds.

Maintenance: Maintenance supports the current conditions on the site, and could employ hand pulling, mowing, and/or biological methods to prevent colony spread.

Once the population has been contained and reduced to a point where the action threshold is no longer exceeded, the strategy for the site then becomes Maintenance. If post-treatment monitoring conducted during Phase 3 indicates a breech of the established action threshold, the process reverts to Phase 1, the containment phase. For a Maintenance strategy, the objective is containment during Phase 1. Regular monitoring is necessary during all phases, and as long as the action threshold is not exceeded, the Maintenance strategy remains in effect. If the on-site noxious weed population exceeds the action threshold, the Maintenance strategy would be re-evaluated and the Correction strategy would be implemented.

No Action: No action would be taken on the site to interfere with natural processes. The No Action strategy is not applicable to Class A and B-designate species but could be used against Class B-nondesignate and C species. Site monitoring must be maintained to detect changes that might require the selection of a different strategy (Maintenance or Correction) and objective(s) (containment and reduction).

In a No Action strategy, the objective is to monitor noxious weed population levels to determine if or when the established action threshold is exceeded. If the threshold is surpassed, the site is re-evaluated and either a Maintenance or Correction strategy is then selected and implemented.

3.6.4 Noxious Emergent Plant Species-Specific Management Plans

Because development of a specific IWM plan depends on plant invasive status and infestation density; the resource to be protected; and budgetary, labor force, and other constraints, it is not possible to detail absolute procedures to be followed in every potential management situation. The decision to use a combination of treatments and methods must be based on (1) an assessment of plant developmental status (flowering or non-flowering) and density, (2) a characterization of sites infested or susceptible to infestation within the resource habitat, (3) treatment method use constraints, (4) anticipated method-induced environmental impacts, (5) available mitigation measures, and (6) various other considerations. Flexibility in decision-making and management option selection is essential to the successful application of the integrated approach.

Generic integrated management treatment options are presented for *Spartina* and purple loosestrife (Tables 9 and 10). These tables describe methods available to weed managers and efficacy estimates for various infestation situations. Unfortunately, little is known about the efficacy of some of the management methods listed in each of these tables. Most available information is anecdotal or relates to limited studies, sometimes without adequate experimental design. Selection of management methods included in the table is based on best professional judgement of the authors, state agency reviewers, and other scientists with technical expertise and is based on balancing efficacy against consideration of environmental impacts.

Table 9. Potential methods to use in an integrated weed management program for general infestation situations for *Spartina* species.

INFESTATION THREAT AND LOCATION WITHIN INFESTATION	OBJECTIVE	MANAGEMENT METHOD	POTENTIAL EFFICACY[1]		PLANT GROWTH STAGE	IMPACTS/MITIGATION DISCUSSION
			SMALL AREA	LARGE AREA		
Established Invader: Core	Containment, Reduction	Herbicides	Low to High	Low to High	Actively growing, especially pre-flowering	Section 4.5
		Cutting/mowing	Medium to High	Medium to High	Pre-flowering or early flowering, every month	Section 4.3
		Mechanical crushing	Low to Medium	Low to Medium	Brittle stem	Section 4.3
		Covering	Medium	Low	All stages during growing season	Section 4.2
		Burning (for containment)[2]	Low to Medium?	Low	Pre-flowering	Section 4.2
	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---
Established Invader: Perimeter	Containment, Reduction	Herbicides	Low to High	Low to High	Pre-flowering	Section 4.5
		Cutting/mowing	Medium to High	Medium to High	Pre-flowering to early flowering, every month	Section 4.3
		Mechanical crushing	Low to Medium	Low to Medium	Brittle stem	Section 4.3
		Burning (for containment)[2]	Medium	Low to Medium?	Pre-flowering	Section 4.2
		Flaming (for containment)	Medium?	Medium?	Pre-flowering	Section 4.2
	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---

Table 9. Continued.

INFESTATION THREAT AND LOCATION WITHIN INFESTATION	OBJECTIVE	MANAGEMENT METHOD	POTENTIAL EFFICACY[1]		PLANT GROWTH STAGE	IMPACTS/MITIGATION DISCUSSION
			SMALL AREA	LARGE AREA		
Established Invader: Outliers	Containment or Control	Hand pulling	Medium to High	Medium to High	Seedlings to small plants	Section 4.2
		Covering	High	Medium to High	All stages during growing season, treatment repeated every month	Section 4.2
		Herbicides	Low to High	Low to High	Seedlings, pre-flowering	Section 4.5
		Flaming	Medium to High?	Low to Medium?	Pre-flowering	Section 4.2
	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---
New Invader	Eradication, Reduction, Containment, Control	Herbicides	Low to High	Low to High	Seedling, pre-flowering	Section 4.5
		Hand pulling/digging	Medium to High	Medium	Seedling to small plant	Section 4.2
		Covering	High	Medium to High	All stages during growing season, treatments repeated every month	Section 4.2
		Mechanical crushing	Low to Medium	Low to Medium	Brittle stem	Section 4.3
	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---
Potential New Invader	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---

[1] Actual efficacy is site- and project-specific and depends on type of infestation, site characteristics, techniques used in implementing management methods, application timing, and number of treatments.
[2] Burning might require use of an accelerant such as hay. Use of petroleum-based accelerants would cause severe effects on water quality and wildlife and would not be permitted.

Table 10. Potential methods to use in an integrated weed management program for general monospecific infestation situations for purple loosestrife (*Lythrum salicaria*).

INFESTATION THREAT AND LOCATION WITHIN INFESTATION	OBJECTIVE	MANAGEMENT METHOD	POTENTIAL EFFICACY[1/]		ACTION OR PLANT GROWTH STAGE	IMPACTS/MITIGATION DISCUSSION
			SMALL INFESTATION	LARGE INFESTATION		
Established Invader: Core	Containment, Reduction	Biocontrol (insects)	Medium	Medium to High	Insect releases or redistributions	Section 4.4
		Competitive Plantings (trees and other vegetation)	Medium	Medium	Planting/seeding	Section 4.4
		Herbicides	High	Medium to High	Seedling to pre-flowering	Section 4.5
		Burning	Medium	Medium	Seedling and old-growth	Section 4.2
		Covering	Medium to High	Medium?	All plant stages	Section 4.2
		Cutting/mowing	Medium	Medium	Pre-flowering	Section 4.3
		Grazing	Medium to High?	Low to Medium?	Seedling to pre-flowering	Section 4.4
	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---
Established Invader: Perimeter	Containment, Reduction	Biocontrol (insects)	Low to Medium	Medium	Pre-flowering	Section 4.4
		Herbicides	Medium to High	Medium	Pre-flowering	Section 4.5
		Cutting/mowing	Medium	Medium	Pre-flowering	Section 4.3
		Burning	Medium to High?	Medium to High?	Seedling and old-growth	Section 4.2
		Flaming	Medium to High?	Medium to High?	Seedling and pre-flowering	Section 4.2
	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---

Table 10. Continued.

INFESTATION THREAT AND LOCATION WITHIN INFESTATION	OBJECTIVE	MANAGEMENT METHOD	POTENTIAL EFFICACY[1/]		ACTION OR PLANT GROWTH STAGE	IMPACTS/MITIGATION DISCUSSION
			SMALL INFESTATION	LARGE INFESTATION		
Established Invader: Outliers	Containment, Control, Reduction	Hand pulling/digging	High	High	Seedling to flowering plants	Section 4.2
		Herbicides	High	High	Seedling to pre-flowering	Section 4.5
		Flaming	Medium to High?	Medium to High?	Seedling	Section 4.2
	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---
New Invader	Eradication	Herbicides	High	Medium to High	Seedling, pre-flowering	Section 4.5
		Hand pulling/digging	High	Medium	Seedling, pre-flowering	Section 4.2
	Containment, Control, Reduction	Covering	High	Medium to High	Seedling, pre-flowering	Section 4.2
		Competitive plantings	Medium to High	Medium to High	---	Section 4.4
	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	High	High	---	---
		Competitive plantings	Medium to High	Medium to High	---	Section 4.4
Potential New Invader	Prevention	Education/awareness	Medium to High	Medium to High	---	---
		Surveys	Medium to High	Medium to High	---	---

[1/] Actual efficacy is site- and project-specific and depends on type of infestation, site characteristics, techniques used in implementing methods, application timing, and number of treatments.

4.0 IMPACTS ANALYSIS

This section considers impacts to elements of the natural, built, and agricultural/aquacultural environment associated with each of the proposed alternatives. Elements of the environment to be considered during the EIS process are specified in WAC 197-11-444. These elements were discussed and their significance to this proposal was evaluated as part of the scoping process. To focus on the significant issues—as well as to simplify the EIS format, alleviate redundancy, and improve readability—some of these elements of the environment have been grouped into categories. These groupings of elements are explained in Table 11. For each alternative, impacts to all elements listed in Table 11 were fully considered. However, only significant environmental impacts are discussed below. If the technical reports (Appendices A through K) indicate that an element would not be significantly affected, either negatively or positively, then that element is not discussed in this section. Depth of discussion for each impact is commensurate with the importance of the impact.

As defined by SEPA, mitigation means the following, in order of preference:

- Avoiding an impact altogether by not taking a certain action or part of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- Compensation for the impact by replacing, enhancing, or providing substitute resources or environments.

Possible mitigation measures for specific impacts are discussed. Mitigation measures required for a particular control method would depend on site characteristics and applicable regulations. Efforts were made to standardize the presentation of impacts and mitigation

Table 11. Elements of the natural, agricultural, and built environment considered in the Impacts Analysis

SEDIMENT/SOILS

- Sediment composition
- Erosion
- Shoreline stability
- Sediment accretion/redistribution

WATER QUALITY & MOVEMENT

- Water circulation (flooding, tidal inundation, surface water)
- Ground water (water table elevation, recharge/discharge)
- Storm water run-off
- Public water supplies
- Irrigation systems

BIOTIC COMMUNITIES

- Wildlife, fish and benthic habitats
- Non-target biota (including rare species)
- Food web dynamics
- Habitats vulnerable to infestation
- Agricultural/Aquacultural species (livestock, shellfish) & practices (pasturing)

AIR QUALITY

- Odor
- Climate
- Emissions
- Pollutant levels

HUMAN HEALTH

- Public exposure
- Toxicity (human/mammalian risk)
- Risks

RECREATION, AESTHETIC & CULTURAL RESOURCES

- Areas designated for preservation
- Land use
- Recreational areas and activities (hunting, fishing, boating, birdwatching)
- Areas of historical or cultural importance including archaeological sites
- Noise levels

measures among the alternatives. However, because of the different subject matter contained in each alternative, and to minimize redundancy within and among sections, discussion format varies.

Finally, additional information needs for each alternative are identified and prioritized. Priority for these research needs was established by balancing several factors. High priority research or information needs are those items that would: (1) reveal serious data gaps that might result in significant environmental impacts; (2) provide information about immediate threats to environmentally or economically sensitive environments; or, (3) focus on the most effective treatments that seem to have minimal associated environmental impacts.

4.1 NO ACTION ALTERNATIVE

This section describes potential significant adverse impacts to natural, agricultural/ aquacultural, and built environments that might result from the No Action Alternative. A description of this alternative is presented in Section 3.1. Results in this section are summarized from the technical report, No Action: Efficacy and Impacts, which is included in this volume as Appendix C. Mitigation efforts under this alternative would be limited to interested agencies continuing to monitor populations of noxious weeds and participate in public outreach programs. These plants would still be listed as noxious weeds.

4.1.1 *Spartina*

The spread of *Spartina* species would continue under the No Action Alternative, and would be limited only by extent of available habitat, possibly competition from native species or other natural processes. There are several significant impacts associated with *Spartina* colonization of tidal flats in Washington. These impacts are related to two major consequences of uncontrolled *Spartina* colonization: sediment accretion associated with *Spartina* colonies and conversion of tidal flats to *Spartina* marsh. The three species of *Spartina* are, collectively, able to colonize the entire intertidal zone. A summary of the positive and negative impacts associated with the continued spread of *Spartina* species is provided in Table 12.

<u>Sediment Accretion and Topographic Change</u>: Increased rates of sediment accretion and changes in sediment composition and substrate topography would occur in intertidal areas

Table 12. Summary of major impacts of the No Action Alternative on *Spartina* infestations in Washington intertidal waters.

Potential Positive Impacts	Potential Negative Impacts
• Increased cover availability in some situations for some fish, waterfowl, and wading birds	• Continued spread of *Spartina* species
• More nesting habitat for some birds	• Decrease of salt marsh and eelgrass communities
• Greater foraging habitat for some small mammals	• Significant loss of habitat for shellfish, other invertebrates, and fish dependent upon intertidal flats
• Shoreline stabilization	• Reduction in feeding and roosting habitat for migratory and wintering waterfowl and shorebirds
• Reduction of sediment deposition on other sensitive areas by sediment trapping	• Loss of preinfestation biodiversity
• Increase in available food for fish due to increase in salt marsh mosquitos	• Reduction in nutrient inputs to estuarine waters where nutrient concentrations are not excessive and subsequent decreases in phytoplankton
• Reduction in nutrient inputs to estuarine waters in areas with excessive concentrations of nutrients	• Increased flooding of residential and commercial properties, agriculture/aquaculture facilities, and public works developments
	• Changes in topography and elevation of intertidal areas due to sediment accretion
	• Impacts to recreation due to increase in salt marsh mosquitos

colonized by *Spartina*. *Spartina* stems and rhizomes trap and accrete fine sediments from tidal and river flow and overland runoff. In Willapa Bay, exposed clumps of *Spartina* accreted sediment at a rate of 0.5 to 2.0 cm/year, depending on shoot density (K. Sayce, pers. comm. 1993). This rate was measured in an exposed, erosion-prone area (Leadbetter Point) and therefore represents a conservative estimate of accretion rates. Accretion rates are expected to be higher in quieter waters. Substrate of *Spartina* marshes consist of a higher proportion of softer, finer particles such as silts and clays, than tidal flats dominated by either sand or mud. With the accretion of sediments there is a concurrent reduction in sediment inputs to surrounding areas.

Extensive dieback of *Spartina* stands and subsequent erosion of accreted sediments by waves or tidal currents could cause sediment to be redeposited in other areas. This has been documented in *S. anglica* infestations in England (University of Hull, 1987). The amount of erosion in dieback areas would likely depend on the strength of waves or tidal currents in the area. Temporary or permanent burial of bottom-dwelling organisms and would result from redeposition of sediments in some areas.

Alteration of topography in intertidal areas would also likely occur from *Spartina* colonization. Sediment accretion increases the elevation of a growing *Spartina* marsh above surrounding tidal flats. In contrast to the formerly open, gently sloping flats with shallow tidal channels, fully-developed *Spartina* marshes have steeply sloping seaward edges and deep, steep-sided tidal channels. Because of the abundance of long low gradients, and available sediment, Willapa Bay is particularly susceptible to this type of topographic change. *Spartina* has been intentionally planted for shoreline stabilization and erosion control in some areas. Some shoreline areas would be stabilized as the result of *Spartina* colonization.

Impacts to Water Quality/Water Movement

The No Action Alternative would impact water quality and water circulation patterns in some areas. Few studies have evaluated the effects of *Spartina* infestations on water quality and movement, it is conceivable that water quality in areas with extensive *Spartina* infestations would be affected by decreased dissolved oxygen content caused by natural decomposition of *Spartina* litter, particularly during late summer and fall. Conversely, water quality in some areas might, at least temporarily, improve because of *Spartina* trapping suspended sediments

and filtering and assimilating organic and inorganic pollutants from stream and tidal flows and from overland runoff.

Kraus (1989) found that *S. alterniflora* is capable of accumulating, chemically altering, and transporting a variety of heavy-metal compounds. Heavy metals are exported when dead leaves and stems are removed by tidal action and could enter the food web and be concentrated in higher levels of the food chain. *Spartina alterniflora* also excretes a variety of heavy-metal salts and could release volatile metals such as mercury through its gas transport system. Kraus concludes that *S. alterniflora* marshes delay, but do not prevent, heavy-metal pollution of water and that heavy-metal laden wastewater should not be filtered through these marshes.

Some areas of *Spartina* would be subject to decreased frequency of tidal inundation due to vertical accretion of sediments. This situation has been observed at the Willapa Bay National Wildlife Refuge (F. Paveglio, pers. comm. 1992). In these areas, tidal exchange is limited to deeper channels. Where it occurred, decreased tidal inundation would increase surface water temperatures and either increase or decrease soil salinities (depending on freshwater inputs and rate of evapotranspiration) within a *Spartina* marsh. Increased water flows and velocities would also occur in tidal or stream channels if surrounding areas no longer transport tidal flows.

Flooding frequency in shoreline and river delta areas would increase if accretion is sufficient to inhibit the retreat of tidal waters. Large infestations in or near the mouths of rivers might restrict flow and cause increased flooding in river delta areas, particularly during periods of heavy precipitation or above normal tides. Extensive *Spartina* infestations might cause increased frequency and extent of flooding in shoreline areas. Residences, commercial properties, resorts, parks, and other areas could be affected by floods. Public water supplies located near *Spartina*-infested areas might also be affected by increased flooding. Decreased water quality in surface water supplies or shallow wells might result from salt water intrusion from tidal waters. Additionally, water table levels in septic fields could rise during periods of flooding. Septic systems might be unusable at certain times of the year and leachates from septic systems could affect the quality of surrounding ground or surface waters.

A significant increase in the number of salt marsh mosquitos might also be a consequence of sediment accretion and topographic changes associated with *Spartina* colonization (M.

Landin, pers. comm. *fide* K. Sayce 1993). Clumps of *Spartina* trap water and the standing pools of water increase breeding habitat for the mosquitos.

Impacts to Recreation

Recreational opportunities could be affected by *Spartina* infestations, although there have been no studies of changes in recreation use due to *Spartina* infestations. It is reasonable to assume loss of beach habitat, reduced access to water, beaches or streams, loss of navigation routes, and alterations to estuarine ecosystems might result from *Spartina* growth. Such changes could negatively impact recreational activities including sport fishing, waterfowl hunting, bird watching, recreational shellfish harvesting, boating, and hiking.

Impacts to the Biotic Community

Estuarine environments being colonized by *Spartina* species are productive, biologically diverse habitats. Little information, however, exists on the value of *Spartina* marshes in Washington to fish and wildlife. Thus, actual consequences to fish and wildlife from *Spartina* invasions are difficult to predict. Potential positive and negative impacts to animals due to *Spartina* infestations, based on the results of studies and personal observations conducted in Washington and elsewhere in the world evaluating the habitat value of introduced *Spartina* marshes, are discussed below. For citations of original observations, see Appendix C.

Impacts to Tidal Flats and Existing Vegetation: The conversion of tidal flats and native marshes to *Spartina* marsh would result in the loss of open tidal mud and sand flats, eelgrass and macroalgae beds, and other native salt marsh vegetation. *Spartina* species colonize formerly unvegetated tidal flats or displace native salt marsh species by establishing in an area and expanding vegetatively. In addition, wracks of *Spartina* litter wash up onto and kill the native vegetation (K. Sayce, pers. comm. 1993). Increased flooding frequency in shoreline and river delta areas would occur if sediment in *Spartina* marshes accretes to a level sufficient to block the retreat of tidal waters, and this change in hydrology could degrade native habitats. Colonization of tidal flats and loss of native flora by *Spartina* would have significant implications for the fauna associated with these important communities, as discussed below. Although positive and negative effects from *Spartina* infestations have not

been quantified, it is clear that native habitats would be significantly altered, and habitat for many species would be diminished, while habitat for others could be enhanced.

Unvegetated tidal flats in Washington are primary habitats for clams, oysters, other shellfish species, and other organisms living on the sea bed (benthic). These open flats are critical feeding areas for shorebirds and waterfowl, particularly during spring and fall migrations. Small mammals—such as shrews, voles, and moles—also utilize salt marsh areas. Fishes also use tidal flats and salt marshes as feeding areas during incoming tides.

Replacement of eelgrass and other native vegetation habitat by *S. alterniflora* has been observed in some areas of Willapa Bay. Hundreds of acres on the Willapa National Wildlife Refuge that once supported eelgrass (either *Zostera marina* or *Z. japonica)* have been colonized by *S. alterniflora* (F. Paveglio, pers. comm. 1992). Oysters, clams, shrimp, crabs, polychaete worms, snails, and other invertebrates inhabit the various niches of an eelgrass community, including the water column, sediment, sediment surface, and roots and blades of eelgrass. In addition, shorebirds, waterfowl, and gulls eat a variety of foods from eelgrass beds, including eelgrass seeds and blades, epifauna (animals on the sediment or water surface), and invertebrate and fish eggs. Fishes that inhabit eelgrass beds are prey for birds and other fishes. Eelgrass beds are important seasonal and year-round habitat for many fishes.

Invertebrates

Shellfish species that commonly occur in tidal flats or eelgrass beds might not be able to colonize or survive in *Spartina* marshes because of the dense root mat and thick layer of soft, fine sediments associated with these habitats. Thus, populations of some species might decline in areas with extensive *Spartina* infestations. Preliminary investigations in Willapa Bay indicate potential exclusion of shellfish and other benthic macroinvertebrate species from *Spartina* marshes (Atkinson 1992). Early results of a Washington Department of Fisheries study being conducted by Brett Dumbauld indicate that some, but not all, shellfish are excluded from *Spartina* marshes (C. Samuelson, pers. comm. 1993).

Birds and Mammals

Conversion of large areas of tidal flats or eelgrass beds to *Spartina* marshes might cause reductions in numbers of migratory and wintering shorebirds and waterfowl that can be supported in critical staging and wintering areas such as Willapa Bay, Padilla Bay, Skagit Bay, and Grays Harbor. Willapa and Padilla bays are the two major overwintering areas for black brant (*Branta bernicula nigricans*) in Washington. Large flocks of migratory waterfowl and shorebirds that congregate in these and other waters feed heavily on invertebrates in the tidal flats, and on eelgrass and its associated fauna. Smaller numbers of waterfowl also overwinter in Washington bays and estuaries. Observations in Willapa Bay indicate that waterfowl no longer frequent areas that have converted from tidal flat to *S. alterniflora* stands. In other areas of Washington, displacement of native vegetation by *Spartina* is also negatively impacting waterfowl habitat. For example, in some areas, American bulrush (*Scirpus americanus*) is being displaced by *S. anglica*, resulting in the loss of a food source for snow geese and black brant. Thus, conversion of large areas of tidal flats, eelgrass beds, or other native vegetated marshes to continuous *Spartina* marsh would likely cause decreased availability of suitable waterfowl habitat.

Based on the results of a British estuarine study, the benthic invertebrate composition is different between tidal flats, eelgrass beds, and *S. anglica* colonies. Worms, bivalves, and amphipods dominated the open flats, whereas only gastropods occurred in high numbers in *Spartina* clumps and only shore crabs occurred at high densities in closed stands. Correspondingly, the diversity and total numbers of shorebirds feeding in *S. anglica* clumps and stands were dramatically lower than in tidal flats. It appeared that most species of shorebirds avoided areas of *Spartina*. The tight flocking behavior of many species of shorebirds might preclude their use of *Spartina* marshes because the visual communication necessary to maintain flock structure is impaired. Moreover, the high density of *Spartina* stems is likely to prevent birds from landing easily and also might restrict their movement on the ground.

Increased cover associated with *Spartina* marshes might benefit some birds, although possibly not the same species as before *Spartina* infestation. For example, herons and bitterns have been observed hunting in *S. alterniflora* stands in Willapa Bay. In addition, the physical structure of *Spartina* stands might benefit some songbirds. High densities of marsh wrens have been observed nesting in mature *S. alterniflora* stands in Willapa Bay. Although

continuous stands of *Spartina* marsh appear unsuitable for waterfowl, impacts might be less harmful when isolated *Spartina* clones are scattered throughout a tidal flat area. Such a situation might not impair flocking behavior and could provide the added benefit of increased cover. However, the value of isolated clones is temporary because clones eventually grow together into closed stands.

Seals, otters, and other marine mammals that use tide flats and shallow subtidal areas, as well as elk, small mammals, coyotes, and other land-based mammals would be impacted by *Spartina* infestations.

Fish

Large losses of tidal flat or eelgrass habitats could negatively impact some native fish species that depend on these areas for feeding, spawning, or rearing habitats. In addition, prey organisms, particularly benthic fauna and their consumers, would likely be different in *Spartina* marshes than in tidal flat, eelgrass, or native salt marsh habitats. The effects of such shifts on fish populations and predator-prey relationships are unknown.

Numerous fish species are associated with the surface and tidal channels of *S. alterniflora* and *S. patens* salt marshes in its native range along the Atlantic coast of North America. It is possible that many Washington species could adapt to *Spartina* habitats. The cover afforded by *Spartina* might be particularly beneficial to juvenile surfperch and other species. However, this benefit might only apply for small clones and the edges of larger clones or stands. *Spartina* could also provide protection from predation to salmonids migrating downstream. The value of isolated clones to fish would be lost once the clones have grown together into closed stands. Additionally, retention of sediment in *Spartina* marshes could prevent further degradation of spawning habitats for species that have apparently been affected by siltation (Cheney *et al.* 1986).

Some fish species might not successfully utilize *Spartina*. For example, benthic predators such as sole and sturgeon might not adapt to the physical structure of *Spartina* marshes. In addition, *Spartina* marshes are probably not suitable spawning habitat for Pacific herring or other species that typically spawn in eelgrass beds. In some areas, vertical accretion of sediments might prevent entry of tidal waters and fish in *Spartina* marshes. Stranding of fish

that entered marshes at extremely high tides could also occur on the outgoing tide, leaving them susceptible to predation, temperature extremes, and low dissolved oxygen.

Threatened and Endangered Species

One state-listed threatened (and federal candidate) wetland plant species could occur in salt marshes in Washington. Thick-glume reedgrass (*Calamagrostis crassiglumis*) has been documented in salt marshes in Alaska and might be vulnerable to infestations by *Spartina* species in Washington. In addition, two state sensitive species, Alaska alkaligrass (*Puccinellia nutkaensis*), known from Puget Sound, and sharp fruited peppergrass (*Lepidium oxycarpum*), known from San Juan County, could potentially be affected by *Spartina* colonization and the resultant loss of native habitat. In addition, some species listed as "Sensitive," such as black lily (*Fritillaria camschatcensis*), could also be vulnerable.

Populations of three state endangered animal species, brown pelican (*Pelecanus occidentalis*), Aleutian Canada goose (*Branta canadensis leucopareia*), and peregrine falcon (*Falco peregrinus*), and two state threatened bird species, bald eagle (*Haliaeetus leucocephalus*) and marbled murrelet (*Brachyramphus marmoratus*), could potentially be affected by *Spartina* infestations. Populations of these bird species could be affected by changes in availability of prey species or foraging habitats resulting from *Spartina* infestations. The Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*) is federally listed as threatened. This species is known from only two sites in Washington State, and colonization of estuaries by exotic plants is considered to be one of the reasons for loss of its nesting habitat (J. Civille, pers. comm. 1993; Federal Register, March 5, 1993).

Food Web Dynamics

Detritus (organic debris derived from fragmented, decaying plant or animal matter) is a vital link in estuarine food webs. The pathway from detritus to benthic crustacea to fish, birds, and mammals is particularly important. Large *Spartina* infestations could alter the food web dynamics of Washington estuarine systems by reducing nutrient inputs to estuarine waters, causing decreases in benthic or epiphytic algal production, changing habitat availability for animals, and causing major shifts in invertebrate prey bases. For example, benthic and epiphytic algae populations might be limited in *Spartina* stands because of the effects of shading, increased water temperatures, and increased frequency of desiccation. A study of

outmigrating juvenile chum salmon in Hood Canal determined that eelgrass and its associated algae are the basis of the food web for this salmon species in the estuary. These findings could differ for other Northwest estuaries and salmon species, however, this example illustrates the importance of epiphytic and benthic algae to estuarine ecosystems.

Changes in habitat availability for plants and animals and shifts in prey bases, particularly benthic fauna for higher level consumers, would probably occur in infested estuaries and might drastically alter estuarine food webs. Although the long-term effects of such changes are unknown, it is possible that competition among organisms for decreased resources and inability of organisms to adapt to the new physical conditions in *Spartina* stands might negatively impact populations of fish and wildlife in the state.

Conversely, *Spartina* leaves and aerial stems, which die back each year, provide an extensive source of detritus that is used by organisms at the base of the food chain. A change in food web dynamics would clearly occur if large infestations of *Spartina* became established in a particular area, resulting in changes in relative abundance of fish and wildlife species, but the balance of potential positive and negative effects is unknown.

Impacts to Human Health

The No Action Alternative is expected to have no impacts on human health.

Agricultural/Aquacultural

Aquaculture

Spartina infestations might have significant economic impacts in regions where ground culture is the primary method of shellfish aquaculture. Fine sediments accreted in *Spartina* colonies could smother shellfish and increase elevation of bed areas above levels of regular tidal inundation. Dense root mats could preclude burrowing by clams. Conversion of open tidal flats to *Spartina* marsh would result in the loss of areas currently suitable for ground culture of oysters, although normal intensive cultural activities could prevent this conversion. It is possible that longline and rack culture could be practiced in some infested areas, where tidal exchange within the *Spartina* stand is adequate, because oysters are suspended

off the bottom. However, the impacts of *Spartina* on suspended culture have not been investigated, and the two would probably not be compatible in the long run.

Commercial Fisheries

Spartina infestations can affect commercial fishing through long-term changes in habitat and production of fish and shellfish. Generally, these changes are not expected to be of positive benefit. However, the significance of the change or its effect on commercial species cannot be predicted with existing information. Fishing would be impacted to some extent by loss or degradation of navigable waters and fouling of nets and other gear by wracks of *Spartina* litter.

4.1.2 Purple Loosestrife

Purple loosestrife would continue to invade natural, disturbed, and constructed freshwater wetland communities in Washington under the No Action Alternative. Suitable purple loosestrife habitat includes alluvial floodplains, wetlands, irrigation wasteways and canals, roadside ditches, wet pastures, stream or river banks, and pond and lake shores, which are abundant in Washington. The potential for widespread colonization of sensitive habitats is great, and this species would have severe environmental and economical impacts in many areas. Associated impacts might include displacement of native species and the resulting loss of species diversity, reduction and degradation of available habitat for wildlife (primarily waterfowl, songbirds, shorebirds, and fur-bearing mammals), decreases in irrigation canal and ditch channel capacities, degradation of bird watching, hunting and fishing areas, and declines in the quality of wetland pastures and hay fields. A summary of the positive and negative impacts associated with the continued spread of purple loosestrife is provided in Table 13.

<u>Impacts to Water Quality/Water Movement</u>: Impacts of purple loosestrife infestations on the water quality and groundwater recharge/discharge functions of wetlands have not been examined. Biofiltration of suspended solids would improve, but increased sedimentation would decrease the water storage capacity of a wetland and reduce its ability to attenuate floods. Such alterations in wetland hydrology and the potential increases in evapotranspiration caused by infestations might decrease the amount of groundwater recharge. These impacts might ultimately affect the groundwater on which some public

Table 13. Summary of major impacts of the No Action Alternative for managing purple loosestrife infestations in Washington wetlands.

Potential Positive Impacts	Potential Negative Impacts
• Abundant source of pollen and nectar	• Continued spread of purple loosestrife
• Aesthetic values	• Decreased cover and forage for wetland wildlife—primarily waterfowl, song birds, shorebirds, and fur-bearing mammals
• Biofiltration of road runoff and irrigation return ditches	• Decreased species diversity
	• Decreased irrigation canal and ditch channel capacity and concomitant increase in operation and maintenance costs
	• Degradation of hunting and fishing opportunities and reduction of potential for other wildlife related activities
	• Alteration of existing food web

water supplies depend. Increased vegetation and sediment deposition could also potentially alter flows and currents in infested watercourses.

The quality of public water supplies might be adversely affected if detention basins become infested with purple loosestrife. Colonization of purple loosestrife could affect the ability of the detention basin to store water, although these effects would be similar to those due to growth of other emergent species, and might be insignificant. If the basin functions as a biofiltration area for stormwater and roadside runoff, the decreased storage capacity and decreased efficacy for biofiltration of some water contaminants would adversely affect water quality.

Purple loosestrife infestations also affect ditch systems used to convey stormwater and roadside runoff away from urban areas. Adverse impacts of infestations on ditch systems include: (1) increased rate of sediment accretion and the associated frequency and cost of cleaning; (2) reduced storage capacity; (3) increased vegetation control requirements; (4) damaged roadways resulting from impedance of drainage; and (5) dispersal of the plant within a drainage system.

There are extensive purple loosestrife infestations in irrigation systems in eastern Washington. Dense stands of this species interfere with ditchbank integrity and channel capacity. Under the No Action Alternative, irrigation systems would continue to be infested. They are particularly susceptible to purple loosestrife infestations because they are regularly maintained (disturbed) and are part of an interconnected waterway that serves as an efficient dispersal route for floating seeds and propagules. It is also probable that flow rates within these channels and irrigation water available to agricultural producers would continue to decrease.

<u>Impacts to the Biotic Community</u>: Possible impacts to the biotic communities of Washington wetlands, streams, and rivers from the invasion of purple loosestrife have not been well-studied. However, the loss of plant species diversity associated with purple loosestrife infestation would cause elimination of natural foods and cover essential to many wetland wildlife inhabitants. Based on the few studies that have been conducted, the primary impact is habitat loss for birds and fur-bearing mammals. Wildlife impacts are closely related to the replacement of native plant communities. Additionally, purple loosestrife

colonization of moist soil areas results in loss of open-water space, open shorelines, and low vegetation near the water's edge, which has negative impacts on some species of wildlife.

Monospecific stands of purple loosestrife can jeopardize threatened and endangered native wetland plant and animal species. The Pacific Northwest has several state-listed threatened and endangered species that rely on wetlands during their life cycle. Without management, purple loosestrife would contribute to local extirpations or declines of these vulnerable species.

Plants

Native wetland plant communities would be eliminated from many areas under the No Action Alternative. This would result in decrease in habitat for many species, which could make these species more vulnerable to extinction or extirpation from Washington. Table 14 lists the endangered and threatened wetland plant species in Washington State and summarizes the vulnerability of their habitats to purple loosestrife infestation. State-listed Sensitive species, which are also vulnerable to purple loosestrife infestation, are too numerous to discuss here. Based on their preferred habitat and plant associates, Kalm's lobelia (*Lobelia kalmii*) and howellia (*Howellia aquatilis*) are at relatively high risk from purple loosestrife infestation. The degree of risk depends on the vigor of the endangered population, the level of disturbance within the habitat, and the proximity and accessibility of purple loosestrife infestations. Populations of yellow lady's slipper (*Cypripedium calceolus* var. *parviflorum*) in vernal pool habitats in the channeled scablands are moderately vulnerable and might be jeopardized by nearby purple loosestrife infestations. Species listed in Table 14 as having low vulnerability to purple loosestrife occupy habitats typically not exploited by purple loosestrife.

Animals

The No Action Alternative would result in the elimination or degradation of native wetland plant communities in many areas, which would adversely impact bird, mammal, amphibian, reptile, and invertebrate species that depend on these sensitive habitats. Predators that prey on residents of wetlands could also be affected.

Table 14. State threatened and endangered plant species that might occur in wetlands in Washington.

SPECIES	GENERAL HABITAT	VULNERABILITY TO PURPLE LOOSESTRIFE
Threatened		
Calamagrostis crassiglumis (thick-glume reedgrass)	Coastal freshwater and brackish marshes; lakeshores.	MODERATE. Purple loosestrife inhabits freshwater marshes and lakeshores.
Corydalis aquae-gelidae (Clackamas corydalis)	Mostly >2,500 feet elevation in Pacific silver fir zone. Forested boggy areas, small streams, seeps, and springs.	LOW. Purple loosestrife does not occur at this elevation.
Eryngium petiolatum (Oregon coyote-thistle)	Vernally moist wetlands	MODERATE. Often associated with potential purple loosestrife habitat.
Lobelia kalmii (Kalm's lobelia)	Marshlands or springs, along shores and in other wet areas.	HIGH. Occurs near existing infestations.
Ophioglossum vulgatum (adder's tongue)	Vernally moist wetlands	MODERATE. Often associated with potential purple loosestrife habitat.
Platanthera chorisiana (Choriso bog orchid)	Moist areas, especially at the edge of subalpine streams or bogs.	LOW. Purple loosestrife rarely occurs in subalpine zone.
Sisyrinchium sarmentosum (pale blue-eyed grass)	Perimeter of moist meadows in mixed coniferous forests, 2,500 to 3,900 feet elevation.	LOW. Purple loosestrife rarely occurs at these elevations.
Endangered		
Cypripedium calceolus var. *parviflorum* (yellow lady's slipper)	Shady areas. Bogs to damp, mossy woods. Mostly forested habitats or adjacent to vernal pools in channeled scabland.	MODERATE. Purple loosestrife not very shade tolerant. Some populations close to existing purple loosestrife infestations in vernal pools in channeled scabland.
Delphinium viridescens (Wenatchee larkspur)	Highly restricted in Wenatchee Mountains; wet meadows, shrub thickets, springs.	LOW. Isolated and at higher elevation than most purple loosestrife infestations.
Howellia aquatilis (howellia)	In vernal or permanent ponds and lakes, channeled scablands.	HIGH. Usually associated with potential purple loosestrife habitat.
Liparis loeselii (twayblade)	Mostly around springs and in sphagnum bogs.	LOW. Unlikely purple loosestrife habitat.
Polemonium pectinatum (Washington polemonium)	Intermittent streams, sometimes found on upland sites.	LOW. Habitat too dry for purple loosestrife.

Table 14. Continued.

SPECIES	GENERAL HABITAT	VULNERABILITY TO PURPLE LOOSESTRIFE
Rorippa columbiae (persistentsepal yellowcress)	Moist sandy soil in the periodically inundated zone of the Columbia River, usually in areas subjected to wave action.	LOW. Unlikely purple loosestrife habitat.

Some habitat information and vulnerability assessments provided by John Gamon (pers. comm., 1992)

The Western pond turtle (*Clemmys marmorata*) is a state-listed candidate threatened species confined to wetland habitats in Washington State. Two other state-listed candidate threatened species would also be vulnerable: the spotted frog (*Rana pretiosa*) inhabits marshy edges of ponds and lakes, and the tiger salamander (*Ambystoma tigrinum*) is found in ponds and lakes (J. Civille, pers. comm. 1993). In addition, three state endangered species, the peregrine falcon (*Falco peregrinus*), sandhill crane (*Grus canadensis*), and Columbian white-tailed deer (*Odocoileus virginianus leucurus*), use wetlands in addition to other habitats.

Found in western and south-central Washington, the Western pond turtle inhabits marshes, sloughs, moderately deep ponds, and slow-moving portions of creeks and rivers. Western pond turtle populations in wetlands invaded by purple loosestrife would be negatively affected by the loss of native food plants and suitable basking sites. Nesting sites appear to be less vulnerable because nests are usually sunny, dry fields or banks hundreds of meters from the water, although sometimes the turtles nest in sandy banks near the water. Access to some nest sites could be prevented by purple loosestrife because plant growth and litter are very dense and plants grow from open water to high on the shore, which could prevent the turtles from traversing the weed patches.

Peregrine falcons utilize riparian and wetland areas as forage areas. These habitats yield higher densities of prey such as ducks and shorebirds. If these forage areas are infested by purple loosestrife, prey species populations might decline.

Sandhill cranes nest in persistent emergent wetlands. They build platform nests utilizing native vegetation such as cattail and bulrush (*Scirpus* spp.). If these native plant species were displaced by purple loosestrife, populations would be negatively affected because purple loosestrife is not suitable nesting material. The decrease in vegetative diversity and loss of open water would cause a decrease of prey-species populations.

Columbian white-tailed deer use riparian areas and forested scrub-shrub wetlands for reproduction in spring and early summer. These are vital habitats because the deer can find food and cover within a relatively small area—an important criterion when movements are restricted during fawning. It is possible that purple loosestrife would displace native plant species in these habitats and reduce forage values.

Impacts to Agriculture

Infestations of purple loosestrife might reduce the quality of wetland pasture. Native forage species such as grasses and sedges are more palatable to livestock than mature purple loosestrife plants. The young foliage of purple loosestrife is palatable to livestock but mature plants are less frequently grazed, giving purple loosestrife a growth advantage over the more heavily grazed native forages. Additionally, pastures with heavy purple loosestrife infestations are difficult to mow and manage. Western Washington has extensive wetland pasture suitable for occupation by purple loosestrife. Dense stands of purple loosestrife in wasteways inhibit flows and result in sub-irrigation of adjacent croplands, resulting in crop damage and eventual loss of arable land.

Due to water-dependent cultivation practices, cranberry bogs and wild rice beds in the Pacific Northwest might be highly susceptible to purple loosestrife invasion. At present, there are no reports of purple loosestrife in cranberry bogs or wild rice beds in Washington.

Cutting of wild hay is an agricultural practice in the Pacific Northwest that might be affected by the spread of purple loosestrife. More information is needed on the extent of cultivated wild hay pastures in Pacific Northwest before the impacts of purple loosestrife infestations on this practice can be fully evaluated.

Economic Impacts: Purple loosestrife infestations often have significant economic impacts in areas with interconnected irrigation and drainage systems. In eastern Washington, this species interferes with ditchbank integrity and channel capacity of the irrigation canals. Infestations create additional operating and maintenance expenses for irrigation districts. Channel capacity is reduced because vegetation slows down the velocity of water through the canals, allowing sediment to accumulate around the base of the purple loosestrife plants. As sediment accumulation progresses, berms form in the canals. The subsequent decrease in carrying capacity and flow velocity would restrict the delivery of irrigation water and elevate the canal water level and adjacent water table. A back up of the delivery system would saturate adjacent irrigated areas, potentially damaging crops and making some forms of irrigation difficult. Further spread of purple loosestrife within irrigation delivery systems would also increase the amount of seed present in the irrigation water. Perennial, moist crops—such as mint and alfalfa—could become infested with purple loosestrife if irrigated

with seed-laden water. Purple loosestrife seed is a noxious contaminant that would decrease the quality and value of seed crops, if irrigation water was contaminated with its seed.

More information is needed to estimate the long- and short-term impacts of purple loosestrife infestation on native wetland pastures and wild hay meadows. Studies are needed to evaluate the susceptibility and current extent of purple loosestrife infestation in cranberry bogs and wild rice beds.

Property damage from flooding might occur in some areas as a result of decreased storage and carrying capacity of detention basins, wetlands, and ditch systems, requiring increased maintenance frequency.

Impacts to Recreation: If the spread and colonization of purple loosestrife are not controlled, several recreational activities would be negatively affected. Hunting and fishing, and other activities associated with wetland wildlife, are most directly affected. Reduction of bird populations and duck productivity are concomitant with purple loosestrife infestations. Additionally, purple loosestrife does not provide blind (cover) opportunity for hunters. Decline in bird species diversity would affect bird-watching activities commonly associated with wetland habitats. Dense stands of purple loosestrife make shore-fishing difficult because the vegetation creates an impenetrable wall to access. Boating would also be adversely affected by dense stands of purple loosestrife because water level might decrease and maneuverability would become more difficult.

Impacts to Human Health

The No Action Alternative is expected to have no impacts on human health.

4.1.3 MISCELLANEOUS SPECIES

For each of the miscellaneous species, information is scant regarding the environmental impacts associated with an infestation. The discussion presented below is based on the few pertinent references in the literature and subjective appraisals of some possible impacts.

Impacts to Water Quality/Water Movement: Potential impacts of infestations on water quality and movement have not been investigated. Increased erosion caused by giant

hogweed could adversely impact water quality of wetlands, streams, and rivers during storm or high-flow events. Infestations of indigobush along shorelines of streams and rivers might alter the speed and currents of water in those bodies, thus suggesting possible flooding effects. No information is available on erosional rates within stands of indigobush. Additionally, there is some indication that indigobush transpires large amounts of soil moisture during the growing season, which could adversely impact wetland and stream hydrologic regimes and effect subsequent changes in associated biota.

Potential impacts of infestations on the sediment dynamics of wetlands or shorelines are mostly unknown. Impacts potentially posed by garden loosestrife might be considered similar to those of purple loosestrife due to similarities in habitat preference, morphology, and life history. However, little is known of the biology of infestation for this species in Washington. Infestations of giant hogweed have caused increased erosional rates, particularly in riverine/riverbank environments. This is because giant hogweed is able to successfully shade out competing vegetation, but dies back each year thus exposing bare soil to the elements.

Impacts to the Biotic Community: Specific impacts of infestations of these species to the biotic communities in Washington or elsewhere have not been investigated. Giant hogweed is well-known to shade out competing native vegetation. Both giant hogweed and indigobush are able to displace large areas of native plant habitat in uplands, wetlands, and riparian zones. Indigobush also colonizes shorelines and riparian habitats in Washington, to the near-complete exclusion of other native vegetation.

Plant competition posed by these infesting species would lead to the localized extirpation of unusual or rare plant species in some areas because many rare plants in Washington inhabit wetland and riparian communities. The elimination or reduction in plant species diversity in habitats could also result in the elimination of natural foods and cover essential to many wetland wildlife inhabitants, possibly including rare species.

Impacts to Agriculture: Based on available information, the species most likely to impact agricultural areas is giant hogweed, which has been observed to invade pastures, gardens, and orchards. Because giant hogweed produces massive, deciduous, leaves that effectively shade out all competing vegetation, infestations on pasture lands would likely lead to increased erosion on bare ground exposed after the growing season. Giant hogweed is

known to be consumed by cows and hogs without ill effect. However, goats have been observed to be susceptible to the photodermatitis caused by giant hogweed.

Impacts to Recreation: Recreation opportunities on private, commercial, or public lands might be altered, particularly by infestations of giant hogweed and indigobush. Giant hogweed is considered a significant threat to human health and has been shown to cause photodermatitis in susceptible humans. The clear, watery sap found in roots and shoots contains the furanocoumarins that sensitize skin to ultraviolet radiation. This causes disintegration of intra-epidermal cells, resulting in severe blistering and painful dermatitis. After the blisters subside, skin might remain abnormally pigmented for several months.

Indigobush forms dense impenetrable dams along rivers and streams and presents a nuisance to anglers and boaters. In contrast, restricted access to some rivers, streams, and wetlands might be viewed positively by some individuals. Conversion of emergent wetlands and shorelines to habitats dominated by one of these species might be perceived aesthetically as either positive or negative. Adverse effects of infestations for any of the species might include loss of beach or shoreline habitat, reduced access to water, beaches or streams, and loss of navigation routes.

4.1.4 Information Needs

Spartina: The following studies might provide more information on the efficacy and impacts of the No Action Alternative:

- **Investigations to determine the extent to which, and the rate at which *Spartina* species are displacing native salt marsh and eelgrass communities.**

- **Long-term productivity studies to determine the potential impacts of *Spartina* to food webs in estuaries of the Pacific Northwest.**

- **Studies to determine the fish and wildlife use of different clone sizes and meadows to assess the impacts of *Spartina* infestations.**

- **Fish use of *Spartina* at different heights within the intertidal zone.** A one-year study in Willapa Bay, the only study to date to investigate *Spartina* use by Washington fishes,

found no significant differences between the total number of fish collected in *S. alterniflora* clones 3 to 6 meters (10 to 20 feet) in diameter and mudflat habitats (Allard 1991). Small clones or the edges of larger *Spartina* stands might be suitable cover or feeding habitat for some species. Because isolated clumps are a transitional state, additional research should focus on fish utilization of continuous *Spartina* meadows adjacent to native marshes.

- **Local studies to determine the habitat value of *Spartina* and the positive or negative impacts of infestations to resident and migratory fish and wildlife.**

  Little research has been done evaluating the impacts of *Spartina* infestations to local fish and wildlife. The Washington State Department of Fisheries has initiated a study to directly evaluate the impacts of *Spartina* colonization to clams and other shellfish (B. Dumbauld 1992, pers. comm.).

  A study funded by Washington Sea Grant (anticipated to begin on January 1, 1993) will compare the characteristics of tidal flats and differing size stands of *S. alterniflora* in Willapa Bay, including benthic invertebrate and algal colonization, fish use, prey utilization by fish, rates of sediment accretion, and detrital export/retention. Shorebird habitat availability and utilization studies were conducted in Willapa Bay and Grays Harbor in the early 1980s. It might be possible to gather comparative data to assess changes in habitat suitability for shorebirds resulting from *Spartina* infestations (Herman 1992, pers. comm.).

  Studies on food web dynamics and overall ecosystem function could be conducted to compare *Spartina* marsh habitats with a variety of naturally occurring habitats.

- **Continuation of mapping and development of statewide Geographic Information System (GIS) database for *Spartina* distribution and population changes.** This is currently being conducted by the Washington State Department of Natural Resources.

- **Monitoring the occurrence of dieback and determining the environmental conditions under which it occurs.** This information might help to better evaluate the potential for extensive natural dieback as a natural control method. Studies should investigate the occurrence of dieback induced by composting mats of *Spartina* shoots. Studies should

also attempt to determine whether the dieback areas are re-colonized by *Spartina* or native species, or whether a return to pre-invasion conditions occurs.

- **Evaluation of potential agricultural, aquacultural, or other uses of *Spartina*.** Development of new economic enterprises could offset some of the economic impacts that might result from *Spartina* infestations.

Purple Loosestrife: The following studies might provide more information on the efficacy and impacts of the No Action Alternative. Many of the conclusions drawn in this report are based on research done in Europe and northeastern and midwestern North America. Thus, local studies would be of particular relevance.

- **Remote detection of early stages of purple loosestrife infestations.** The Washington Department of Wildlife has initiated studies using video and still photography, neither of which has allowed reliable identification of purple loosestrife from the air. Direct observation from helicopters is possible.

- **Evaluation of the susceptibility of Washington agricultural lands to purple loosestrife infestation.** Regional studies are of particular importance to estimate the potential impacts of purple loosestrife on various agricultural practices in Washington (wetland pastures, wild hay meadows, cranberry bogs, and wild rice beds). Studies should focus on assessment of the current extent of infestations, susceptibility of habitats, existing damages, and current and projected economic impacts.

- **Local quantification of the distribution of purple loosestrife relative to salinity gradients and other environmental conditions.** One study (Hutchinson undated) reports purple loosestrife in habitats on the Fraser River delta foreshore where it experienced salinity values up to 8 ppt for short periods, early in the growing season. It has also spread to brackish marshes in Baker Bay at the mouth of the Columbia River (J. Civille, pers. comm. 1993). Salinity tolerance of purple loosestrife has important implications on the susceptibility of certain habitats. Other environmental factors that affect the ability of purple loosestrife to grow in, and often dominate native plant communities should also be studied.

- **Evaluation of impacts of purple loosestrife on irrigation practices.** Emphasis should be placed on economic impacts and the role of interconnected irrigations systems as dispersal corridors for loosestrife.

- **Documentation of changes in sediment deposition as a function of purple loosestrife infestations.** This information is needed to assess impacts to streams, rivers, and wetlands, as well as constructed features such as ditches and irrigation canals.

- **Investigations on the impacts of purple loosestrife infestations on fish, wildlife, and invertebrate populations.** Local studies are necessary to determine the habitat value of purple loosestrife to resident and migratory fish, wildlife, and invertebrate populations. In addition, studies are needed to determine the importance of purple loosestrife as a food source for birds and mammals. The Washington Department of Wildlife has initiated studies to determine the effect that purple loosestrife has on wildlife use of lakes and ponds.

- **Comparative genetic studies of European and North American purple loosestrife populations to address the differential stability of North American populations compared to European populations.** For example, do local populations remain as monospecific stands for decades because there are more vigorous and adaptive North American biotypes?

- **Long-term productivity studies to determine the potential impacts of purple loosestrife to food webs in the Pacific Northwest.**

- **Monitoring of the various stages of purple loosestrife infestations and assessment of subsequent impacts on the structure, functions, and productivity of infested wetlands.**

- **Studies of purple loosestrife as a source of animal feed.** This should include studies of the viability of seeds in animal manure.

4.2 PHYSICAL METHODS ONLY

The application of physical methods for controlling or eradicating noxious emergent plants has environmental impacts that vary depending on control method used, species being treated, type of infestation, and characteristics of the specific treatment site. Some impacts are associated with nearly all of the control methods and species considered here. Impacts and associated mitigation opportunities are summarized in Table 15, and are discussed below:

4.2.1 Impacts Common to all Physical Control Methods

Impacts to Sediments/Soils: Treatment of infestation sites using physical methods requires entering the site, either by foot or by vehicle. This might result in damage to organisms living in the soil, since soils are often soft and susceptible to compaction. Impacts due to compaction would vary, depending on type of vehicle used or extent of area walked on, and number of times the wetland is entered. During control efforts, soils might be mixed, and bare soil might be exposed. Following eradication of noxious weeds, erosion might be problematic because soils would no longer be anchored by living plants. Erosion would be more pronounced on slopes and along stream banks. Sediments washed away from treatment sites could be deposited in environmentally sensitive areas.

Impacts to Water Quality and Movement: Water turbidity might temporarily increase in treatment sites, or in surrounding bodies of water, following implementation of control measures. Soil disturbance would result in exposing sediments that would be suspended in the water. Oil and fuel from motorized equipment used at treatment sites might enter water bodies. However, manual removal techniques are not expected to significantly affect groundwater quality or public water supplies.

Impacts to Biotic Communities: Noxious emergent plants often occur in environmentally sensitive areas that provide habitat for unique assemblages of plants and animals. Some plants including threatened, endangered, or sensitive (TES) species intermingled with the weeds or in surrounding areas would be killed or injured by physical control methods. Soil compaction and trampling might kill infauna (animal life within the sediment) or delay reestablishment of infauna or native vegetation. Infauna and epifauna populations would be temporarily affected by changes in sedimentation and erosion, both within the area treated and at lower elevations. Sediment transported away from the site could smother infauna,

Table 15. Possible impacts and mitigation associated with physical and mechancial control methods. (Note: impacts and mitigation are site-specific and not all apply to a given site. Impacts associated with specific control methods are discussed in the text.)

IMPACTS	MITIGATION MEASURES
SEDIMENT/SOILS	
- Shifting of accreted sediment to sensitive areas (*Spartina*)	- Remove accreted sediments; survey for sensitive areas
- Bank erosion	- Plant native, nonweedy species
- Soil compaction	- Use mudluks, use boats or wide tires on vehicles where possible; minimize number of treatment applications; establish fixed access paths
- Changes in soil chemistry, decreases in dissolved oxygen	- Survey for sensitive biota; limit size of area treated each year; test soils to identify potential problems
BIOTIC COMMUNITIES	
- Loss of wildlife, fish, and benthic habitat	- Use selective methods in mixed vegetation; survey for sensitive habitats; monitor damage during treatment; fill holes so fish aren't trapped at low tide; restore topography to pre-invasion elevations (*Spartina*)
- Mortality of non-target biota	- Monitor integrity of covers and remove torn covers; inform local residents about contacts for bird or mammal rescue; restock with fish if habitat destroyed during treatment (purple loosestrife)
- Decrease in primary production and disruption of aquatic food web due to increases in water turbidity; smothering of oysters, clams, and other aquacultural species	- Minimize soil disturbance; construct dredge disposal sites with settling ponds (dredging); conduct treatments at low tide (*Spartina*); remove accreted sediments (*Spartina*); avoid treatments during oyster and clam larval and juvenile stages (*Spartina*)

Table 15. Continued.

- Enlargement of infestation and establishment in new sites following dispersal of noxious weed seeds and vegetative propagules	- Clean footwear, vehicles, and boats before leaving treatment site; select control method to minimize dispersal of propagules; inspect treatment area for propagules remaining after treatment; inspect area after treatment for seed pool seeds germinating (purple loosestrife); plant competing plant vegetation immediately after exposing bare soil (purple loosestrife); perform control measures before seed set; use containment booms (*Spartina*) or seed screens (purple loosestrife); educate the public to be watchful for new invaders; survey surrounding potential noxious weed habitat
- Mortality of infauna	- Minimize soil compaction and disturbance
- Interference with fish or wildlife breeding or migration activities	- Conduct treatments at times of year when breeding activities or migration are not occurring in the site vicinity
- Mortality or habitat destruction of TES plant species	- Conduct surveys for TES species; use selective control measures in TES species habitats
HUMAN HEALTH	
- Public and worker exposure to smoke	- Conduct burns on days when winds are blowing away from treatment areas; conduct burns when vegetation is dry; alert public in advance of treatments; provide workers with masks and protective clothing; establish acceptable safety standards
- Worker injury	- Provide safety training
- Boating accidents	- Light dikes; update navigation maps; inform public about changes in sediment deposition patterns

Table 15. Continued.

WATER QUALITY AND MOVEMENT	
- Increased turbidity	- Minimize soil disturbance; construct dredge disposal sites with settling ponds (dredging); conduct treatments at low tide (*Spartina*); remove accreted sediments (*Spartina*); minimize covering on slopes (purple loosestrife)
- Decreases in dissolved oxygen levels	- Remove dead vegetation after treatment; monitor water outflowing from dredge spoil sites; avoid or minimize dredging where water has low dissolved oxygen levels
- Increased nutrient levels	- Remove dead vegetation after treatment; remove dead fish and animals (flooding)
- Changes in water circulation patterns	- Design dikes to minimize adverse changes; remove accreted sediments (*Spartina*)
- Oil and fuel pollution	- Properly maintain and use vehicles and equipment; use propane for burning/flaming
AIR QUALITY	
- Increases in air pollution (smoke, vehicle emissions)	- Burn small areas at a time, when atmosphere is not inverted, and when wind would blow smoke away from inhabited areas; alert public in advance of treatments; conduct burns when plants are not wet; properly maintain and use vehicles and equipment
- Unpleasant odors from rotting vegetation	- Dispose of vegetation in non-residential areas

Table 15. Continued.

RECREATION, AESTHETIC, AND CULTURAL RESOURCES	
- Destruction of sites of archaeological, historical, or cultural importance	- Conduct surveys for archaeological or historical sites; consult tribes about potential cultural/religious significance of sites
- Interference with boating due to changes in water circulation patterns, sediment deposition, and dikes	- Remove accreted sediments (*Spartina*); place lights on dikes; update navigational maps; inform public of changes in channel configurations
- Loss of recreation (hunting, fishing, boating, birdwatching) opportunities during treatment periods	- Schedule treatments to avoid periods of heavy use; inform public about planned activities
- Negative public perception of control activities	- Educate public about detrimental effects of infestations; inform public about planned activities; post informative signs in public facilities near treatment sites
- Degradation of site appearance	- Schedule treatments to avoid periods of recreational use; plant native vegetation

epifauna, and algae. Removal of noxious weeds would cause reductions in organic matter available for decomposers, and consequently, would alter food web dynamics. Increased turbidity would temporarily reduce light penetration in the water and would reduce photosynthesis by algae and green plants. Eradication of *Spartina* would result in a reduction of habitat for small mammals until or unless native vegetation establishes in the area. *Spartina* marshes are utilized by small mammals such as shrews, voles, moles, and mice during low tide as an extension to their usual upland habit.

Potential for Spread of Noxious Species to Unaffected Areas: Noxious weeds can be spread to new sites by seeds or vegetative propagules. For example, in the proper conditions the stems of purple loosestrife are able to form roots and shoots and develop into full plants. *Spartina* rhizomes are likewise capable of sprouting new shoots. Some of the control methods discussed here might result in the dispersal of vegetative propagules or seeds to new sites, where they could establish new infestations. Propagules might also be transported to new sites in mud attached to the footwear and clothing of workers or on vehicles and boats entering the treatment area.

Impacts to Air Quality: Air quality would not be affected by most of the treatment techniques discussed here. Emissions would be produced by the combustion of gasoline and diesel oil used to power machinery used for accessing treatment sites or transporting materials away from the sites. The small amounts produced, however, are not likely to significantly impact air quality. Rotting waste hauled away from treatment areas could emit odors.

Impacts to Aesthetics, Recreation, and Cultural Resources: Eradication of weed infestations might have either a positive or negative impact on aesthetics, depending upon the attitude of the observer. The visual appeal of sites from which noxious weeds were eradicated would be increased for those people who prefer appearances of natural settings. Soils disturbed during treatments and dead or unhealthy plants might be unsightly for a short period of time.

While treatments are in progress, recreational use of treatment sites might be disrupted. Treatment areas would ultimately be improved for walking, bird watching, hunting, and other recreational uses. Removal of noxious weeds might eventually result in reestablishment of some boating areas.

Manual control measures could potentially disturb or destroy unidentified cultural resources on or near the soil surface.

Impacts to Human Health: Direct impacts to human health from the control of noxious weeds would be minimal. Workers might be exposed to the hazards associated with physically demanding operations, and falls might occur when traversing uneven terrain or upon contact with slippery soils.

Impacts to Agricultural/Aquacultural Environment: Components of the aquacultural environment potentially adversely impacted by *Spartina* control measures include oyster beds and clam beds, which might be affected by changes in sediment dynamics that result in sediment deposition on the beds. Total eradication of *Spartina* populations would eliminate potential agricultural uses of the plants in Washington, such as papermaking and basket making. Purple loosestrife occurs in many agricultural areas and control measures might affect the function of irrigation canals. Seeds might be transported to cultivated areas and plants might become established and compete with crops.

Mitigation Measures: Mitigation measures that relate to all physical control methods for all species are described below. Additional mitigation measures are included in discussions relating to specific control methods for each species.

Before initiating control measures, surveys should be done in the treatment area to determine potential dispersal of noxious weeds to new sites, adverse changes in sediment dynamics, death of non-target species, degradation of water quality, loss of habitat, adverse impacts to human health, built environments, and aquacultural and agricultural practices, and loss of cultural resources. Steps should be taken to avoid or minimize adverse impacts.

Workshops should be conducted to educate the public in surrounding communities about noxious weed identification, impacts of infestations, appropriate control methods, environmental concerns, and applicable regulations.

Treatments should be timed to avoid disruption of wildlife breeding or migrating or fish or spawning in surrounding areas, and to minimize noise disturbance to wildlife, tourists, and recreationists. Treatments should not be conducted during critical bivalve early life history stages (larval and early juvenile), when increased turbidity might hinder feeding and retard

growth. Impacts to native vegetation in or adjacent to treatment sites should be avoided or minimized. Precautions should be taken to prevent oil and fuel from motorized equipment from entering waterbodies. Workers should take measures such as wearing mudluks or establishing fixed access paths to minimize soil disturbance while walking on soft sediments. Corridors should be established for movement of machinery or vehicles across upland areas to the treatment site. Work should be limited to as small an area as possible.

The vicinity of the treatment site should be inspected for vegetative propagules remaining after treatment, if there is danger of these being dispersed and establishing infestations in new sites. Vehicles and footwear should be cleaned before leaving the site to avoid dispersal of seeds or vegetative propagules to new sites. To minimize seed dispersal, control measures should be performed before seed set. Personnel involved in implementing control methods should receive appropriate safety training.

4.2.2 *Spartina*

Unlike other species included in this discussion, *Spartina* grows in the area between low and high tides (intertidal area). It is typically exposed to the air at low tide and submerged at high tide. This twice-daily fluctuation of water levels, along with wave action, results in water motion that can accelerate erosion, increase water turbidity, increase sediment redeposition, and enhance plant dispersal. In addition, *Spartina* colonies build up layers of sediment that might be mobilized and redistributed following eradication of colonies. These factors might exacerbate adverse impacts to shellfish beds, eelgrass marshes, and fish spawning or rearing areas.

Environmental impacts of each control method are discussed below when these are significant concerns or the impacts are unique to the particular method.

<u>Mitigation Measures</u>: Possible mitigation measures discussed above for all species apply to most of the physical control methods. Additional mitigation measures common to physical control of *Spartina* are described in the following paragraph.

Use of vehicles or equipment in the intertidal area is forbidden for certain times of the year and should not be used on eelgrass or other native vegetation. Work activities should be planned to avoid areas where seals are observed or known to be present. Equipment should

be operated to minimize siltation to other waters. Project activities may be forbidden when the treatment area is inundated. Pollutants from machinery, such as oil and gasoline, should not be allowed to enter the water. Operations must stop if fish are killed or observed in distress. Water quality is not to be degraded.

Hand removal (digging/pulling): Hand removal is a selective technique and sensitive resources, such as surrounding vegetation, special habitats, and cultural sites can be avoided. This is one of the least environmentally damaging control methods. The most significant potential impacts include soil compaction, and loss of soil affixed to roots. Large amounts of soil surrounding each clump of *Spartina* might need to be removed to ensure that plants would not survive and vehicles used to transport the soil and plants away from the site might compact the soil or leak pollutants. Depressions left in the soil might strand fish at low tide. Dislodged rhizomes might float to other sites and start new infestations. In order to be effective, multiple treatments might be required.

Mitigation: Additional mitigation for impacts caused by hand removal of *Spartina* include: avoiding creation of large depressions; filling depressions before low tide to prevent fish stranding and mortality; and removing dug or pulled plants off site.

Covering: *Spartina* plants killed by covering have intact (though dead) root and rhizome systems that decompose slowly. The decomposing roots and rhizomes continue to anchor sediments. Following eradication, however, there would be short-term increases in surface erosion, especially along stream banks and tidal channels. Sediment dynamics would be altered. The weight of humans walking in the treatment area would result in compaction of soils. Soils beneath the covers would become more anaerobic. Some desirable plants, benthic organisms, and infauna present under covers would be killed, although others, such as crabs, might utilize the space under the covers for shelter and feeding. Birds or mammals might be injured or killed by ingesting covering material or being strangled or trapped by it.

Mitigation: Additional mitigation for impacts caused by covering *Spartina* colonies include: monitoring treatment sites for fragmented or unattached covers and repairing or removing damaged ones; informing local residents of contacts for bird or mammal rescue; avoiding use of plastic or non-biodegradable materials; attaching the interior of the covering material to the substrate in a quilted fashion to eliminate the potential for billowing; and avoiding

stockpiling of covering materials below the high tide line except within the perimeter of the area to be covered.

Dewatering/draining: Habitat degradation of areas surrounding the infestation resulting from draining saltmarshes might outweigh the benefits of *Spartina* eradication. Changes in wetland hydrology in the treatment area would eliminate species intolerant to these changes that are unable to move to more favorable habitats. Ditching leads to marked declines in invertebrate fauna in tidal marshes, and would impact the food web. Dewatering would subject non-target species to new competition from upland or upper marsh species. Ditch excavation, construction of dikes, soil compaction from heavy machinery, and trampling might lead to death of plants, infauna, and epifauna. Water turbidity would probably increase. Draining *Spartina* colonies would also change the hydrology of areas upslope of infestations targeted for treatment and might kill wetland plants and animals in these areas.

Mitigation: Additional mitigation for impacts caused by draining *Spartina* colonies include: removing accreted sediments to pre-infestation elevations; removing dikes and ditches after treatment is complete to restore original topography and wetland hydrology; and if necessary, lighting dikes at night to prevent boating accidents.

Flooding/inundating: Flooding *Spartina* infestations would require the construction of dikes, which would compact soils and change water circulation patterns. Sediment dynamics in the vicinity of the treatment site would be affected. Soil chemistry would be changed, and soils would become more anaerobic, possibly resulting in sulfide accumulation. Soil salinity would decrease because fresh water from precipitation and surface flow would dilute salts in the soil. Many, if not most, species occupying the treatment site would not survive, and would be replaced by other species better adapted to the new conditions. Diking would limit fish access to impounded areas and fish migration might be impacted.

Mitigation: Additional mitigation for impacts caused by flooding *Spartina* colonies include: removing dikes or cylinders after treatment is complete to restore original wetland hydrology; and if necessary, lighting dikes at night to prevent boating accidents.

Burning/flaming: Air quality would be adversely impacted by burning. Burning might be hampered by wet and salt-covered *Spartina* plants and combustion could produce harmful gases and suspended particulates. Burning cellulose (present in all plants) in the presence of

chloride (salt) might produce chlorinated dioxins and furans, which are highly toxic and carcinogenic compounds. Potential concentrations of air pollutants following burning and associated health impacts are not known. Soil chemistry would be affected by burning, especially if heat from the fire was sufficient to warm the soil, but effects may be only temporary. Burning increases amounts of nutrients available to the soil, especially nitrogen, although much of this would be washed away by the tide. By-products from incomplete combustion of vegetation would enter waterways. Animals and aerial stems of plants living among *Spartina* colonies would be destroyed during a burn, and benthic organisms might be killed by heat or toxic compounds. Decreased levels of decaying vegetation would locally reduce populations of detritivores and associated higher trophic organisms.

Flaming individual flowering plants to control seed production would have fewer impacts because most plants would be scorched and fewer harmful gases and suspended particulates would be produced. The surface of the soil would not be heated, and benthic organisms should not be greatly affected.

Mitigation: Additional mitigation for impacts caused by burning or flaming *Spartina* colonies include: establishing acceptable safety standards for human exposure to smoke from burning *Spartina*; providing safety equipment to workers, such as masks and protective clothing; timing burns at low tides on warm, dry days, when combustion would yield less smoke; conducting burns when wind would carry smoke away from inhabited areas; alerting local residents to planned burning activities; avoiding flaming eelgrass or other native vegetation; and avoiding stockpiling of burned material below the high tide line.

4.2.3 Purple Loosestrife

Purple loosestrife readily reproduces by seed or by vegetative propagules such as stem fragments. As many as 300,000 seeds can be produced per stalk, and most of these are able to survive in the soil for at least 3 years. Seeds are very small and light, and are readily dispersed by wind or water. The seeds are able to germinate in a broad range of environmental conditions. Roots and shoots sprout from clipped, trampled, or buried stems or rootstalk fragments. Disturbed areas where shade has been removed can be readily colonized if purple loosestrife is present in the area and the soil is sufficiently moist. If hand pulling is delayed until seeds have developed on the plants, some seeds might be dislodged and fall to the soil surface, thus enhancing the extant seed bank. Some seed might be

transported on the clothing of workers. Due to the high potential for spread of purple loosestrife, control measures that might significantly contribute to the dispersal of the plant are not recommended. Honey production might be reduced if bees are dependent on purple loosestrife for late summer pasturage.

Mitigation Measures: Possible mitigation measures discussed above for all species apply to most of the physical control methods. Additional mitigation measures common to physical control of purple loosestrife are described in the following paragraph.

All disturbed areas should be revegetated with native plant species or otherwise protected from erosion. Siltation to adjacent areas should be avoided and a silt barrier should be placed around the treatment site until the silt has settled. Turbidity, phosphorous levels, dissolved oxygen levels, total suspended solids, and fish mortality and/or injury should be monitored in and around the treatment site. If fish are observed in vegetation that is being removed, they should be caught and returned to the water. If fish are observed in distress or have been killed, operations should cease immediately and the department granting permits should be contacted. Loss of purple loosestrife use by bees could be mitigated by planting other species as bee forage.

Digging/pulling: Digging or pulling purple loosestrife plants is selective, and impacts to surrounding plants, animals, and other sensitive resources can mostly be avoided. Potential adverse impacts include soil compaction, especially as a result of repeated treatments. Hand removal methods might contribute to purple loosestrife spread. Disturbance of wetland soils by humans might provide sites favorable for seed germination and seedling growth.

Mitigation: Additional mitigation for impacts caused by digging or pulling purple loosestrife includes: clipping and disposing of flower spikes if digging cannot be done before flowering has begun, and removal of dug/pulled plants off-site.

Covering: Gas exchange in covered soils would be greatly reduced. Anaerobic decomposer activity might cause the production of nitrates, sulfates, and phosphates that would eventually enter surface waters. Removal of covers would expose an open soil surface on which purple loosestrife seedlings could become established. Soil erosion might be problematic in some areas. Desirable plants and animals might be injured or killed by the covering treatment or by cutting or burning treatments used to prepare sites.

Mitigation: Additional mitigation for impacts caused by covering purple loosestrife infestations include: minimizing covering of sloped sites to prevent erosion and increases in sedimentation and turbidity of nearby waters; removing dead plants after treatment is complete to prevent excessive nutrient accumulations from entering waterbodies; and securely anchoring covering materials to the substrate.

Dewatering/draining: Drainage of a waterbody is not a selective form of control and all resident plants and animals would be adversely impacted. All free-floating, submersed, and most emergent plants would be killed. Dewatering would eliminate habitat essential to the survival of many shore birds, some mammals, all fish, and benthic organisms. Re-establishment of fish and benthic infauna would occur after restoring the wetland hydrology, and most wildlife species would benefit from purple loosestrife removal in the affected habitat. Draining marshes would also change the hydrology of areas upslope of treated infestations and might kill wetland plants and animals in these areas. Purple loosestrife seeds present in the soil could be transported out of the treatment area in outflow from the site or attached to machinery or clothing. Purple loosestrife seeds occurring in bottom sediments would be exposed to optimum conditions for germination, resulting in a flush of seedling development.

Mitigation: Additional mitigation for impacts caused by draining purple loosestrife infestations include: (1) removing fish or other animals killed by draining; (2) restocking the waterbody with fish after treatment is complete (if present before draining); (3) removing dikes or ditches and restoring wetland hydrology to the site at the completion of the treatment; and (4) installing screens with small mesh, and possibly skimming boards at all water outlets to intercept floating seeds.

Flooding/inundating: Flooding would kill most emergent plant species. Soils would become more anaerobic, which would kill soil organisms not adapted to these conditions. Rapid decomposition of large quantities of plant biomass would deplete dissolved oxygen and could kill some animals, especially fish. Additionally, phosphorous would be released into the water during the decomposition process. Algal blooms could be triggered, which might produce toxic compounds detrimental to surface water quality. The flooded area might no longer be accessible to fish for feeding or spawning. Species abundance and diversity would probably decline. Elimination of emergent plants would affect wildlife feeding, sheltering, breeding, and nesting opportunities. Songbird, shorebird, and dabbling duck species habitat

would be reduced by flooding; diving duck and other bird species habitat would be expanded. Dike construction would disturb wetland soils and could provide new sites for purple loosestrife establishment.

Mitigation: Additional mitigation for impacts caused by flooding purple loosestrife infestations include: (1) removing dying or dead plants to minimize dissolved oxygen depletion and nutrient increases in the water; and (2) regulate velocity of water entering the impoundment area to minimize turbidity.

Burning/flaming: A controlled burn would destroy or injure all existing vegetation and animals unable to flee the site. Many detritus-feeding arthropods and microorganisms would perish from the heat generated by the fire. Other species might not persist for long because of the destruction of their food source. The loss of soil organic matter during the burn and from subsequent erosion would affect levels of nitrogen and sulphur available to plants. Ash entering water bodies, either directly or in surface runoff, would diminish water quality. Air quality would be temporarily reduced.

Flaming individual plants is a highly selective form of control. Torching individual purple loosestrife plants would not adversely affect non-target plant species. Flaming seedlings would kill some organisms living on the soil surface.

Mitigation: Additional mitigation for impacts caused by flooding purple loosestrife infestations include: (1) burning small areas at times when atmospheric inversions aren't present; (2) providing safety equipment to workers; (3) timing burns on warm, dry days, when combustion would yield less smoke; (4) conducting burns when wind would carry smoke away from inhabited areas; and (5) alerting local residents to planned burning activities.

4.2.4 Miscellaneous Species

Impacts associated with physical control methods would be similar when applied to the miscellaneous species included here. However, giant hogweed is a toxic plant, and produces contact dermatitis in susceptible individuals. Physical contact with the plant might result in photodermatitis, which sensitizes the skin to ultraviolet light. Disposal of the plant by burning might have detrimental health effects.

Mitigation: Additional mitigation for impacts caused by applying physical control measures to giant hogweed includes avoiding activities that would expose workers or the public to contact with the plants, their cuttings, or smoke from burning them.

4.2.5 Information Needs

Additional information on the utility of physical control methods for controlling or eradicating noxious emergent plants is needed. Research could be undertaken to address the following:

For all species (unless indicated otherwise):

- **Studies of impacts to plant and animal occupants of wetland habitats due to the use of physical control methods.**

- **Studies on restoration of habitat for non-target species.**

- **Determination of effects of control methods on sediment dynamics.** Are pre-invasion regimes restored, or can they be?

- **Effects on biota within and below colony sites due to changes in sediment dynamics following eradication.**

- **Effects of smoke from burning vegetation on human health.** Burning *Spartina*, for example, could produce carcinogenic compounds.

- **Determination of burning techniques that can reduce adverse effects.** Permit requirements for burning *Spartina* or purple loosestrife also need to be reviewed.

- **Further research on efficacy of hand pulling in containing or eradicating established populations.**

- **Further research on length of time required that seedling and established plants need to be covered for control to be effected.**

- **Determination of the largest site that can be effectively covered with plastic or biodegradable covering materials.**

- **Susceptibility of growth stages to flooding.**

- **Critical water depth required to kill established plants.** How long must plants remain submerged? Do *Spartina* plants need to be completely submerged or is flooding just the sediment surface adequate?

- **Frequency of burning treatments required to be effective.**

- **Efficacy of flame torching and controlled burning against variously aged plants.**

4.3 MECHANICAL METHODS ONLY

Many impacts associated with the use of machines used in mechanical control methods apply to all of the species considered here. Some control methods, such as rotovating, however, are not applicable to all species. Impacts and associated mitigation opportunities are summarized in Table 15, and are discussed below:

4.3.1 Impacts Common to all Mechanical Control Methods

Impacts to Sediments/Soils: Entry of the treatment site with wheeled machinery results in soil compaction, which kills organisms living in the soil and might inhibit establishment of native plants. During implementation of several of the methods, soils would be mixed or removed, and bare soil would be exposed. Erosion would be problematic in some areas, where sediments would be washed away from treatment sites and deposited in environmentally sensitive areas.

Impacts to Water Quality and Movement: Implementation of control methods would increase water turbidity in the vicinity of treatment sites. Oil and fuel from motorized equipment might enter water bodies.

Impacts to Biotic Communities: Mechanical methods for treating infestations of noxious weeds are, in general, not selective, and might harm plant or animal species in the treatment

site. Threatened, endangered, or sensitive, or other ecologically important species intermingled with the weeds or in surrounding areas would be affected. Soil compaction and trampling might kill infauna or delay reestablishment of infauna or native vegetation. Changes in sedimentation and erosion might damage or destroy environmentally sensitive habitats in the vicinity of the treatment site. Decomposer populations might be depressed following removal of organic material from the site, resulting in alteration of food web dynamics. Photosynthesis by aquatic algae and green plants would temporarily be reduced due to increases in water turbidity. Noise from use of machinery might disrupt wildlife activities in the vicinity of the treatment site. Eradication of *Spartina* would result in a reduction of habitat for shrews, voles, moles, and mice, which use the marshes at low tide, until or unless native vegetation establishes in the area.

Potential for Spread of Noxious Species to Unaffected Areas: The most critical, and environmentally damaging impact of many mechanical control methods is a high potential for dispersal of viable plant parts to new sites and therefore, use of many of these methods is precluded. Soil adhering to mechanical equipment or clothing might contain seeds or vegetative propagules, which could establish new infestations. Seeds and vegetative propagules might be exposed at the surface of the soil during treatments, and might be washed to new sites.

Impacts to Air Quality: Air quality would not be significantly affected by the treatment techniques discussed here. Machinery used in control treatments would produce emissions, but these would be in small quantities and are not likely to significantly impact air quality. Rotting plants could emit odors that might have a local impact.

Impacts to Aesthetics, Recreation, and Cultural Resources: Eradication of weed infestations might have either a positive or negative impact on aesthetics, depending on the attitude of the observer. Soils disturbed during treatments and dead or unhealthy plants might be unsightly for a short period of time. The intrusion of large vehicles into a natural setting would impact work area aesthetics.

Recreational use of treatment sites would be disrupted while treatments were being conducted, but would be improved once eradication of noxious weeds was complete and native habitats were reestablished. Noise from use of machinery might disrupt recreational use of surrounding areas.

Cultural resources, such as archaeological sites, could be damaged or destroyed during implementation of mechanical control methods.

Impacts to Human Health: The eradication of noxious weeds would have no adverse impacts on human health. Accidents involving machinery might debilitate workers, and falls might occur when traversing uneven terrain or upon contact with slippery soils.

Impacts to Agricultural/Aquacultural Environment: Components of the aquacultural environment potentially adversely impacted by *Spartina* control measures include oyster beds and clam beds, which might be affected by changes in sediment dynamics that result in sediment deposition on the beds. Total eradication, or substantial decreases of *Spartina* populations would eliminate potential agricultural uses of the plants in Washington, such as papermaking and basket making. Purple loosestrife occurs in many agricultural areas and control measures might affect the function of irrigation canals. Seeds might be transported to cultivated areas and plants might become established and compete with crops.

Mitigation Measures: Mitigation measures that relate to all mechanical control methods are described below. Additional mitigation measures are included in discussions relating to specific control methods for each species.

Before initiating control measures, surveys should be done in the treatment area to determine potential dispersal of noxious weeds to new sites, adverse changes in sediment dynamics, death of non-target species, degradation of water quality, loss of habitat, adverse impacts to human health, built environments, and aquacultural and agricultural practices, and loss of cultural resources. Steps should be taken to avoid or minimize adverse impacts.

Workshops should be conducted to educate the public in surrounding communities about noxious weed identification, impacts of infestations, appropriate control methods, environmental concerns, and applicable regulations.

Use of machinery should be timed to avoid disruption of wildlife breeding or migrating or fish spawning in surrounding areas, and to minimize noise disturbance to wildlife, tourists, and recreationists. Impacts to native vegetation in or adjacent to treatment sites should be avoided or minimized. Noise reduction devices should be used on machinery. Precautions

should be taken to prevent oil and fuel from motorized equipment from entering waterbodies. Measures should be taken to minimize soil disturbance and water turbidity.

Plant parts should be disposed off-site. The vicinity of the treatment site should be inspected for plant fragments remaining after treatment, if there is danger of these being dispersed and establishing infestations in new sites. To minimize seed dispersal, control measures should be performed before seed set. Vehicles and footwear should be cleaned before leaving the site to avoid dispersal of seeds or vegetative propagules to new sites. Personnel involved in implementing control methods should receive appropriate safety training.

4.3.2 *Spartina*

The motion of water in intertidal areas can accelerate erosion, increase water turbidity, increase sediment redeposition, and enhance plant dispersal. Accreted sediment might be mobilized and redistributed if not removed during mechanical treatments. Shellfish beds, eelgrass marshes, and fish habitat areas might be affected.

Environmental impacts of each control method are discussed below when these are significant concerns or are unique to the particular method. Potential impacts and possible mitigation measures discussed above apply to most of the mechanical control methods.

Mitigation Measures: Possible mitigation measures discussed above for all species apply to most of the mechanical control methods for *Spartina*. Additional mitigation measures common to these *Spartina* control methods are described in the following paragraph.

Use of vehicles or equipment in the intertidal area is forbidden for certain times of the year and should not be used on eelgrass or other native vegetation. Treatments should also be timed to avoid impacts to critical bivalve early life history stages (larval and early juvenile), when increased turbidity might hinder feeding and retard growth. Equipment should be operated to minimize siltation to other waters. Project activities may be forbidden when the treatment area is inundated. A specific access corridor should be used to get equipment to and from *Spartina* treatment sites, and work should be limited to as small an area as possible. Pollutants from machinery, such as oil and gasoline, should not be allowed to enter the water. Operations must stop if fish are killed or observed in distress. Water quality is not to be degraded.

Dredging: Dredging would significantly impact sediments at the sites of removal and disposal. Dredges would remove sediment to the depth of the root mass in the infested intertidal area. This layer is sometimes up to several feet thick at the water edge of the patch, tapering off towards the shoreward edge. Fine sediments released during dredging and suspended in the water returning from disposal sites would settle out and impact sensitive habitats, including fish spawning areas, at various distances from the dredging site, depending on tidal currents and wave action. Extended periods of turbidity or sedimentation might suppress oyster or clam growth, temporarily interfere with respiration, or kill larval or juvenile animals. Banks would become more susceptible to erosion. Dredging would probably kill all organisms in the dredged sediments, including eelgrass and other benthic organisms. Crabs might be killed during dredging operations. Water turbidity would increase, and this could affect primary productivity. If sediments are contaminated, sediment-bound contaminants such as heavy metals, nutrients, and petroleum and chlorinated hydrocarbons might be released to the water. Hydrogen sulfide would be released to the water, and addition of organic material would result in decreased dissolved oxygen (DO) levels. This could be critical in areas that already have low DO levels and could injure or kill organisms. Water circulation patterns would be impacted. Depressions left by dredging could trap fish on the outgoing tide, leaving them susceptible to predation, temperature extremes, and low DO. Dredge disposal sites might contain important resources that could be impacted by the placement of dredged material. The topography of the site could be restored to elevations present before infestation by *Spartina*, which would enhance the likelihood of restoration of pre-infestation conditions.

Mitigation: Additional mitigation for impacts caused by dredging *Spartina* marshes include: (1) avoiding creation of large depressions; (2) filling depressions before low tide to prevent fish stranding and mortality; (3) placing containment booms around the dredging area to contain floating plant fragments; (4) designing control structures to keep plant material from escaping diked disposal areas; (5) preventing barges from settling on valuable eelgrass beds; (6) limiting dredging to areas with low organic content sediments; and (7) avoiding dredging during seasons of the year when DO is typically low or juvenile salmonid, other juvenile fish, or crab migrations are occurring in the area.

Digging: Impacts of digging on soils, water quality, plants, animals, and other organisms would be substantial, and similar to those described for dredging. Digging impacts would be less severe than impacts due to dredging, because it would be done only at low tides, when

intertidal areas are more visible and treatment could be more selective. Roads built to transport equipment would destroy any benthic and desirable plant resources over which they were built.

Mitigation: Additional mitigation for impacts caused by digging *Spartina* colonies include: (1) avoiding creation of large depressions; (2) smoothing the surface of disturbed sediments at low tide; (3) refraining from disturbing adjacent areas; (4) testing sediments for contaminants before digging to avoid release of contaminants at levels of concern into the water column; (5) backfilling depressions with appropriate sediment hauled by trucks that could also be used to transport material to upland disposal sites; (6) replanting backfilled areas with appropriate native vegetation (unless mudflat habitat is to be restored); and (7) removing temporary roads built to access sites.

Plowing: Plowing has not been shown to be effective for controlling or eradicating *Spartina* infestations.

Rotovating: Rotovating has not been shown to be effective for controlling or eradicating *Spartina* infestations.

Crushing: Dense *Spartina* root masses create a firm bed even in very soft substrates, and trampling or driving a wide tracked or wheeled vehicle over *Spartina* beds therefore usually would not mix or disturb the soils to a great degree. However, some compaction would undoubtedly occur, especially in uncolonized areas along the approach to the colony. Crushing would kill some non-target plants growing in or near the colonies, and animals that were unable to move out of the way. Infauna and epifauna populations might be temporarily affected by sedimentation and erosion caused by soil disturbance. A temporary increase in *Spartina* detritus would enhance decomposer populations.

Mitigation: Additional mitigation for impacts caused by crushing *Spartina* colonies include: (1) carefully selecting vehicle type, including weight and tread pattern best suited for a particular substrate; (2) operating vehicles in a careful and methodical manner; (3) inspecting the treatment site for propagules throughout the tidal cycle; and (4) testing success of revegetation with native species (unless mudflat habitat is to be restored) and, if successful, replanting bare areas left in salt marshes after eradication of *Spartina*.

Mowing: Some plants growing within the treatment area and many animals that are not able to escape might be injured or killed during mowing activities. However, preliminary results of studies conducted by the Department of Natural Resources indicate that many marsh species respond well to mowing (J. Civille, pers. comm. 1993). Furthermore, mowing could reduce the quantity of plant litter (which smothers native vegetation in some areas) that is generated each fall when *Spartina* clones die back because the release of litter would be distributed throughout the year. Because mowing occurs near or below the sediment surface, it would have a direct impact on benthic epifauna and infauna. Some soil compaction and disturbance would occur, depending on the substrate type, the weight of the person or vehicle used, and tire or tread types. Cutting/mulching blades would occasionally cut below the sediment surface, causing short term soil disturbances and increased water turbidity. *Spartina* plants killed by repeated mowing have intact (though dead) root and rhizome systems that decompose slowly. The decomposing roots and rhizomes would continue to anchor sediments, especially in areas with weak or moderate tidal flows. Significant movement of sediment might occur following treatment, especially along channel and creek banks, which could collapse and widen. The mowed area could be rapidly colonized by native marsh species, which would prevent erosion of accumulated sediments and keep the area from returning to pre-infestation elevations. Plant litter would float and be transported away by wind and tides, and might cover native salt marsh habitats. Mowing and cutting might contribute to the spread of *Spartina* by dispersal of seed, rhizome fragments, and entire plants.

Mitigation: Additional mitigation for impacts caused by mowing *Spartina* colonies includes avoiding work during the salmon (*Oncorhynchus* spp.) outmigration period, and wearing mudluks on soft sediments to minimize soil disturbance. Mowed material should not be stockpiled on a temporary or permanent basis below the high tide line and should be disposed of upland where they will not reenter surface waters.

Harvesting: If harvesting was practiced, *Spartina* species would continue to trap sediments during periods of growth, and harvested beds would continue spreading vegetatively. Changes in topography would parallel those expected under the No Action Alternative. The process of harvesting would slow the spread of *Spartina* by reducing seed production. Repeated harvesting might not allow recuperation of the benthic community, on which shrews, voles, moles, and mice feed. However, small mammals also feed on marsh vegetation, and thus it is possible that a harvested *Spartina* bed would support as many small

mammals. An aquatic plant harvester would disturb sediments if the cutter blades hit bottom, and in shallow water the paddle wheels would stir up bottom sediments. As in crop farming, there could be a loss of nutrients from the overall system over the long term.

Mitigation: Additional mitigation for impacts caused by harvesting *Spartina* colonies includes: carefully selecting vehicle type, including weight and tread pattern best suited for a particular substrate; harvesting before seed set; and training and education of workers to avoid practices contributing to colony spread. Harvested material should not be stockpiled on a temporary or permanent basis below the high tide line and should be disposed of upland where they will not reenter surface waters.

4.3.3 Purple Loosestrife

The prolific production of long-lived seeds and the high potential for stem fragments to take root limits the utility of some of the mechanical methods for controlling purple loosestrife. Areas disturbed by use of heavy machinery might provide new habitat for seeds to germinate and new infestations become established. Due to the high potential for spread of purple loosestrife, control measures that might significantly contribute to the dispersal of the plant are not recommended. Honey production might be reduced if bees are dependent on purple loosestrife for late summer pasturage.

Mitigation Measures: Possible mitigation measures discussed above for all species (Section 4.3.1) apply to most of the mechanical control methods. Additional mitigation measures common to use of mechanical control treatments of purple loosestrife are described in the following paragraph.

All disturbed areas should be revegetated with native plant species or otherwise protected from erosion. Siltation to adjacent areas should be avoided and a silt barrier should be placed around the treatment site until the silt has settled. Turbidity, phosphorous levels, dissolved oxygen levels, total suspended solids, and fish mortality and/or injury should be monitored in and around the treatment site. If fish are observed in vegetation that is being removed, they should be caught and returned to the water. If fish are observed in distress or have been killed, operations should cease immediately and the department granting permits should be contacted. Loss of purple loosestrife use by bees could be mitigated by planting other species as bee forage.

Dredging: This method is not feasible for treatment of purple loosestrife infestations because plants are not adequately submerged.

Digging: The probability of mechanical digging eliminating and preventing the spread of purple loosestrife is low. This, along with the high potential for dispersal of seeds and vegetative propagules by opening up disturbed habitat, eliminates digging as a feasible option for control of purple loosestrife.

Plowing: Plowing has not been shown to be effective for controlling or eradicating purple loosestrife infestations.

Rotovating: Rotovating has not been shown to be effective for controlling or eradicating purple loosestrife infestations.

Crushing: Crushing/trampling operations would result in the fragmentation of purple loosestrife stems, which might be able to root and reestablish the infestation. The integrity of wetland soils would be substantially disturbed and areas could be opened up for seedling establishment. Sediments might be disturbed and enter adjacent waterbodies and temporarily increase turbidity and nutrient infusion. Some animals that feed, hide, or nest in vegetation where purple loosestrife grows could be displaced or destroyed, especially if unable to escape while treatments are being conducted. Dead purple loosestrife material would be processed by decomposers and nutrients would be released into the soil for plant and animal utilization.

Mitigation: Additional mitigation for impacts caused by crushing purple loosestrife includes collecting all broken stems and properly disposing of them.

Mowing: Plants and animals might be killed or injured during mowing operations, especially if vehicles and heavy machinery are used. Soil compaction and disturbance would occur, especially in soft wetland soils. Soil disturbance could lead to increased sedimentation, seed dispersal, and could open up habitat for purple loosestrife seedling establishment. Many cut purple loosestrife stems would be able to root and reestablish the infestation if not removed from the site.

Mitigation: Additional mitigation for impacts caused by mowing purple loosestrife includes collecting all broken stems and properly disposing of them.

Harvesting: Commercial uses have not been developed for purple loosestrife and are not currently being pursued.

4.3.4 Miscellaneous Species

Impacts due to mechanical control of giant hogweed, indigobush, and garden loosestrife would be similar to those related to purple loosestrife control, although little specific information is available.

Any of the mechanical control measures for eradicating giant hogweed might impact human health by exposing workers to this toxic plant. Contact dermatitis has been associated with use of brush cutters, and the use of machinery on giant hogweed would pose a health hazard to the machinery operator, bystanders and people cleaning up plant cuttings. Impacts on soil organisms due to digging giant hogweed would be less severe than for other species, because digging would only need to be done to a depth of 10 cm (4 in.) to kill the plants.

Mitigation: Additional mitigation for impacts caused by applying mechanical control measures to giant hogweed includes avoiding activities that would expose workers or the public to contact with the plants, their cuttings, or smoke from burning them.

4.3.5 Information Needs

Additional information on the utility of mechanical control methods for controlling or eradicating the noxious emergent plants discussed is needed. Research could be undertaken to address the following:

- **Timing of crushing or mowing purple loosestrife to avoid producing stem fragments that are capable of rooting.**

- **Techniques for efficient collection of purple loosestrife stem fragments or *Spartina* rhizomes after crushing or mowing treatments.**

- **Most practical and effective ways of eliminating purple loosestrife seedlings that grow on soils disturbed during implementation of mechanical control methods.**

- **Necessity of digging out or dredging all *Spartina* rhizomes to kill the plants.** Dredged areas would have a soil surface lower than the original level, and these areas would be lower in the intertidal zone or might be subtidal. If holes dug to remove plants are backfilled, would rhizomes be capable of growing through sediment that was 1 m deep? It might be possible to minimize digging depth if some rhizomes can be left in the ground.

- **Efficacy of crushing, digging, and mowing in killing or preventing seed set of giant hogweed, garden loosestrife, and indigobush.**

- **Number and timing of crushing treatments needed to kill plants (all species).**

4.4 BIOLOGICAL METHODS ONLY

This section describes potential significant impacts to natural, agricultural, and built environments that might result from the Biological Methods Only Alternative. A description of this alternative and the various methods considered is presented in Section 3.4. Under this alternative, five categories of biological agents/controls were considered. Impacts associated with each of these categories is discussed below. Information in this section is summarized from the technical report, Biological Control Methods: Efficacy and Impacts included in this EIS as Appendix H. If available, measures that could mitigate specific environmental impacts are also discussed. Tables summarizing the environmental impacts and measures available to mitigate these impacts are provided for *Spartina* (Table 16) and purple loosestrife (Table 17). A prioritized list of additional information/research needed to fully assess the environmental impacts and/or efficacy associated with this alternative is also provided.

4.4.1 *Spartina*

Impacts associated with the various biological control agents are discussed in the following sections.

<u>Microbial Pathogens</u>: Several viruses and fungi naturally associated with *Spartina* populations (within and outside of Washington) have been identified. However, their specificity to *Spartina* species has not been investigated and 8 to 12 years might be necessary to complete testing and gain regulatory approvals. Based on available information, seed

Table 16. Significant environmental impacts and available mitigation measures associated with biological control methods for controlling *Spartina*.

Biological Control Method	Significant Environmental Impacts	Mitigation Measures
Microbial Pathogens (seed fungi)	- Specificity to noxious *Spartina* species and the affects of fungal releases on human health unknown	- Comply with pre-introduction regulations concerning non-target species, human health, and other affected resources
Insects (*Prokelisia marginata*)	- Specificity to noxious *Spartina* species (susceptability of native species) unknown	- Comply with pre-introduction regulations concerning non-target species, and other affected resources
Grazing (livestock)	- Soil compaction - Inputs of nutrients, sediments, and fecal coliform bacteria to surrounding waters - Non-target plants and animals disturbed and/or destroyed	- None - Avoid grazing in partially submerged sites; graze only one or two times annually - Conduct threatened and endangered species surveys prior to grazing; fence areas to confine animals to specific treatment sites
Genetic Engineering	---	---
Plant Competition and Forced Succession	- *Spartina* stands displaced by native high marsh species are converted from low salt marsh areas to high salt marsh - Success of introduced plantings unknown (expensive)	- None - Monitor planting site, replace dead plants

Table 17. Significant environmental impacts and available mitigation measures associated with biological control methods for controlling purple loosestrife.

Biological Control Method	Significant Environmental Impacts	Mitigation Measures
Microbial Pathogens	---	---
Insects	Honey production in managed apiaries might be decreased	None
Grazing (livestock)	- Soil compaction - Inputs of nutrients, sediments, and fecal coliform bacteria to surrounding waters - Non-target plants and animals disturbed and/or destroyed	- None - Avoid grazing in partially submerged sites; graze only one or two times annually - Conduct threatened and endangered species surveys prior to grazing; fence areas to confine animals to specific treatment sites
Genetic Engineering	---	---
Plant Competition and Forced Succession	- Non-target plants and animals disturbed and/or destroyed - Impacts associated with methods potentially used for site preparation (such as mowing or burning). See tables 3 and 1 for those impacts.	- Conduct threatened and endangered species surveys prior to introduction of indigenous or exotic vegetation - See Table 15 for mitigation measures for impacts associated with mowing or burning

fungi appear to be the most promising microbial control agent for *Spartina* seed production. Fifteen species of seed fungi were found associated with *S. alterniflora* plants in North Carolina. One of these species, *Claviceps purpurea* (ergot) has been shown to impact *S. anglica* seed production. Ergot has also been observed growing on *S. alterniflora* in Willapa Bay and might have lowered seed viability. However, this fungus poses a serious health risk to all herbivores feeding on ergot-infected species. The toxins in this fungus are powerful constrictants of blood vessels, causing gangrene and potentially death in large mammals and humans. Use of ergot as a biological control could result in severe impacts for small and large mammals around infected areas. Human health risks could be especially severe if this agent is introduced to *Spartina* populations near homes or public beaches. Ergot infestations go virtually unnoticed by the general public—most people assume they are looking at seeds, not a fungal disease. Additionally, native *Spartina* species or cereal grains could also be susceptible to ergot. For example, this fungus has been found on a native dunegrass (*Elymus mollis*) at Leadbetter Point, in Willapa Bay (K. Sayce, pers. comm. 1993).

Mitigation: Because little is known about the efficacy and application of biological agents to the control of *Spartina* species, knowledge of potential mitigation measures is limited. Studies need to be conducted to better determine the feasibility of seed fungi as biological control agents for *Spartina*. In particular, specificity to noxious *Spartina* species and effects of fungal releases on human health should be investigated.

<u>Insects</u>: One insect, the planthopper *Prokelisia marginata*, or a subspecies, is associated with *S. foliosa* and *S. alterniflora* in California. Potentially, this planthopper could be a biological control candidate to limit the spread of *S. alterniflora* in Washington because the insect appears to reduce or prevent seed production. However, it has not been determined that the planthopper is specific to *Spartina* species non-native to Washington. Research is needed to determine specificity and threats to any native plant species before impacts to non-target plant species can be fully determined. Eight to twelve years are often necessary to complete testing and gain regulatory approvals for release of biocontrol agents, but the enormous potential benefit of use of this control method outweighs the time required for its research and development. A biological control program for *Spartina* involving the planthopper would not negatively impact habitat for wildlife, fish, benthic, or other organisms as long as insects were specific for *Spartina*. Insect infestations might, however, reduce the palatability of *Spartina* plants to livestock and/or waterfowl.

Mitigation: Research should be conducted to determine specificity of insects to noxious species of *Spartina*, and potential impacts before insects are released.

Grazing: The impacts associated with grazing as a potential control technique for *Spartina* depend on the type of grazing animal. Heavy grazing by a native European snail, *Littorina littorea*, has been shown to significantly limit *S. alterniflora* distribution on the Atlantic Coast. The introduction of this snail into Washington as a potential control for *Spartina* is currently not recommended because of possible impacts to our native *Littorina* species or native vegetation, although further investigation may show that these potential impacts are not significant. Similarly, the introduction of other exotic wildlife species that graze on a variety of wetland and aquatic plants, such as additional introductions of nutria (*Myocastor coypus*), is not recommended because of potential negative impacts to desirable vegetation.

Intensive grazing by domestic livestock would be necessary on a continual basis to be effective in killing or severely impacting the vigor of *Spartina* in monospecific areas, grazing is not recommended because of adverse impacts associated with this treatment method. Trampling by livestock would compact wetland soils. Sediments would also be transported on the hooves of livestock. Soil chemistry would be altered by fecal and urine deposition. Grazing of salt marshes by livestock might result in the transport of sediments, nutrients, and fecal coliform bacteria to surrounding waters. Surface water flow patterns could be altered by soil disturbance. Additionally, livestock could transport seeds and/or vegetative propagules to uninfested areas.

Grazing would selectively affect *Spartina* if livestock were confined to monospecific stands. However, impacts to non-target plants would occur in mixed stands. Some animals that feed, hide, or nest in salt marsh vegetation would be displaced as a consequence of the physical presence of livestock or through their grazing. Soil compaction might affect animal life within the sediment (infauna). Water quality would be affected by high levels of nutrients, increased suspended sediments, or reduced dissolved oxygen levels. Shellfish beds would be negatively impacted by increased levels of fecal coliform bacteria in overlying waters.

Presence of livestock in salt marshes might be unappealing to some viewers. Recreational activities might be disrupted in areas where livestock are present. Public access might be restricted to insure both human and animal safety. Pasturing of livestock might be prohibited

in some areas by zoning codes or other regulations. Archaeological resources at or near the soil surface could be damaged by livestock trampling. Human health could be endangered if microbes harmful to humans increased in nearby surface waters from livestock presence.

Mitigation: Research should be conducted to determine specificity of *Littorina* to noxious species of *Spartina*, and potential impacts of the snails before they are released. Livestock grazing is not recommended because impacts to water quality and non-target biota cannot be mitigated.

Genetic Engineering: No information was found on the application of genetic engineering to control *Spartina* species.

Plant Competition and Forced Succession: Once sediment in a *Spartina* marsh accretes to the level of the higher marsh areas, *Spartina* stands might be naturally invaded and displaced by native high marsh species such as pickleweed (*Salicornia virginica*) and saltgrass (*Distichlis spicata*). Competition from native high marsh species might ultimately reduce the landward extent of *Spartina* infestations in some areas. Plantings of native vegetation have not been previously tried to control exotic *Spartina* species. Because of the cost and labor associated with extensive planting efforts, this approach does not appear feasible as a large-scale control.

Mitigation: Research should be conducted on the success of planting native vegetation in the intertidal zone.

4.4.2 Purple Loosestrife

Impacts associated with the various biological control agents are discussed in the following sections.

Microbial Pathogens: The use of exotic microorganisms for the biological control of purple loosestrife is not currently viewed as a viable approach. There are no reports in the American and European literature of significant pathogens being recovered from purple loosestrife. The few native species of fungi reported as pathogens of purple loosestrife in North America were incidental and non-damaging. Field surveys conducted in Europe and in Washington did not reveal any damaging pathogens attacking purple loosestrife.

Insects: Several herbivorous insects appear to be promising biocontrol agents for purple loosestrife. Impacts associated with six most promising insects are discussed below. Three of the six species (three beetles) have been approved for release by federal and state regulatory agencies in 1992 and limited releases of the beetles in Washington have begun.

Use of these insects for control of purple loosestrife would not have a detrimental effect on sediment/soil stability and chemistry. The roots of plants killed as a consequence of the attack by these species would remain in the soil and contribute to soil stability. Sediment trapping would decrease as purple loosestrife density is lowered. No adverse impacts would be produced on the quality of surface water supplies and groundwater by the insects themselves. Flow rates in streams and rivers and flow patterns in impounded waterbodies should be enhanced by the control of purple loosestrife.

Host-specificity tests involving the three beetles confirmed that all three species are highly host-specific for purple loosestrife. Therefore, no non-target plants would be impacted by the release of these beetle species. Host-specificity testing is still in progress for the other three potential insect species (two beetle and one fly species) but preliminary results suggest that all species exhibit a high degree of host-specificity. Any endangered and threatened biota occurring in purple loosestrife-infested sites would benefit from its biological control by insects. There are no sensitive, threatened, or endangered plant species in the family Lythraceae in Washington. The insects would not adversely affect the survival of any listed threatened or endangered wildlife species in Washington.

The bioagents released to date, and those species whose release is pending, for control of purple loosestrife are incapable of injuring domesticated or undomesticated animals. Biological control would improve animal utilization of infested sites if purple loosestrife is replaced by plants that are better food, nesting, and shelter species. Some of the introduced insects might serve as food themselves for some wetlands animals (e.g., birds, small mammals, amphibians, and predatory arthropods).

Honey bee use of purple loosestrife as a nectar and pollen source would be impacted by its biological control. However, honey bees survived on other plants prior to the invasion of purple loosestrife and now survive in areas not yet invaded by it. Furthermore, not all purple loosestrife plants would be eliminated by bioagent attack. Surviving purple loosestrife

plants would still provide nectar and pollen. It is conceivable that other bee forage plants would occupy sites vacated by purple loosestrife.

Human health would not be endangered from the use of insect biological control agents. The insects are not capable of biting or stinging humans, producing toxic secretions, or transmitting pathogenic microorganisms.

Natural enemy population densities are regulated by the abundance of purple loosestrife. As plant densities decline, corresponding decreases also would occur in control organism populations. Initial bioagent release sites should be isolated from human activities that might interfere with organism establishment success but sites should be reasonably accessible for monitoring purposes.

To maximize biological control organism survival, releases should be avoided in sites that might receive synthetic organic insecticide treatments directed against certain pest arthropod populations. Release would also be unwise in purple loosestrife infestations specifically targeted for control by the unilateral use of herbicides or certain physical methods (burning, mowing, flooding), or in areas subjected to heavy livestock grazing.

Mitigation: Pre-introduction regulations mitigate concerns about non-target plant impacts. Thus, no measures to mitigate the effects of introduced bioagents would be necessary or desirable.

Grazing: Heavy grazing might result in soil compaction and short-term increases in soil erosion, particularly along stream banks and shorelines. Soil chemistry would be altered by fecal and urine deposition. Animal grazing activities might also result in sediment and nutrient infusion of adjacent surface waters. Temporary increases in turbidity and phytoplankton growth and a decrease in dissolved oxygen content might occur. Surface water flow patterns could be altered by soil disturbance.

If grazing were confined to monospecific stands of purple loosestrife, it would be a very selective form of control. However, mature purple loosestrife plants are nearly impalatable to livestock. If stands of mixed species vegetation are browsed, some non-target plants would be injured or killed. Damage to some plant species, especially those with poor regenerative capabilities, could be significant. Trampling by livestock or other animals could

potentially disturb or destroy unidentified resources on or near the soil surface. Furthermore, livestock could transport seeds and/or vegetative propagules to uninfested areas.

Some animals that feed, hide, or nest in target site vegetation would be displaced as a consequence of the physical presence of the livestock or through their feeding activities. Habitat for benthic infauna would be impacted by trampling. Water quality would be affected by high levels of fecal coliform bacteria or nutrients.

Human health could be endangered if bacteria counts in nearby surface waters were increased to dangerous levels as a direct consequence of livestock defecation. Such contamination probably would be infrequent because of the limited amount of time animals would be maintained and grazed at a site. Recreational activities in areas where livestock are being utilized might be disrupted by their presence. Hunting and wildlife/wildflower viewing activities would be impacted because of reductions in or the elimination of some animal and plant populations. Use of livestock in many human-managed landscapes might be prohibited by zoning codes or other regulations.

Mitigation: Impacts to water quality could not be mitigated. Fencing would be necessary to confine grazing animals to specific treatment sites since unconfined animals might extensively damage non-target plants. Public access might be restricted by control authorities to insure both human and animal safety. Sites should only be grazed one or two times annually to minimize impacts to non-target plants and animals, and soil and water resources. Grazing of partially submersed stands of purple loosestrife is not recommended. Cultural resource and threatened and endangered species surveys should be undertaken in purple loosestrife-infested sites targeted for control prior to the introduction of any livestock. Steps should be taken to avoid or minimize impacts to these resources.

Genetic Engineering: Currently, no known biotechnological techniques would be of value in the management of purple loosestrife. Therefore, this control method is not currently viewed as a viable approach.

Plant Competition and Forced Succession: A substantial investment of labor might be required to initiate and maintain forced succession in a purple loosestrife-infested waterbody. Intentional disturbances (burning, flooding, cutting, herbicides) would be required to initiate

the successional pathway at the control site. Labor inputs would be required for direct planting and seeding to effect site colonization. After desired plant species are established and colonization is complete, additional human involvement might be required to modify the growth and reproduction of the plants in the successional pathway. Such measures might include cutting, burning, herbicide use, and encouraging or excluding grazers. Depending on the life cycles, reproductive capacities, and survivorship abilities of the plants selected, it might be necessary to periodically supplement their population densities to maintain a sufficient level of competitiveness against purple loosestrife.

Surface water and groundwater quality and quantity would not be significantly adversely impacted by competitive plant species. Replacement vegetation might slow surface water flow but this could be viewed as being desirable since soil erosion potential would be diminished. Flow rates in streams and rivers and current patterns in large impoundments would be enhanced by the replacement of purple loosestrife with other non-environmentally disruptive plants.

Plants introduced into a site would compete with previously established species. If the competitive abilities of established species are poorer than those of introduced species, some displacement or loss of established plants might occur. In particular, undetected populations of sensitive, threatened, and endangered plants could be displaced through competition with replacement plant species. These species might also be displaced by intentional disturbances (burning, flooding, cutting, herbicides) that would be required to prepare the control site for planting. Some animal mortality might also result from the various physical control methods utilized at a site preparatory to revegetation efforts. If the replacement vegetation out-competes other plant species already established at the site, death or displacement of certain animal species (e.g., insects) utilizing the out-competed plants as hosts could occur.

The use of competing plants in wild hay meadows and riparian pastures should not harm non-target biota. Rapidly growing, non-poisonous, broadleaved plants with good palatability characteristics and high livestock forage values could be grown in pasture areas to out-compete purple loosestrife.

It is important to curtail purple loosestrife growth and development as early as possible in the growing season to decrease the plant's competitive ability. Competitive plantings should be initiated during the spring and summer months when adequate moisture would be available to

insure germination and growth. Depending upon the life cycle and seeding/vegetative reproduction characteristics of the competitive species grown, it might be necessary to replant or augment returning plant populations annually to insure that a sufficient level of competitive pressure is maintained against purple loosestrife.

Since human intervention is necessary to initiate and maintain the process of forced succession, treatment sites must readily lend themselves to access by people and/or equipment. Once the successional pathway has been developed, the process would probably best proceed in a natural environment not subjected to repetitive human- and/or animal-induced disturbance. However, this needs to be determined through experimentation.

This form of biological suppression should be incorporated into existing maintenance and beautification programs in order to keep such landscapes free of purple loosestrife or to minimize its continued spread within the system under consideration.

Mitigation: Surveys for sensitive, threatened or endangered species should be conducted prior to planting indigenous or exotic vegetation. Impacts to species of concern should be avoided or minimized. Areas in which competitive plants are grown should not be overgrazed or else purple loosestrife might soon regain its dominance of a site.

Since physical (hand removal, covering, water level manipulation, trampling/crushing, burning) and/or herbicidal control methods typically would be used preparatory to the planting of competitive vegetation, all mitigative measures described in Sections 4.2 and 4.5 should be utilized.

4.4.3 Miscellaneous Species

As discussed in Section 3.4.4, very little is known about the use and efficacy of various biological control methods in the management of giant hogweed, garden loosestrife, and indigobush. Consequently, discussion of associated environmental impacts would be speculative at this time. Clearly more information is needed on potential methods before significant impacts associated with these methods can be identified. Similarly, mitigation measures cannot be discussed until environmental impacts are understood.

4.4.4 Research and Information Needs

Spartina:

- **Additional information on the use of biologically-based control methods** in natural, agricultural, and human-managed environments is required. In particular, more studies are required to determine the feasibility of *Prokelisia marginata* as a bioagent for noxious *Spartina* species.

Purple Loosestrife: The most information exists on biological controls for purple loosestrife. However, research could be undertaken to address the following questions:

- **Information on which endemic or introduced plant species of value to wildlife might out-compete purple loosestrife and yet allow reestablishment of diverse wetland communities.** Research in progress: Washington Department of Wildlife personnel have begun an assessment of the competitive abilities of several plant species (Beckstead et al., 1991). University of Minnesota weed scientists are also exploring competitive planting utilization (Anon., 1990). Additional wetland plant species needed to be identified and subjected to evaluation by agency personnel and plant ecologists. Plant species that do not allow the reestablishment of diverse wetland communities should be avoided.

- **Efficacy of grazing as a control method for purple loosestrife.** Additional issues include timing of grazing and what stocking rates and amounts of time are required to produce an effect.

- **Information on which livestock species are the most efficient grazers of purple loosestrife.**

- **Determine at what point during the plant's phenological development that palatability to livestock diminishes.**

- **Determine the optimal number of insect bioagents that should be released at a site to effect colonization/establishment.** Research in progress: This question will be addressed by G. Piper, Department of Entomology, Washington State University, once

larger quantities of the various bioagents become available for release during 1993 and in succeeding years.

Miscellaneous Species:

- **Basic research identifying potential insect or microbial species and the effectiveness of livestock for control of giant hogweed, garden loosestrife, and indigobush is needed.**

4.5 Chemical Methods Only

In this section, the potential impacts associated with using chemical methods to control noxious aquatic weeds are summarized, potential mitigation measures (if available) for these impacts are discussed, and information needs are listed. Many of the mitigation or impact minimization measures identified in this section are already in effect, due to herbicide label directions, permit restrictions, and State regulations. Unless specified otherwise, the information in this section was summarized from three technical reports: "Environmental Effects of Glyphosate and 2,4-D" (Appendix E), "Human Health Effects of Glyphosate" (Appendix F), and "Human Health Effects of 2,4-D" (Appendix G).

4.5.1 Glyphosate Impacts and Mitigation Measures

Of the two herbicides evaluated in this EIS, only glyphosate is registered for both marine and freshwater use. Therefore, the impacts associated with using glyphosate could result from application to control *Spartina* or purple loosestrife. These impacts and potential mitigation measures, if available, are summarized below and in Table 18. Since glyphosate is to be used with a surfactant according to the label directions, the impacts would result from use of glyphosate plus surfactant.

Impacts to Soil and Sediment: The potential for soil instability and erosion in glyphosate application areas depends on a number of factors including the wetland system, watershed position and topography, water regime and gradient, and the physical and chemical characteristics of the soil and sediment. Unless physically removed after treatment, the dead vegetation would function to help reduce erosion until the area is revegetated. However, assuming that the emergent vegetation is not immediately replaced, and that decomposing

Table 18. Glyphosate and 2,4-D potential impacts and mitigation measures.

Area of Impact	Glyphosate		2,4-D	
	Potential Impacts	Mitigation Measures	Potential Impacts	Mitigation Measures
Soil and Sediment	Short-term risk of erosion and sediment instability.	Restore native vegetation; implements erosion control measures.	Short-term risk of erosion and sediment instability.	Revegetate treated areas; implement erosion control measures.
Water	Algal blooms; decrease in oxygen in the water.	Use careful application procedures-Rodeo® label recommends strip spraying; minimize drift and overspray; spray at low tide and low wind speed; consider wicking as an alternative to spraying.	Algal blooms; decrease in oxygen in the water.	Use careful application procedures; minimize drift and overspray; spray at low wind speed; consider wicking as an alternative to spraying.
Non-Target Plants	Loss of non-target vegetation.	Use careful application procedures to minimize drift and overspray; spray when wind speed is low; consider wicking as an alternative to spraying.	Loss of non-target vegetation.	Minimize overspray by using appropriate spray nozzle diameters, add thickeners, spray close to ground, restrict application to periods when winds low.
Mammals, Birds, Fish, Invertebrates	Short-term impacts on potential habitat for mammals.	Replant treated area to help establish vegetation more rapidly.	Short-term impacts on potential habitat for mammals; potential toxic effects on some mammals, avian species, fish, and aquatic invertebrates.	Replant treated area to help establish vegetation more rapidly; minimize amount of 2,4-D entering non-target areas by using careful application procedures and minimizing drift; use of DMA may be less toxic to fish and aquatic invertebrates.

Table 18. Continued.

Area of Impact	Glyphosate		2,4-D	
	Potential Impacts	Mitigation Measures	Potential Impacts	Mitigation Measures
Effects from Surfactants, Trace Impurities, Mixtures of Chemicals	X-77 and R-11 moderately toxic to fish & highly toxic to aquatic invertebrates; potential additive, synergistic impacts with other chemicals.	Use least toxic surfactant, which may be LI-700 (on basis of fish and aquatic invertebrate toxicity); stagger application of different chemicals to same area.	Potential additive, synergistic impacts with other chemicals; potential impacts from impurities.	Stagger application of different chemicals to same area.
Aesthetics	Short-term loss of vegetation; noise impacts from helicopter or boat spraying; short-term closure of recreational lands.	Apply glyphosate early in week if possible so that lands can be open for recreation on weekend.	Possible short-term odor problems; possible inferior taste of tainted fish flesh; short-term loss of vegetation; noise impacts from helicopter or boat spraying; short-term closure of recreational lands.	Use careful application procedures to avoid drift or overspray into water; spray early enough that re-entry interval on product label is completed before the weekend.
Human Health	No major impacts identified from glyphosate risk assessment.	Take prudent precautions (e.g., temporarily restrict public access to application area; post signs; distribute education brochures to help reduce public exposure).	No major impacts identified from 2,4-D risk assessment.	Take prudent precautions (e.g., temporarily restrict public access to application area; post signs; distribute education brochures to help reduce public exposure).

vegetation provides little soil or sediment stability, soils could erode and sediment could become instable within the glyphosate application area. Accreted sediment in *Spartina* marshes would eventually be mobilized, unless the marshes were revegetated.

Mitigation: The risk of erosion impacts can be minimized by revegetating with desirable species, where appropriate, and implementing erosion control measures.

Impacts to Water Quality and Movement: Because interception by foliage reduces the amount of glyphosate reaching the water surface, overspray and drift are the primary sources of glyphosate introduction to surface waters. Dilution, dissipation, and biodegradation quickly diminish the concentration of glyphosate in the water column, minimizing degradation of surface water quality. However, decomposition of dense stands of *Spartina* or loosestrife following glyphosate application could temporarily reduce dissolved oxygen levels and increase levels of nutrients (nitrogen, phosphorus, and carbon), which might contribute to algal blooms. By contrast, release of nutrients from decaying emergent vegetation in treated areas might be beneficial to primary productivity and food chain support, particularly in estuarine ecosystems.

Mitigation: Adverse impacts to water quality can be mitigated by careful glyphosate application procedures in which drift and overspray are minimized. For example, if spraying were chosen as an application method, overspray could be minimized by using appropriate spray nozzle diameters and spraying close to the ground. Also, the Rodeo® label recommends strip spraying to mitigate for potential oxygen depletion. Spraying during times with the minimal wind speed could also reduce drift and overspray, and spraying at low tide could help limit the amount of glyphosate entering the water. Alternative application methods could also be considered. For example, wicking plants greatly reduces the possibility of drift, compared with spraying. However, wicking is more labor intensive than other application methods.

Impacts to Biotic Community:

Non-Target Plants

Glyphosate impacts to non-target plants depends on several factors, including plant physiological status, plant retention, timing of application, application rate, extent of

overspray and drift losses during glyphosate application, species-specific uptake and translocation rates, and inherent sensitivity of plants to glyphosate. For example, after glyphosate/surfactant application to control *Spartina* in Padilla Bay, no adverse effects on eelgrass were noted (Bulthuis and Shaw, 1993). The study by Fresh and Carr (1993) , one of three fate and effects studies in Willapa Bay, found significant decreases in above-ground biomass and percent cover of eelgrass following treatment with glyphosate at the minimum recommended rate for *Spartina* control. Glyphosate biodegrades rapidly and does not appear to inhibit seed germination or establishment immediately after application. However, if glyphosate inadvertently killed desirable vegetation but failed to kill all noxious vegetation, it is possible that the nontarget plant species killed by glyphosate could be replaced by *Spartina* or other non-native plants. The length of time required for regrowth of desirable vegetation is unknown.

Mitigation: This potential impact can be mitigated through careful application procedures and by applying glyphosate during low wind conditions, thereby minimizing the potential for drift. Overspray could be minimized by using appropriate spray nozzle diameters and spraying close to the ground. Alternative application methods could also be considered. For example, wicking plants greatly reduces the possibility of drift, compared with spraying. However, wicking is more labor intensive than other application methods. Backpack spraying is an alternative that may minimize drift yet be less labor intensive than wicking.

<u>Mammals</u>

The potential adverse effects to mammalian wildlife from glyphosate used to control noxious vegetation depend on the numbers and types of mammals using treated areas; the availability of other suitable habitats if unfavorable alterations in habitat occur; and the effects of exposure on reproduction, growth, and survival of these animals. The length of time required for revegetation of the habitat is unknown. Based on the toxicity data available from rabbit and rat studies, it appears unlikely that potential doses to terrestrial or aquatic mammals from noxious weed control would result in adverse acute or chronic health effects.

Mitigation: Revegetating bare areas to restore native habitat would shorten the period of time that mammalian habitat would be disturbed.

Birds

Glyphosate is practically nontoxic to bobwhite quails and mallard ducks and presumably to other members of these bird groups. Lethal toxicity information is not available for other bird groups that use wetland areas, such as perching birds and shorebirds. These birds nest and feed in emergent wetlands and might have different tolerances to glyphosate because of different diets, physiology, and behavior. However, extrapolating from available toxicity information for quail and ducks, significant adverse health impacts to birds are not considered likely.

Fish and Aquatic Invertebrates

Based on available toxicity data, acute or chronic fish toxicity hazards from glyphosate applied to control noxious aquatic vegetation are not expected to occur. However, most of the toxicity studies have been of freshwater fishes and salmonids. The only available data for marine fishes are from two Monsanto-sponsored studies. The 96 hour LC_{50} for the harlequin is 188 mg/L and the 96 hour LC_{50} for the sheepshead minnow (an anadramous fish) is >1000 mg/L. Long term food chain and reproductive effects have not been evaluated.

Available data also suggest that lethal toxicity and adverse behavioral effects for most invertebrates, such as shellfish, are unlikely from the concentrations of glyphosate that would be used to control noxious vegetation (i.e., approximately 0.3 ppm). A study of Rodeo®/X-77® found lethal concentrations to invertebrates to be 200 to 300 ppm. However, a study sponsored by Monsanto found 50 percent inhibition of growth in algae after 7 days of continuous exposure to glyphosate at a concentration of 0.64 mg/L, which is close to the maximum concentration found in off-site seawater on the first high tide (an instantaneous measurement) in the Willapa Bay study (0.52 mg/L). It is uncertain whether these results would apply to a Rodeo®/surfactant application program in Washington. In addition, the exposure period in the Monsanto study was longer than might occur in Willapa Bay waters.

Results from the Willapa Bay study of invertebrates (Simenstad *et al.*, 1993) showed no significant adverse effects on abundance of organisms after aerial spraying at the lowest recommended rate. There was significant variability between control and test plots prior to spraying making comparisons of the two difficult. This study did not provide information on effects at higher application rates and did not evaluate long-term effects in some of the test

organisms. This study only evaluated organism abundance and provides no information on non-lethal effects.

Reductions in dissolved oxygen from decaying *Spartina* would be harmful to fish and invertebrates, though decomposition is likely to be slow relative to tidal water exchange. Toxicity data for surfactants is covered in a subsequent section.

To date, no studies examining presence or toxicity of glyphosate or surfactants in the microlayer (the thin "skin" on the surface of the water) have been performed. The microlayer provides habitat for a wide variety of biota, including juveniles stages of fish and crustaceans, bacteria, metazoans, and protozoans. Because these life forms are often highly susceptible to toxicants, there is a possibility that impacts may occur until dilution or dispersion reduce concentrations of glyphosate in the microlayer.

Mitigation: To reduce impacts to invertebrates, spraying could be done at times that are less likely to affect them. For instance, spraying around oyster beds could be delayed until after the larvae have developed.

Impacts to Aesthetics, Recreation, and Cultural Resources: Minimal adverse aesthetic impacts could occur from application of glyphosate to control noxious emergent weeds. Some individuals might view the loss of vegetation that would occur prior to the establishment of desirable vegetation as an adverse impact, while others might not be concerned. Short-term noise impacts could occur if helicopter, boat, ATV, or truck spraying were to occur. Additionally, temporary closure of recreational lands would occur as a result of spray activities.

Mitigation: Testing success of revegetation with native species (unless mudflat habitat is to be restored) and, if successful, replanting bare areas left in salt marshes after eradication of *Spartina* would hasten the re-establishment of vegetation. By applying glyphosate early in the week (e.g., Monday or Tuesday), recreational impacts could be minimized because there is usually less recreational use at these times, rather than a weekend. However, weather and tides would be more important considerations in the timing of the application.

Impacts to Human Health: Potential noncancerous effects associated with human exposure to glyphosate can be extrapolated from laboratory mammalian toxicity studies. Acute toxic

effects of glyphosate in rats, rabbits, and mice include mild nasal irritation, slight dermal irritation, and decreased body weight gains. Also, kidney effects in a three-generation rat study and a decrease in absolute and relative pituitary weight in male dogs in a one-year feeding study have been observed. Maternal and developmental toxicity were noted in pregnant rats, and maternal toxicity was also noted in pregnant rabbits.

Currently, glyphosate is classified by USEPA Carcinogen Assessment Group as "Group E--evidence of noncarcinogenicity for humans." The available carcinogenicity data for glyphosate include one chronic study in mice and two chronic studies in rats. No statistically significant treatment-related carcinogenic effects were found in any study.

To evaluate the potential for adverse human health effects resulting from exposure to glyphosate used to control noxious emergent vegetation, a human health risk assessment was conducted. In the risk assessment, conservative estimates of noncancer and cancer toxicity (i.e., estimates that might overstate the amount of chemical toxicity) derived from some of the toxicity data summarized above were compared with a conservative estimate of the amount of glyphosate to which the public could be exposed. The routes of exposure evaluated include: inhalation of spray; dermal exposure from vegetation and water; and ingestion of surface water, soil, sediment, wild game, fish, shellfish, garden vegetables, and berries. Potential concentrations in the environment were estimated by assuming that no glyphosate degradation occurred. Potential human intake rates were calculated using reasonable maximum exposure assumptions developed by EPA.

Results of the human health risk assessment suggest little potential for adverse noncancer or cancer effects as a result of potential exposures from noxious vegetation control. Short-term (acute) and long-term (chronic) noncancer health effects were estimated for adults and children and were all below levels of potential concern. Similarly, all risks calculated for cancer effects were below a common regulatory level of concern (i.e., 1 in 1,000,000). Through use of highly conservative estimates of exposure and toxicity, the results of the risk assessment are more likely to over-estimate the risks associated with exposure than underestimate the risks.

Mitigation: While exposure to glyphosate, surfactants, and trace impurities appear unlikely to cause human health effects at the concentrations to which people could be exposed, prudent measures should be taken as precautions. Mitigation efforts to protect human health

should be aimed at reducing exposure to combinations of chemicals if other chemicals were applied in the areas where glyphosate is applied. Mitigation efforts can include restricting public access to recreation lands on a spray site and public education measures, such as posted signs near spray sites and information brochures sent to homes that border a spray site.

<u>Impacts from Surfactants, Trace Impurities, and Mixtures of Chemicals</u>: Impacts to human health and the environment could also result from exposure to surfactants used with glyphosate, trace impurities in glyphosate or its surfactants, and application of glyphosate to areas where other herbicides are sprayed. Information on the toxicity of surfactants, impurities, and chemical mixtures is limited.

The ecological impacts associated with surfactants are a function of toxicity of the surfactant and the concentration to which an organism could be exposed. Acute toxicity information based on limited studies with fish and aquatic invertebrates indicates that X-77® and R-11® are moderately toxic to fish and slightly to highly toxic to aquatic invertebrates. LI-700® is practically nontoxic to both fish and aquatic invertebrates. No data exist to evaluate avian toxicity of these products. While these toxicity tests indicate some potential toxicity for X-77® and R-11®, the concentrations anticipated as a result of herbicide application procedures are likely to be much less than the concentration of surfactant that elicited a toxic response in the studies. The study at Willapa Bay (Simenstad *et al.*, 1993) found no significant adverse effects on invertebrate abundance from aerial spraying of Rodeo® at the lowest recommended application rate of 4.7 L/ha with the surfactant X-77® at a rate of 0.9 L/ha which is higher than the recommended surfactant application rate for *Spartina* control. The fate and persistence study (Paveglio *et al.*, 1993) found surfactant concentrations of 0.10 to 0.18 ppm in sediments and 2.8 to 16 ppm in off-site seawater. These concentrations are much less than the levels that caused toxicity to invertebrates in laboratory studies.

Mammalian studies indicate that the surfactants X-77®, R-11®, and LI-700® are practically nontoxic to rats and rabbits, but both X-77® and LI-700® are rated as corrosive, based on eye irritation in rabbits. LI-700® is also rated corrosive based on dermal irritation in rabbits. However, the concentrations of surfactant required to elicit these responses are greater than the concentrations expected as a result of glyphosate applications to control noxious vegetation.

Trace impurities in glyphosate at levels less than or equal to 0.1 ppm include N-nitroso-glyphosate (NNG). Monsanto Agricultural Company has evaluated NNG for mutagenicity, carcinogenicity, and teratogenicity, and has found that this chemical does not elicit negative effects and is excreted unchanged (F. Dost, pers. comm., 1993).

The surfactant X-77® reportedly can contain trace amounts of ethylene oxide. Ethylene oxide is considered a probable human carcinogen by the International Agency for Research on Cancer (IARC). However, ethylene oxide is highly volatile and is not likely to persist long in the environment.

In addition to surfactant toxicity and trace impurities, ecological effects might also occur when glyphosate is applied in locations where other herbicides or pesticides are applied. Exposure to multiple chemicals that have similar toxic effects could cause greater toxicity than exposure to a single chemical. However, both data and methodology for assessing the additive and synergistic impacts of combined pesticides are lacking.

Mitigation: In general, these impacts can be minimized through careful glyphosate application procedures that minimize overspray and drift. To minimize the possibility of multiple exposures and adverse interactions with other chemicals in the environment, the number and amount of chemicals applied to the same area over a given time period (e.g., week, month) should be limited so that degradation of a chemical can begin before another chemical is applied to the area. One mitigation technique is to use the least toxic surfactant available. On the basis of fish and aquatic invertebrate effects, LI-700® appears to be the least toxic surfactant.

4.5.2 2,4-D Impacts and Mitigation Measures

2,4-D is not registered for use in marine environments in Washington state, and therefore, its potential impacts are only associated with applying this herbicide to control purple loosestrife in a freshwater environment.

<u>Impacts to Soil and Sediments</u>: Although erosion of soil and sediment could increase after 2,4-D treatment due to the reduction in plant cover, other vegetation such as grasses and rushes that remain after 2,4-D treatment would tend to ameliorate the potential erosion impacts. Unless physically removed after treatment, dead vegetation would function like a

mulch material to help reduce erosion until the area is revegetated. A worst-case scenario could occur if the area does not revegetate before the dead vegetation completely decomposes and exposes the underlying soil/sediment. The length of time required for revegetation to occur is not known. 2,4-D transport to non-target areas could result if organically rich sediment with adsorbed herbicide becomes mobile in flowing water systems or wind. However, unless this worst-case scenario were to occur, wind erosion and 2,4-D transport is likely to be negligible.

Mitigation: Revegetation of treated areas with native plants and implementation of erosion control measures can be used to mitigate potential erosion.

<u>Impacts to Water Quality</u>: Reductions in dissolved oxygen concentrations caused by decomposing plant material treated with 2,4-D could reduce water quality by increasing bioavailable nitrogen and phosphorus. Also, results from one study indicate that 2,4-D applications for control of emergent vegetation could stimulate the growth of toxic algae such as *Anabaena*.

Due to the relatively high potential mobility of 2,4-D in soils, shallow groundwater can be affected, but data indicate that residues from proper application do not tend to concentrate below the first foot of the soil profile. The concentrations of 2,4-D measured in a comprehensive groundwater survey were well below regulatory levels of concern (i.e., federal maximum contaminant level and Washington State Model Toxics Control Act Method B level).

Mitigation: All 2,4-D product labels alert the user to the toxic effects of 2,4-D and describe mandatory precautions to mitigate contamination of domestic, animal, and irrigation water sources. Proper herbicide application methods that minimize overspray would also help reduce impacts to water. For example, if spraying were chosen as an application method, overspray could be minimized by using appropriate spray nozzle types and sizes and spraying close to the ground. Spraying during times with the least possible wind speed (i.e., lower than the maximum wind speed allowed by label specifications) could also reduce drift and overspray. Wicking plants greatly reduces the possibility of drift, compared with spraying. However, wicking is more labor intensive than other application methods.

Impacts to Biotic Communities:

Non-Target Plants

2,4-D might kill or otherwise adversely affect broadleaf crops and other nontarget broadleaf species exposed to overspray and drift but would not affect grasses in the area. Fungi, algae, and phytoplankton appear to be adversely affected only at high 2,4-D concentrations. Adverse effects on the food chain as a result of exposure to 2,4-D concentrations associated with emergent weed control activities are unlikely.

Mitigation: Potential adverse impacts on crops and other nontarget species can be mitigated by using careful application techniques, such as those described in the previous paragraph.

Mammals

The potential adverse effects on mammalian wildlife from 2,4-D used to control noxious emergent vegetation depend on the numbers and types of mammals using treated areas, the availability of other suitable habitats if unfavorable alterations in habitat occur, and the effects of exposure on reproduction, growth, and survival of these animals. Adverse effects from 2,4-D treatment on preferred habitat areas are likely to be temporary, pending regrowth of desirable emergent vegetation in the treated area.

Available toxicity data indicate a range of adverse health effects on mammals dosed with 2,4-D. Animal toxicity studies use doses that are many times higher than doses that animals would receive from a weed-spraying program. For example, sodium salt and acid 2,4-D formulations produce slight to moderate acute toxic effects on mice, rats, guinea pigs, and rabbits. Dog and mule deer studies also indicate slight to moderate acute toxic effects. Chronic effects of 2,4-D include gastrointestinal disturbance, weight loss, muscle weakness, and loss of coordination in mammals. Some formulations cause mild eye, skin, and respiratory irritation. Several studies of laboratory animals have identified toxic responses to unborn mammals, including decreased birth weight, decreased litter size, or decreased fertility, often at doses that cause adult toxicity. Data regarding the carcinogenicity of 2,4-D are not conclusive. There are many animal studies that have not yet been completed but are required by EPA for re-registration of 2,4-D. The current status of 2,4-D reregistration studies is summarized in Attachment 1 of Appendix 5.

Given the uncertainties associated with the potential degree of mammalian wildlife exposure to 2,4-D from noxious emergent vegetation control, the possibility of adverse health impacts cannot be ruled out. However, the concentrations of 2,4-D to which mammalian wildlife are exposed are expected to be significantly lower than those identified in toxicity tests for several reasons. First, 2,4-D concentrations from spraying are expected to result in much lower initial environmental concentrations than those used in the toxicity tests. Second, 2,4-D half-lives in soil, sediment, and freshwater range from days to approximately one month, thereby further lowering the potential available chronic dose for the mammal. Third, environmental dissipation of the herbicide in freshwater would further reduce the concentration potentially available for uptake. Fourth, the home range of the mammal would likely include areas outside of the spray area, and therefore, the potential dose to the mammal from drinking water, grazing, and other activities would only be a fraction of the mammal's total daily intake of food, water, soil, and sediment.

Mitigation: The potential for mammalian exposure to 2,4-D can be reduced by use of careful application procedures that minimize overspray and drift, thereby reducing the potential exposure area. Testing success of revegetation with native species and, if successful, replanting bare areas could hasten the restoration of habitat.

Birds

In dietary toxicity studies, the dimethylamine salt (DMA) and butoxyethyl ester (BEE) of 2,4-D are practically nontoxic to bobwhite quail, Japanese quail, ring-necked pheasant, and mallard ducks. Oral test results indicate avian responses to 2,4-D exposure result in practically nontoxic to moderately toxic effects.

Mitigation: As with mammalian exposures, the potential for toxic effects for avian species resulting from exposure to 2,4-D can be minimized through careful application procedures that minimize overspray and drift potential.

Fish

Available fish toxicity data indicate that 2,4-D formulations are practically nontoxic to highly toxic, with ester forms exhibiting the greatest toxicity. Data used to support the

reregistration of 2,4-D indicate that DMA is considered practically nontoxic, BEE is slightly to highly toxic, and the isooctyl (2-ethylhexyl) ester is slightly toxic to freshwater fish.

Ester formulations appear to be more toxic to juvenile coho and pink salmon and rainbow trout in hard water environments. Therefore, potential adverse effects on these species are more likely to occur in eastern Washington lakes, where hard water/higher Ph conditions are generally found. By contrast, DMA appears to be toxic to juvenile salmonids of these species in both soft and hard water only at much higher concentrations. It appears unlikely that the use of DMA would have adverse acute effects in either eastern or western Washington lakes.

Mitigation: One action to mitigate potential effects from 2,4-D is to use the DMA formulation of 2,4-D, which is generally less toxic than the BEE and ester forms. Further, careful application procedures that minimize the amount of overspray and drift could help reduce the amount of 2,4-D that enters the water.

Invertebrates

Toxicity rankings for aquatic invertebrates exposed to 2,4-D range from practically nontoxic to highly toxic. Data used to support the reregistration of 2,4-D indicate that the DMA and BEE formulations are moderately to highly toxic and the isooctyl (2-ethylhexyl) ester is highly toxic to aquatic invertebrates. Based on suggested application rates for liquid formulations of 2,4-D, it is possible that application of 2,4-D for control of nuisance emergent vegetation could have toxic effects on aquatic invertebrates.

Mitigation: Use of the DMA and BEE formulations could be less toxic to some species of aquatic invertebrates than the isoctyl ester form of the herbicide. Also, careful application procedures that minimize the amount of overspray and drift could help reduce the amount of 2,4-D that enters the water.

Impacts to Aesthetics, Recreation, and Cultural Resources: 2,4-D is described as phenolic smelling to odorless. Although unlikely, if 2,4-D application contributes to odor problems, it might become a regulatory concern of the Washington Department of Ecology. Also, taste tests indicate that rainbow trout exposed to DMA are inferior to control fish. Although 2,4-D residue concentrations were low to unmeasurable, tainting of fish flesh might

have resulted from metabolic by-products. Also, some individuals might view the short-term loss of vegetation that would occur prior to the establishment of desirable vegetation as an adverse impact, while others might not be concerned. Additionally, temporary closure of recreational lands would occur during and after the spray activities.

Mitigation: Potential mitigation measures could include careful application procedures that minimize the amount of 2,4-D that enters the water. Replanting treated areas might mitigate adverse aesthetic impacts by hastening the establishment of vegetation. By applying 2,4-D early in the week (e.g., Monday or Tuesday) or at other times of low recreational use, recreational impacts could be minimized.

Impacts to Human Health: Toxic effects from 2,4-D that may occur after short-term exposures in mammal studies include skin irritation, muscle weakness, incoordination, intestinal and liver damage, and death. The effects in mammals from long-term oral exposure include damage to the intestinal tract, liver, and kidneys. There have been a few reports of nerve damage in humans who were exposed to 2,4-D, but there was not enough information about their exposures to other chemicals or infections which could have caused the same symptoms to say that 2,4-D was the cause of the damage. Effects on reproduction in animals included fetal malformations in rats. There have been no scientifically valid studies showing harmful effects on human reproduction. The doses of 2,4-D used in animal studies are much higher than the dose to which humans would be exposed from a weed-spraying program.

Human health studies from Sweden that showed an increased risk for soft-tissue sarcoma (cancer of "soft" tissues such as fat and muscle) in men exposed to 2,4-D have been criticized for not evaluating exposures carefully. More recent studies sponsored by the National Cancer Institute have shown small increases in risk for non-Hodgkin's lymphoma (a type of lymph gland cancer) in farmers who were exposed to 2,4-D for more than 20 days per year. In these studies it was difficult to describe their exposure accurately because farmers use many chemicals and often the histories of their chemical use had to come from next-of-kin. Another study showed that workers in 2,4-D manufacturing plants had a higher rate of death from lymph cancer than the general population. Other studies of farmers and pesticide manufacturers have not found increases in cancer.

Panels of experts have reached differing conclusions about whether these studies indicate that 2,4-D is a possible cause of cancer in humans. A scientific advisory board convened by the EPA met in April 1993 to review all of the human health and animal cancer studies. The Board's preliminary conclusion was that the data were "weakly suggestive" that 2,4-D was a cause of human cancer. The Board also tentatively concluded that it was improbable that 2,4-D caused cancer in animals and that there was no obvious mechanism of action for 2,4-D as a cause of cancer in humans. EPA will use the results of this investigation to decide whether a special review of 2,4-D is warranted. A decision is expected in the autumn of 1993.

To evaluate the potential for adverse human health effects from exposure to 2,4-D applied to control aquatic weeds, a human health risk assessment was conducted. Six routes of potential human exposure were evaluated:

(1) skin contact with vegetation
(2) skin contact with water
(3) skin contact with sediments
(4) ingestion of fish
(5) ingestion of water
(6) incidental ingestion of sediments

For each aquatic exposure route (which includes all routes except skin contact with vegetation), three separate scenarios were developed to include the most likely places that humans would come into contact with 2,4-D:

(1) small pond
(2) irrigation ditch
(3) large lake

Since 2,4-D breaks down over time, this information was included when the concentrations of 2,4-D in the environment were calculated.

For every type of exposure route that was analyzed in this risk assessment, the potential for non-cancer effects on humans was found to be well within the safe range. At this time, the risk to the public of developing cancer from spraying weeds with 2,4-D cannot be calculated.

The amount of exposure to the general public from a weed-spraying program would be much less than that of the farmers and pesticide manufacturers in the cancer studies discussed above, therefore if there is any risk of developing cancer from this type of exposure to 2,4-D, it is likely to be very low. However, the uncertainty about the status of 2,4-D as a possible cause of cancer in humans and the pending decision by EPA should be considered when evaluating weed control methods.

While the results of the human health risk assessment indicate that exposure to 2,4-D at the levels possible from noxious emergent weed control might not pose acute or chronic health hazards, mitigation efforts might be a prudent tool to help protect human health by reducing exposures to chemicals.

Mitigation: Mitigation efforts can include restricting public access to recreation lands on a spray site and through public education measures, such as posted signs near spray sites and information brochures sent to homes that border a spray site.

Impacts from Adjuvants, Trace Impurities, Mixtures of Chemicals: Adjuvants used with 2,4-D, trace impurities in 2,4-D, and application of 2,4-D to areas where other herbicides are sprayed might cause impacts, as described below. In general, these impacts can be partially mitigated through careful application procedures that minimize overspray and drift. Any other specific mitigation measures associated with these factors are also described below.

Chemical impurities are sometimes introduced into the various 2,4-D formulations during manufacture. The primary impurities found in 2,4-D products include: 2,4-dichlorophenol, halogenated dibenzo-p-dioxins and dibenzofurans, and bis(2,4-dichlorophenoxy)methane. Some of these impurities have been found to cause cancer and birth defects in animals and can be toxic to fish. However, given the low concentrations of these chemicals potentially available for human exposure as a result of noxious emergent weed control, major impacts to human health are not expected.

Some studies indicate that 2,4-D can be more persistent in the presence of other pesticides. However, few field studies have been conducted using pesticide combinations, and it is uncertain whether 2,4-D persistence would be enhanced by other pesticides that might be applied. Information from the Washington State Pesticide Monitoring Program (Davis, 1993)

indicates that there are residues of several pesticides in surface waters. Also, while formulations of 2,4-D might act in combination with other pesticides and might result in antagonistic, synergistic, additive, or unchanged health effects for the individual chemicals, both data and methodology for assessing the additive and synergistic impacts of combined pesticides are lacking.

4.5.3 Information Needs

The known or suspected impacts associated with application of glyphosate or 2,4-D to control noxious vegetation have been addressed in Sections 4.5.1 and 4.5.2. However, a number of other impacts are also possible, but additional data are needed in order to determine their likelihood and severity. The major data gaps associated with these chemicals are indicated and discussed below and those data needs that might be most pertinent for issues regarding noxious emergent weed control in Washington state are highlighted. Toxicity studies that are still pending for the reregistration process are identified in Attachment 1 of Appendix 5.

<u>Glyphosate</u>:

Major data needs:

- **Glyphosate/surfactant toxicity studies.** Since surfactants are required when applying glyphosate, all toxicity studies should use glyphosate/surfactant combinations. The Willapa Bay study of invertebrates found no significant adverse effects on abundance of organisms when Rodeo® and X-77 Spreader® were applied at a rate near the lowest application rate specified on the label for control of *Spartina* (4.7 pints Rodeo® per 10 gallons or approximately 5 percent in solution). Long-term effects were not evaluated in some of the test organisms. There were significant decreases in above-ground biomass and percent cover of eelgrass in the Willapa Bay studies. The effects on eelgrass one year after spraying will be studied in August of this year. The aerial Rodeo® application rate in all of the Willapa Bay studies is near the minimum rate specified on the label for aerial application. Potential toxic effects using the maximum aerial application rate in Washington's marine environment have not been studied.

- **Efficacy of glyphosate and the best application methods for wetland environments.** Data indicate an efficacy of zero to 100 percent for glyphosate to control noxious emergent vegetation. Specifically, for Washington State, the influence of tides, timing of applications, and application methods require further study. A followup study one year after aerial application of Rodeo® at a rate approaching the minimum aerial application rate (4.7 pints Rodeo® per 10 gallons or approximately 5 percent in solution) found no significant decrease in *Spartina* density in Willapa Bay (Paveglio *et al.*, 1993b). However, at one site where additional plots were treated with a hand-held wand using the a rate similar to that applied aerially (the maximum rate in solution for hand application or 5 percent in solution), there was a significant decrease in *Spartina* density. The authors found that the time from application of the herbicide to inundation of the plants by tides did influence the effectiveness of Rodeo®. Although this study gives some information about the efficacy of glyphosate in controlling *Spartina*, more information about the effectiveness of different application methods and application rates is needed.

- **Quantification and evaluation of glyphosate degradation and persistence in both emergent freshwater and saltmarsh sediments.** Some studies indicate that low levels of glyphosate might persist for up to a year or more. Information regarding how repeated applications of glyphosate can influence degradation rates in soils, sediments, and surface water is necessary. To control noxious emergent vegetation in Washington state, glyphosate could be applied to an area more than once a year for a period of years and therefore data regarding glyphosate persistence after repeated applications in various kinds of sediment types could be considered a priority data need. The Willapa Bay fate and persistence study found that 43 percent (2.11 ppm to 0.75 ppm) of glyphosate persisted in sediment four months after a single treatment. There is still no information on the persistence after repeated treatments.

Other data needs:

- **Confirmation of the hypothesis that glyphosate application would not cause growth inhibition of organisms at the base of the food web or other adverse acute or chronic effects.** The position of algae, microorganisms, and phytoplankton is at the base of the food web, and they are extremely important components of marine and freshwater ecosystems. In particular, information is needed on the persistence and

chronic effects of repeated glyphosate treatments on these plants. Although the Monsanto study found inhibition of growth of algae by glyphosate after seven days of continuous exposure, studies of effects on algae from Rodeo® plus surfactant are needed to help predict aquatic toxicity from the types of pesticide application programs planned and possible exposures that could occur in Washington. The Willapa Bay study found no decrease in algal biomass after aerial spraying with the lowest recommended application rate of Rodeo® and X-77®. Studies of the effects at higher application rates are still needed.

- Acute toxicity information on pure glyphosate effects on mammals that are likely to inhabit or use emergent wetlands. No information is available on the toxicity of glyphosate or its degradation products to raccoons, bears, mustelids, foxes, elk, beavers, muskrats, shrew, or other terrestrial or aquatic mammals. However, based on glyphosate toxicities to rats and rabbits, it appears unlikely that glyphosate would adversely affect terrestrial or aquatic mammals.

- **Potential effects of glyphosate applications on surface water nutrient availability and the marine microlayer.**

- **Additional lethal toxicity information for bird groups (other than the gallinaceous and dabbling duck groups) that use wetland areas, such as perching birds and shorebirds.** These birds nest and feed in emergent wetlands and might have different tolerances to glyphosate because of different physiology, diets, and behavior. Also, additional information is needed on the potential cancer, reproductive, and fetal effects of glyphosate on birds.

- **Additional lethal and non-lethal toxicity information to more accurately assess the potential effects of glyphosate on salmonids and other fishes, particularly on larvae and fry.** Available acute toxicity information concentrates primarily on freshwater fishes. Information is lacking on the acute toxicity of glyphosate on all life history stages of marine fishes. No information is currently available on glyphosate toxicity to herring, ocean perch, sturgeon, or sea-run cutthroat trout (*Oncorhynchus clarki*). For accurate assessment of the potential effects of glyphosate on fish

populations, information on the acute toxicity to larvae, fry, fingerlings, smolts, and adults is needed. Studies of the cumulative effects from repeated spraying are also needed.

- **Additional information to assess the potential cancer, fetal, and reproductive effects of pure glyphosate on salmonids and other fishes.** Limited information on the chronic effects (e.g., reproductive, cancer, behavioral, and physiological effects) of Roundup® formulations exists. Additional data on the latent secondary effects of glyphosate exposure, such as susceptibility to parasites or diseases and reduced fitness, are also lacking. Significant information gaps also exist on chronic toxicities to marine fish species. No information is currently available on the effects of glyphosate degradation products on fish or on the effects of repeated applications to fish. Additional information is also needed to assess the potential impacts of water quality parameters, such as pH and temperature on glyphosate toxicity to fish.

- **Additional information on the potential cancer, fetal, and reproductive effects of glyphosate and Rodeo®/nonionic surfactant mixtures to ecologically and commercially important invertebrates such as amphipods, Dungeness crab, mussels, clams, and oysters.** The Monsanto study found no effects on oyster larvae development after 48 hours at concentrations up to 10 ppm of glyphosate, however no surfactant was used in this study. The Willapa Bay study of invertebrates found no significant impact on abundance of amphipods and bivalves after aerial spraying with the minimum recommended application rate of Rodeo® and X-77®. However, it did not provide information on effects at higher application rates or evaluate long-term effects on bivalves. Information on other non-lethal effects is still needed.

- **Acute or chronic effects of glyphosate on amphibians and reptiles.** There is no available information. Because many amphibian species are dependent on wetlands for successful reproduction and juvenile development, the potential effects of glyphosate to amphibian reproduction and growth are of particular importance.

- **Environmental fate and effects of R-11®, LI-700®, and X-77® surfactants.** Adjuvants are not regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and consequently, there is little information available. In the Willapa Bay study, no NEPO (the measurable portion of X-77®) was found in seawater after

the first tide following application. NEPO concentrations in sediments decreased by 48 percent (0.18 ppm to 0.10 ppm) in the first 14 days after treatment but then remained stable for four months. Information regarding persistence, biodegradation, and acute and chronic toxicity associated with these surfactants is needed. Also, information regarding potential impacts associated with exposure to mixtures of chemicals is very limited.

2,4-D:

Major data needs:

- **Additional studies of mammals, birds, fish, and aquatic invertebrates required by EPA for the reregistration of 2,4-D.** These studies should provide the information needed to fill data gaps in noncancer and cancer effects associated with 2,4-D and gaps associated with bioaccumulation and bioconcentration of 2,4-D.

- **Additional mammalian acute, chronic, and carcinogenicity studies.** Currently, uncertainties exist regarding the range of potential noncarcinogenic effects associated with 2,4-D. Also, panels of experts have reached differing conclusions about the carcinogenic potential of 2,4-D. The EPA is expected to decide in Autumn 1993 whether or not to conduct a special review to determine if a change in the classification of the cancer potential of 2,4-D is warranted.

Other data needs:

- **Persistence of multiple applications of 2,4-D in soils, sediments, and freshwater.**

- **Potential effects of 2,4-D applications on surface water nutrient availability.** Further investigation is also required to determine whether application of 2,4-D to control emergent vegetation could stimulate algal blooms.

- **Non-target area phytotoxicity studies that measure seed germination, aquatic plant growth, and vegetative vigor.** These studies are being conducted under the current 2,4-D reregistration effort.

4.6 INTEGRATED WEED MANAGEMENT

4.6.1 Integrated Weed Management Impacts and Mitigation Measures

The Integrated Weed Management Alternative (IWM) allows the selection of a wide variety of treatment methods to match management requirements of a specific site. Treatment methods are selected to maximize efficacy and to minimize negative impacts. In general, impacts due to implementation of a collection of control methods would be the sum of impacts from implementation of the individual methods. Impacts of the various individual treatment methods are discussed in the corresponding sections on physical, mechanical, biological, and chemical control methods (Sections 4.2, 4.3, 4.4, and 4.5). By using the IWM approach, treatment methods can be used in combinations not possible under other alternatives, and therefore, could have additional impacts. For example, the impacts of burning purple loosestrife infestations that have been treated with herbicides on air quality may be more severe than the effects of burning untreated infestations because the smoke would also contain pollutants from burning the herbicides and their breakdown products. In most cases, combinations of treatments at a particular site, especially a large one, will have impacts that are less severe than if only a single method were used. Variation in environmental sensitivity within a site can be addressed by using methods to match the needs of each area within the site. For example, monospecific areas within a *Spartina* infestation could be treated by covering, and areas where *Spartina* is mingled with other species could be treated by hand pulling or wicking with glyphosate to minimize non-target species mortality.

Mitigation: Mitigation would depend on treatment methods selected for implementation of IWM, and are discussed in the corresponding sections on physical, mechanical, biological, and chemical control methods. Additional mitigation measures could be required for impacts associated with combinations of treatments, and could include research in efficacy and impacts.

4.6.2 Information Needs

Because the Integrated Weed Management Alternative uses control methods discussed under the other alternatives, information needs associated with IWM include those of the other

alternatives. The following information needs are unique to the IWM approach:

- **Effective combinations of treatment methods.** How can treatment methods be combined to optimize success?

- **Additional impacts resulting from the use of combinations of treatment methods.** For example, what impacts would result from burning fields sprayed with herbicides that are not associated with using either method alone?

- **Studies on affects of silt and nutrient input on the establishment or growth of noxious weeds.** Does increased silt and nutrient input make establishment or growth of noxious weeds more likely?

- **Studies of agricultural, forest management, or other human activities that could enhance the likelihood of establishment of new invader populations.** How could this information be used for development and implementation of a Prevention strategy? Do forest practices that result in increased stream sediment loads improve habitat for *Spartina*? What are historical sedimentation rates for Willapa Bay? What are the sources of the sediment?

5.0 REGULATORY AUTHORITY

5.1 STATE

This section presents the specific regulatory or land management responsibilities related to various aspects of plant management.

5.1.1 Washington State Department of Agriculture

The following section lists authorities of Washington State Department of Agriculture (Agriculture) related to management of noxious emergent vegetation:

Noxious Weeds--Control Boards (RCW 17.10); Insect Pests and Plant Diseases (RCW 17.24); Weed Districts (RCW 17.06); Intercounty Weed Districts (RCW 17.06); State Noxious Weed List (WAC 16-750); Noxious Weed Grant Program, *Lythrum* Quarantine, Wetland and Aquatic Weed Quarantine, and Noxious Weed Seed and Plant Quarantine (WAC 16-752); Seeds (RCW 15.49); Rules Relating to Noxious Weed Seeds (WAC 16-300); Washington Pesticide Application Act (RCW 17.21); Washington Pesticide Control Act (RCW 15.58); General Pesticide Rules (WAC 16-228).

<u>Noxious Weed Regulatory/Management Responsibilities</u>: Agriculture shares responsibility for Washington State's Noxious Weed Program with the Washington State Noxious Weed Control Board, and county noxious weed control boards and the few remaining weed districts.

Administering a noxious weed grant program to help county boards and weed districts enhance their programs is also a responsibility of Agriculture. Grant assistance includes weed surveys, education, and various methods of control including biological, chemical, mechanical, and hand-pulling. The agency also coordinates weed management activities in conjunction with the WSNWCB.

Agriculture has enforcement responsibilities in counties without weed boards, mediates inter-county disputes, and has quarantine authority. Agriculture has adopted a wetland and aquatic plant quarantine prohibiting the sale, transport, planting, or transplanting of plants and seeds of plants including some weeds specifically addressed in this EIS including salt meadow

cordgrass (*Spartina patens*); common cordgrass (*Spartina anglica*); smooth cordgrass (*Spartina alterniflora*). Agriculture adopted a noxious weed seed and plant quarantine to cover the seed and nursery trade of a number of species, including some emergents.

Additional regulatory functions include nursery inspections to ensure enforcement of the quarantine against noxious weed plant sales, seed field and laboratory inspections to look for noxious weed plants and seed in crop seed.

Agriculture also provides technical support on weed identification and management to the public; weed agencies; and city, county, state, and federal agencies.

Pesticide Management: Agricultures pesticide management branch is responsible for protecting Washington's citizens and environment by providing high quality services that ensure appropriate regulation of pesticides, feed, and fertilizers. To meet this goal, Agriculture's pesticide division does the following:

- Ensures the people using potentially hazardous pesticides are properly trained and certified through testing, and requires the on-going training of certified users.

- Registers and reviews labels of pesticide and feed and fertilizer products for distribution within Washington State.

- Enforces laws and rules designed to prevent pesticide-related environmental damage, crop damage, food contamination, public health problems, and other possible negative effects of mishandling pesticides and fertilizers.

- Coordinates expanded programs such as groundwater protection, and endangered species, with other federal, state and local agencies, and industry and environmental groups.

- Conducts public education outreach programs.

- Provides technical assistance to county and local governments concerning watershed management and possible pesticide activities.

5.1.2 Department of Ecology

The Department of Ecology (Ecology) has interests in noxious emergent plant management from both regulatory and advisory perspectives for several elements of the environment, as explained below.

Surface Water, Short-Term Modifications of Water Quality Standards: Ecology is responsible for state surface water quality laws and regulations (RCW 90.48; RCW 90.54; Chapter 173-201A WAC). The regulations establish numeric and narrative criteria intended to protect public health and maintain the beneficial uses of surface waters of the state. These uses include recreational activities such as swimming, skin diving, water skiing, and aesthetic enjoyment; fish and shellfish rearing, spawning, and harvesting; wildlife habitat, and commerce and navigation.

The Water Quality Standards specifically allow modifications of water quality criteria for use of aquatic herbicides, if use of such herbicides meets the conditions listed in WAC 173-201A-110 including additional conditions that may be prescribed by the director or the director's designee. Use of aquatic herbicides such as glyphosate and 2,4-D would require a Short-term Modification of the Water Quality Standards (STM).

Other plant management activities, such as mechanical methods, may unavoidably violate state water quality criteria (particularly the turbidity criterion) on a short term basis. Such projects will also require an STM.

Shorelands: Ecology has a role in relation to shoreline management. Shoreline jurisdiction covers water areas and lands 200' from saltwater, from lakes 20 acres or more, or from rivers 20 cfs or greater. Also included are wetlands associated with those waters. Some floodplains are also included. Each jurisdiction has its own shoreline master program which regulates development in these areas. Applicants should consult with the local government(s) where control activities are to take place, in order to determine if a permit is needed.

In cases where control requires fill, ditching, draining, alteration of topography, or use restrictions such as closures, a shoreline permit is likely to be required. Other methods of control might be determined by the local government to be exempt from the shoreline permit requirements due to scale and minimal impact.

If a permit is required, the state process alone, as required by law, takes 75 days. SEPA must be done and sometimes there is a public hearing. Therefore, the planning department of the applicable local government should be consulted early on in the process to allow for the possible lengthy permit process.

Ecology is responsible for ensuring consistency between local master programs and decisions and the state Shoreline Management Act. All permits are reviewed by Ecology and in cases where a variance or conditional use are required, Ecology must approve the permit.

Wetlands: Ecology has several roles related to the protection of wetlands. Noxious plant management activities that could degrade or destroy wetlands are regulated through water quality modifications issued for use of both aquatic herbicides and some mechanical methods (discussed above in the "Surface Water" section). Wetlands are also regulated under the Shoreline Management Act and other local, state, and federal laws. Ecology also provides technical assistance to other agencies, local governments, and the public and assists with educational programs, wetland inventories, and preservation and restoration programs.

Groundwater: Ecology has developed groundwater quality standards (WAC 173-200) intended to protect all water in the saturated zone from any activity that has a potential to affect groundwater quality. Ecology is committed to ensuring that all emergent plant control activities, such as pesticide use, are consistent with these standards. Particularly important is ensuring that pesticide use does not conflict with the anti-degradation policy in the standards. This policy is intended to protect existing groundwater quality and existing and future beneficial uses (WAC 173-200-030). Ecology also reviews proposals to ensure adherence to other policies, programs, and regulations of local, state, and federal agencies. These include the Groundwater Management Program, which is initiated at the local level.

— Sediment Standards

5.1.3 Department of Natural Resources

As proprietor and natural resources trustee of state owned lands, the Department of Natural Resources (DNR) has been directed by the Legislature to manage those lands and provide a variety of public benefits. The state took title to all state-owned beds and intertidal areas at the time of statehood in its capacity as sovereign. DNR manages these aquatic lands, which currently total 2 million acres, to provide public access, use renewable resources, ensure

environmental protection, to foster water dependent uses, and generate revenue consistent with the above four items.

Because of this mandate, DNR is interested in protecting aquatic animals, including oysters and clams. Commercial oyster and clam cultivation and harvesting is authorized by DNR on approximately 4,450 acres of state owned aquatic lands which comprises nearly 10% of the total shellfish production lands in the state.

DNR's interests also include the native biodiversity of the state. This responsibility is reflected in the Natural Heritage, Natural Area Preserves and Natural Resource Conservation Area Programs in the Division of Land and Water Conservation. There are approximately 15,000 acres in thirty-seven Natural Area Preserves throughout the state. Preserves provide the highest level of protection for Washington's natural heritage, and are established to protect high quality examples of typical or unique natural features in Washington State. They are genetic resource of native plants and animals and serve as a point of reference in comparing natural and managed environments. The Natural Heritage Program is the state repository of data on Endangered, Threatened and Sensitive plant and animal species, native wetland plant communities and aquatic and non-vegetated wetland systems.

Because of these diverse proprietary and trustee responsibilities, DNR is interested in preventing state-owned lands from colonization by noxious plants, in the most environmentally responsible manner possible. By protecting the native biodiversity and habitats essential to the health of estuarine and freshwater wetlands, DNR hopes to fulfill its obligations to ensure their benefits for future generations.

5.1.4 Department of Fisheries

The mission of the Department of Fisheries (Fisheries) is to preserve, protect, perpetuate and manage food fish and shellfish in state waters. To fulfill this mission, Fisheries manages the habitat upon which these resources depend to achieve no net loss and long-term net gain of functions and values. This habitat often includes those fresh water and marine wetland areas in which noxious emergent vegetation is found.

Regulatory Authority: Hydraulics Approval (WAC 220-110-010; RCW 75.20.100,.103,.106.130,.140).

Fisheries shares authority for administration of the State Hydraulics Code with Wildlife. Hydraulic Project Approval (HPA) is required for work below the ordinary high water line that can use, divert, or change the natural flow or bed of waters of the state. Most mechanical control methods (e.g., mowing, crushing, etc.), burning, bottom barriers, etc. used for control of noxious emergent vegetation will require an HPA. The use of chemicals, hand pulling, and small-scale hand-digging will generally not require an HPA. Driving on tidelands and other wetlands areas to conduct operations, including chemical applications, will require an HPA.

Fisheries HPA jurisdiction applies to all salmon (and other food fish species) bearing waters. Project proposals located in Western Washington (west of the Cascade Crest), all of mainstream, Snake River, and all of mainstream Columbia River downstream from Chief Joseph Dam are generally mailed to Fisheries. Fisheries sends these on to wildlife where no food fish concerns are involved. Wildlife's jurisdiction is explained in the "Wildlife" section, below.

Other Authorities: Fisheries also has substantive comment authority to other agencies for projects affecting aquatic plants. This includes review of projects and documents prepared under the State or National Environmental Policy Acts (SEPA and NEPA) (RCW 43.21) and Corps of Engineers Section 10 and 404 permits. These may include a variety of projects such as dredging, filling, diking, and flooding. Some of these may also required an HPA.

In addition, Fisheries provides review and comment on permit applications submitted to other agencies. This includes short-term modifications to water quality standards (STM) submitted to Ecology for the use of aquatic herbicides (90.48). It can include comments on local shoreline permits (RCW 90.58), floodplain development permits (CFR 44, part 60), forest practice approvals (RCW 76.09) and others.

Aquatic Land Management: WDF has few aquatic land holdings. Generally, Fisheries is concerned with protection and enhancement of non-noxious aquatic plants on these lands. For the past several years, *Spartina* seedlings have been hand pulled from some oyster reserve grounds in Willapa Bay.

5.1.5 Department of Wildlife

The Department of Wildlife (Wildlife) has both regulatory and land management interests in noxious emergent plant management, as explained below.

Regulatory: Hydraulic Project Approval (HPA).

Wildlife shares responsibilities for administration of the State Hydraulic Code with Fisheries. Wildlife has jurisdiction over all "game fish" species. By agreement with Fisheries, generally HPAs for projects in Eastern Washington (including Klickitat County) except those rivers described above in the Fisheries HPA discussion, are mailed to Wildlife. Wildlife and Fisheries work together closely to assure that review is accomplished by the appropriate agency without unneeded duplication of effort.

Requirements for HPAs through Wildlife are similar to those of Fisheries.

Fish Planting Permit

Use of fish for biological control also requires a permit from Wildlife.

Land Management: Wildlife may also participate in emergent noxious plant management activities as land managers, but only when:

(1) it has been determined necessary to improve habitat for fish or wildlife, or

(2) Lake Management Districts are formed on lakes containing Department owned land and the majority of lakeshore property owners vote in favor of plant management, or

(3) as required by the noxious weed law.

These activities may include various alternatives including those addressed in this EIS. Wildlife's current policy emphasizes habitat management such as fertilization, shrub pruning, grazing, prescribed burning, reseeding of native or similar grasses, and mechanical mowing,

etc. Natural methods are used unless agricultural programs can enhance and provide acceptable cost effectiveness.

Project Review and Comment: Wildlife reviews applications that have been submitted to other agencies (such as applications for use of aquatic herbicides that Ecology circulates to other agencies for review and comment). Wildlife reviews these applications and recommends mitigation for protection of fish and wildlife.

Additionally, Wildlife reviews various documents prepared under the State or National Environmental Policy Act (SEPA, NEPA) that relate to various methods of aquatic plant control. Comments on these documents also reflect Wildlife's mandate to preserve, protect, perpetuate the fish and wildlife of the State of Washington.

5.1.6 Washington State Noxious Weed Control Board

The Washington State Noxious Weed Control Board (WSNWCB) determines, classifies, and adopts by rule the noxious weeds of the state. It also has other rule making authority under the state noxious weed law, Chapter 17.10 RCW, including determining the monetary penalties for infractions of the state noxious weed law and defining management options for noxious weeds such as control, contain, eradicate, and prevent the spread of noxious weeds.

The WSNWCB also serves as an advisory board to the Department of Agriculture on the implementation of their responsibilities under Chapter 17.10 RCW.

The Washington State Noxious Weed Control Board is a policy making board with respect to the state's noxious weed program and serves as the state's noxious weed coordination center. Through its actions and policy decisions it directs and influences the activities of 44 county noxious weed control boards and weed districts in Washington.

The Washington State Department of Agriculture, county noxious weed control boards, and weed districts share responsibility in the implementation of the state's noxious weed laws.

5.1.7 Local Government

Local governments may require permits or have other authorities that apply to noxious emergent weed management. Local zoning codes may restrict certain activities in some areas. Local shoreline master programs may require shoreline permits for activities such as use of aquatic pesticides, mechanical harvesting, dredging, or other activities that are conducted in areas defined as shorelines. Many governments have enacted ordinances that protect sensitive areas, such as wetlands, sensitive ground-water recharge areas, and surface waters. Because permit requirements are so variable among different jurisdictions it is critical that local government be consulted before conducting plant management activities.

5.1.8 Other State Agencies

Other State agencies may also have jurisdiction over, management responsibilities for, or other interests in noxious emergent plant management. For example, the Department of Transportation is responsible for control of roadside vegetation, the Departments of General Administration, Corrections, Parks and other agencies with land holdings may be required to control noxious weeds on their lands, and the Department of Health may have interest or jurisdiction as it relates to human health risks related to chemicals proposed for use for noxious emergent plant management.

5.2 FEDERAL

This section presents specific Federal authorities, regulations, and policies that would need to be followed with implementation of an emergent noxious plant management plan involving physical, mechanical and/or biological control methods. Application to the Corps of Engineers is required for any state or local agency planning control of emergent noxious weeds.

5.2.1 Section 10 of the Rivers and Harbors Act of March 3, 1899 (33 U.S.C. §403) and Section 404 of the Clean Water Act (33 U.S.C. §1344)

Agency With Authority: Army Corps of Engineers.

Authority: Section 10 generally requires a Corps of Engineers permit for structures and/or

work in or affecting navigable waters of the United States (Reference 33 CFR 322.3). For non-tidally influenced navigable waters, Corps jurisdiction extends to the Ordinary High Water (OHW) mark (33 CFR 329.11). This includes the construction of any structure in or over any navigable water of the United States, the excavating from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters. The Corps' decision whether to issue a permit is based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity and its intended use on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. The Corps considers three general criteria in the evaluation of every application: (1) the relative extent of the public and private need for the proposed structure or work; (2) where there are unresolved conflicts as to resource use, the practicability of using reasonable alternative locations and methods to accomplish the objective of the proposed structure or work; and (3) the extent and permanence of the beneficial and/or detrimental effects which the proposed structure or work is likely to have on the public and private uses to which the area is suited.

Section 404 generally requires a Corps of Engineers permit for the discharge of dredged or fill material into waters of the United States, including adjacent wetlands. The selection and use of disposal sites will be in accordance with guidelines developed by the Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army. The Corps' decision whether to issue a permit is based on an evaluation of the probable impacts on the public interest as stated above for Section 10, as well as on application of the guidelines promulgated by EPA, otherwise referred to as the Section 404(b)(1) guidelines (40 CFR, Part 230). Discharge of dredged or fill material in jurisdictional wetlands is especially important under this Act. Corps of Engineer regulations state that wetlands constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest. These regulations further state that (1) wetlands perform several functions important to the public interest, (2) although a particular alteration of a wetland may constitute a minor change, the cumulative effect of numerous piecemeal changes can result in a major impairment of wetland resources, and (3) no permit will be granted which involves the alteration of wetlands identified as important unless the Corps concludes based on the very extensive and complex 404(b)(1) evaluation that the benefits of the proposed alteration outweigh the damage to the wetlands resource. Section

404 of the Clean Water Act requires the Corps to evaluate the proposed discharge of dredged material into waters of the United States, including adjacent wetlands, in accordance with the Section 404(b)(1) guidelines. These guidelines require that the following four conditions be met before a Section 404 permit may be issued:

(1) There is no other practicable alternative that would have less adverse impact on the aquatic environment;

(2) The disposal, after consideration of dispersion and dilution, will not cause or contribute to violations of applicable water quality standards; will not violate any applicable toxic effluent standards; nor will it jeopardize the continued existence of threatened or endangered species; nor will it violate any requirement to protect marine sanctuaries;

(3) The disposal will not cause or contribute to significant degradation of waters of the United States; and

(4) All appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic environment (Reference 40 CFR 230.10).

Application to Physical and Mechanical Control Methods for *Spartina* spp.:

Dredging

Since dredging would occur in navigable waters of the United States, including adjacent wetlands, a standard individual permit would be required in accordance with Section 10. Nationwide Permit No. 19, Minor Dredging, for dredging of less than 25 cubic yards as part of a single and complete project would not apply since the activity would occur in wetlands.

As long as the dredged material was not placed in waters of the U.S. or adjacent wetlands, the activity would not be subject to Section 404 and its 404(b)(1) evaluation.

Digging/Excavation

A standard individual permit per Section 10 would be required. As with dredging, excavation of quantities less than 25 cubic yards would not fall under Nationwide Permit No. 19. If the excavated material were placed in waters of the U.S. and/or its adjacent wetlands, the project would be under the jurisdiction of Section 404 and a 404(b)(1) evaluation would be required.

Mowing

The actual cutting process is exempt from Section 10, however, placement of markers (stakes, piling, et cetera) to delineate project boundaries would require Section 10 permit. If the project was minor in nature, only a Letter of Permission would be required. If substantive, the project could require a standard individual permit per Section 10. This method would not fall under Section 404.

Diking and Flooding

Construction of dikes to control *Spartina* would require a Corps permit under authority of Section 10, if any work was performed in a navigable waterway, and under authority of Section 404 if dredged or fill material was placed in a water of the United States or adjacent wetlands. This would require a rigorous evaluation per Section 404 (b)(1) of the Clean Water Act. A Corps 404 permit would not be required for any diking material placed on uplands adjacent to or surrounding a *Spartina* marsh.

Bottom Barriers

Utilization of bottom barriers composed of fabric or plastic materials to cover *Spartina* marshes for extended periods of time would require a Corps of Engineers permit under Section 10 if the barriers would be anchored by stakes or other structures in navigable waters below the OHW line. If the utilization of anchoring structures is considered minor, only a Letter of Permission will be required. Section 404 would likely not apply as this method would not appear to involve placement of dredged or fill material to fulfill its purpose.

Application to Physical and Mechanical Control Methods for Noxious Emergent Freshwater Weeds:

Hand Cutting

Cutting the various freshwater plants at ground level utilizing any hand-held implement would require a permit if the cutting occurred below the ordinary high water mark (OHW) in certain large lakes and if markers were placed to delineate project boundaries. Lakes in Washington in which Section 10 jurisdiction applies are: Lake Washington, Lake Chelan, Lake Sammamish, Lake Union, Drano Lake (Skamania County), and Vancouver Lake. This method is currently not considered under the jurisdiction of Section 404 of the CWA.

Digging/Excavating

Scraping or excavation of noxious emergent plants would require a permit under Section 10 if the action occurred below the OHW mark in certain lakes (see **Hand Cutting** above) or if markers were placed to delineate project boundaries. If the action was conducted in a wetland and soil was removed, this would be considered "land clearing" and would be under the jurisdiction of Section 404 of CWA. The type of 404 permit would be determined by the size of the work. If the work extended over an area less than two acres, it would likely qualify under Nationwide Permit (NWP) No. 26 (NWP 26 appears as Appendix X). An excavation project over two acres of wetlands would require a standard individual permit under the Section 404 jurisdiction. Any scraping or excavation in upland areas would require no Corps of Engineers permit. A 404 permit would also be required if a temporary access road was constructed to the project site, using fill material placed on jurisdictional wetlands.

Dewatering

This method involves lowering water levels in an area infested with emergent noxious weeds. This would likely be accomplished by discharging extra quantities of water through or by existing dams or other water control structures. This would not require a Corps permit under either Section 10 or Section 404, unless markers were placed below the ordinary high water line to delineate project boundaries, which would require a Section 10 permit, probably in the form of a Letter of Permission.

Burning

This method would only require a Corps permit under Section 10 if stakes or other marking structures were placed to delineate project boundaries and these markers were placed below the ordinary high water line. Presuming this action would be considered a minor action by the Corps, only a Letter of Permission would be required.

Bottom Barriers

Utilization of bottom barriers composed of fabric or plastic materials to cover noxious weeds for extended periods of time would require a Corps of Engineers permit under Section 10 if the barriers would be anchored by stakes or other structures in areas below the ordinary high water line. If the utilization of anchoring structures is considered minor, only a Letter of Permission will be required. Section 404 would probably not apply as this method would not normally involve placement of dredged or fill material in a water of the United States or any adjacent wetlands.

Application to Biological Control Methods for *Spartina*: A permit would be required under Section 10 if markers (stakes, pilings, et cetera) were used to delineate project boundaries below the OHW line. This action would probably not require a permit under the authority Section 404, provided no dredged or fill material were placed in wetlands adjacent to waters of the United States for such activities as temporary road access.

Application to Biological Control Methods for Freshwater Noxious Emergent Plants: See Paragraph E. above.

5.2.2 Coastal Zone Management Act (CZMA) of 1972 (Public Law 92-583) as Amended

Agency With Authority: NOAA, delegated to Washington State Department of Ecology.

Authority: The Coastal Zone Management Act as amended requires that applicants for federal permits for activities directly affecting a state's coastal zone to comply with the enforceable policies of approved state coastal zone management programs and to furnish a certification that the proposed activity will comply with the state's coastal zone management

program. The entirety of the following counties constitute Washington's coastal zone: Clallam, Gray's Harbor, Island, Jefferson, King, Kitsap, Mason, Pacific, Pierce, San Juan, Skagit, Snohomish, Thurston, Wahkiakum, and Whatcom counties. In Washington, the enforceable policies of coastal zone management are the Washington State Shoreline Management Act of 1971, the local Shoreline Master Program (SMP), SEPA, and the Clean Air and Clean Water Acts. The CZMA declares a "national interest in the effective management, beneficial use, protection, and development of the coastal zone. Important ecological, cultural, historic, and aesthetic values in the coastal zone which are essential to the well-being of all citizens are being irretrievably damaged or lost." The Act requires the state to have a planning process for the protection of public coastal areas of environmental, recreational, historical, aesthetic, ecological, or cultural value.

Application to Mechanical Control Methods: Any selected mechanical control methods would need to be fully consistent with the state CZMA program.

Application to Biological Control Methods: Same as above.

5.2.3 Endangered Species Act of 1973, as Amended, 16 U.S.C. §1531 *et. seq.*

Agency With Authority: Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service.

Authority: The Endangered Species Act (ESA) declares the intention of the Congress to conserve threatened and endangered species and the ecosystems on which those species depend. The act requires that federal agencies (the Corps of Engineers in the case of a permit application to the Corps), in consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, use their authorities in furtherance of its purposes by carrying out programs for the conservation of endangered or threatened species, and by taking such action necessary to insure that any action authorized, funded, or carried out by the Agency is not likely to jeopardize the continued existence of such endangered or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary of the Interior or Commerce, as appropriate, to be critical (33 CFR 320.3(i)).

Application to Physical and Mechanical Control Methods: All projects involving mechanical control methods that would require a Corps of Engineers permit under Section 10 or Section 404 are subject to the Endangered Species Act. Required coordination between Federal agencies will determine if any endangered or threatened species or their critical habitat are present in the project areas. If so, the Corps of Engineers will be required to prepare a biological assessment that evaluates if the control methods in that area would have significant impacts.

Application to Biological Control Methods: See 4.2 above.

5.2.4 The National Historic Preservation Act of 1966 (16 U.S.C. §470)

Agencies With Authority: Advisory Council on Historic Preservation; U.S. Department of the Interior, National Park Service.

Authority: This act created the Advisory Council on Historic Preservation to advise the President and Congress on matters involving historic preservation. In performing its function, the Council is authorized to review and comment upon activities licensed by the Federal Government which will have an effect upon properties listed in, or eligible for listing in, the National Register of Historic Places or eligible for such listing. The concern of Congress for the preservation of significant historical sites is also expressed in the Preservation of Historical and Archeological Data Act of 1974 (16 U.S.C. 469 et seq.). By this Act, whenever a federally licensed project, activity, or program alters any terrain such that significant historical or archeological data is threatened, the Secretary of the Interior may take action necessary to recover and preserve the data prior to the commencement of the project.

This act requires early coordination with the Advisory Council on Historic Preservation, appropriate State historic preservation officers, the National Park Service, Indian Tribes, and other appropriate groups with cultural resources expertise.

Application to Mechanical Control Methods: If any mechanical control project is deemed to have an effect on any properties listed in the NRHP, or may alter any terrain such that significant historical or archeological data is threatened, appropriate steps will be necessary to coordinate with the Advisory Council on Historic Preservation, the SHPO, Indian Tribes,

and other agencies with cultural resources expertise/jurisdiction as appropriate, so that a program for recovery and preservation of materials is established.

Application to Biological Control Methods: Not applicable.

5.2.5 Federal Plant Pest Act of 1957, as Amended (7 U.S.C. §150 *et seq.*)

Agency With Authority: U.S. Department of Agriculture.

Authority: No plant pest from a foreign country shall be moved into or through the United States, or interstate, unless such movement is authorized under general or specific permit from the Secretary of Agriculture and is made in accordance with such conditions as the Secretary may prescribe in the permit and in such regulations as he may promulgate under this section to prevent the dissemination into the United States, or interstate, of plant pests. The Secretary of Agriculture may refuse to issue a permit for the movement of any plant pest when, in his opinion, such movement would involve a danger of dissemination of such pests.

Application to Mechanical Control Methods: Not applicable.

Application to Biological Control Methods: Any shipment of a control agent (plant pest) must be authorized by permit from the Secretary of Agriculture. Typically, after overseas research has earmarked a specific control agent, a request is made to the U. S. Department of Agriculture, Plant Protection and Quarantine (PPQ), Animal Plant Health Inspection Service (APHIS) Technical Advisory Group (TAG) on Biological Control of Weeds to have the agent introduced into a quarantine facility. If approval is received, the agents are shipped to a U.S. quarantine facility where intensive host specificity testing is conducted and studies are performed to determine other key preferences factors of the agent. If the agent is specific to only the target plant, a petition to release the agent is requested from the USDA-APHIS-PPQ. If the agent is approved for release, the Washington State Department of Agriculture (WSDA) will issue a release permit.

5.2.6 Federal Noxious Weed Act of 1974, Public Law 93-629 (7 U.S.C. §2801 *et seq.*)

Agency With Authority: U. S. Department of Agriculture.

Authority: No person shall knowingly move any noxious weed, identified in a regulation promulgated by the Secretary, into or through the United States or interstate, unless such movement is authorized under general or specific permit from the Secretary of Agriculture (or other person to whom authority may be delegated to act in their stead) and is made in accordance with such conditions as the Secretary may prescribe in the permit and in such regulations as he may promulgate under this Act to prevent the dissemination into the United States, or interstate, of such noxious weeds. The Secretary may refuse to issue a permit for the movement of any such noxious weed when, in his opinion, such movement would involve a danger of dissemination of such noxious weeds into the United States or interstate.

Application to Mechanical Control Methods: Not applicable.

Application to Biological Control Methods: Any selected method that could involve transfer of any noxious weeds, in whole or part, interstate, for whatever reason, would require a permit from the Department of Agriculture.

5.2.7 The National Environmental Policy Act (NEPA) of 1969, as Amended (42 U.S.C. §4321 to §4370c)

Agency With Authority: Any Federal agency with jurisdiction could qualify as responsible Federal agency under NEPA.

Authority: The National Environmental Policy Act requires the use of a systematic interdisciplinary approach in decision-making which may have an impact on the human environment. NEPA is our basic national charter for protection of the environment. The purposes of NEPA are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality. NEPA requires an

environmental impact statement for major Federal actions that significantly affect the quality of the human environment. A Corps of Engineers Section 10 or Section 404 permit for certain proposals may be considered as significant and trigger the requirement for an environmental impact statement (EIS). The EIS is prepared prior to any permit decision and contains the following elements:

(1) The environmental impact of the proposed action,

(2) Any adverse environmental effects which cannot be avoided should the proposal be implemented,

(3) Alternatives to the proposed action,

(4) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(5) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented (42 U.S.C. §4332).

The information generated in the NEPA process is intended to assist public officials in making decisions that are based on an understanding of environmental consequences, and in taking actions that protect, restore, and enhance the environment.

Applications to Mechanical Control Methods: Generally, for any proposed mechanical control action on Federal lands, Tribal lands, or requiring a Corps of Engineers permit application, an environmental assessment (EA) shall be prepared by the responsible Federal agency. The EA will determine if the project requires an environmental impact statement (EIS), i.e., if the project is determined to be a major Federal action that would significantly affect the quality of the human environment and/or would be highly controversial. If it is determined that the project does not require preparation of an EIS, a Finding of No Significant Impact (FONSI) is prepared (40 CFR 1500).

Applications to Biological Control Methods: Generally, for any proposed biological control action on Federal lands, Tribal lands, or requiring a Corps of Engineers permit application, an environmental assessment (EA) shall be prepared by the responsible Federal

agency. The EA will determine if the project requires an environmental impact statement (EIS), i.e., if the project is determined to be a major Federal action that would significantly affect the quality of the human environment and/or would be highly controversial. If it is determined that the project does not require preparation of an EIS, a Finding of No Significant Impact (FONSI) is prepared.

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APPENDICES

CONTENTS
APPENDICES

Two sets of Appendices are referenced in this report. The first set of appendices, which are labelled numerically, provide information regarding implementation of a noxious weed management plan, as indicated below. Because these Appendices were prepared independent of one another by different agencies, their format and style differ. The remainder of this document contains these appendices:

1. Agency Mitigation Measures

2. Simulated IWM Scenarios

3. Draft *Spartina* Work Plan

4. EPA Watershed Restoration Grant Proposal

5. Responsiveness Summary

The second set of Appendices are labelled alphabetically (Appendices A through L). These appendices provide the technical background upon which this EIS is based and are published under separate cover.

APPENDIX 1:

PROPOSED AGENCY MITIGATION MEASURES

INTRODUCTION: AGENCY MITIGATION MEASURES

The following section describes potential mitigation measures prepared by the Departments of Ecology, Wildlife, and Fisheries. The presentation formats of these measures differ because they were independently prepared by different agencies. These are draft measures that agencies anticipate incorporating into permits as conditions, where appropriate and necessary. This is a draft and partial description of possible permit conditions, and regulatory agencies may add to and/or delete some of these measures from permits issued. These draft conditions are provided to help decision-makers incorporate logistical and/or monetary considerations into decisions.

The mitigation section first presents measures that Ecology is considering imposing through Temporary Modifications to the Water Quality Standards (STMs) for use of glyphosate and 2,4-D. Ecology may also require STMs for use of large-scale mechanical methods. Incorporated by reference into this EIS Mitigation Section is the Mitigation Section of the 1992 Aquatic Plants Management Program for Washington State Final Supplemental Environmental Impact Statement (FSEIS), Volume 1. Ecology will defer to mitigation measures contained in this FSEIS for impacts from use of mechanical methods to control noxious emergents.

Ecology's mitigation measures are followed by mitigation that Wildlife may either impose through Hydraulic Project Approvals (HPAs); through projects undertaken on Wildlife-managed lands; or that Wildlife, through Ecology's STM review process, may request be added as conditions to STMs. Measures that Fisheries has developed for HPAs for the 1993 treatment season follow Wildlife's mitigation section.

MITIGATION PROPOSED BY THE DEPARTMENT OF ECOLOGY

Introduction

The following are mitigation measures that Ecology may impose as conditions through Temporary Modifications to Water Quality Standards (STM permits) issued for use of pesticides in or near water. These conditions would apply to situations assessed in this EIS, specifically, when glyphosate or 2,4-D are proposed for use to manage noxious emergent vegetation. If, after this EIS is issued, new information about glyphosate and/or 2,4-D reveals additional impacts to human health and/or the environment, decisions to permit use of these chemicals would be re-evaluated.

Use of Rodeo (glyphosate) to control aquatic vegetation in freshwater is addressed through Ecology's 1980 Aquatic Plant Management EIS as supplemented in 1992. Use of 2,4-D to control vegetation other than noxious emergent vegetation is also addressed through the 1980 and 1992 Supplemental Aquatic Plant Management EIS and therefore would not be permitted.

The following discussion of mitigation proposed by Ecology is divided into three parts. Part One presents measures that would apply to all applications of 2,4-D and Rodeo (in both fresh and salt water environments); additional measures that would apply to application of 2,4-D and glyphosate in freshwater environments only are discussed in Part Two (a discussion subdivided into three groups: 2,4-D and glyphosate, glyphosate only, and 2,4-D only); and Part Three consists of a discussion of additional proposed measures for mitigating impacts associated with use of glyphosate in estuarine environments.

Part One: MITIGATION MEASURES APPLICABLE TO BOTH 2,4-D AND GLYPHOSATE (applicable in both fresh- and saltwater environments)

Project Proponent - Definition

The project proponent is defined as the person, persons, company, agency, etc., with the need or legal obligation to control noxious emergent vegetation in the area proposed on the map submitted in the application.

STM Aerial Boundaries

STMs issued for use of herbicides would cover an area no larger than a watershed. Assessment of potential benefits and impacts of a proposed treatment can best be accomplished by limiting the scope of each proposal to one watershed. Mitigation can then be tailored to fit the environmental characteristics of each watershed.

Public Exposure

Precautions should be taken to minimize the potential for public exposure by avoiding treatment near areas where the public is likely to come into contact with the water during times of high use. Treatment would not be allowed within 24 hours prior to July 4th, weekends, and locally identified public holidays or celebrations.

The potential for public contact with herbicides can be reduced by not treating within 1/2 mile of any boat launch, marina, swim beach, park, or other public access area on weekends, or holidays. This 1/2 mile restriction could be avoided by treating only on weekdays. However situations may arise due to weather or other variables that may make it necessary to treat on high use days. If this is the case, the project proponent could be required to obtain a letter of concurrence with the treatment dates and times from the local government health department, if the local entity is willing to take on this responsibility.

Any label-required fish consumption restrictions should not be in effect during opening day of the fishing season and free fishing weekends.

Public Notice

Legal Notice

Any time that any portion of a proposed treatment site contains a publicly accessible area, a newspaper notice in the legal section of the local newspaper of largest circulation would be required. This notice would need to include a description of the treatment area, the dates of treatment, the herbicide to be used, posting procedures on site, and the phone number of the applicator or project sponsor. The notice would be required to be published at least 24 hours but no more than 10 days before treatment.

On-site Posting

Reasonable effort should be made to post warning and cautionary signs at all access sites leading to treatment areas. Even though one of the two chemicals, glyphosate, has been shown to have minimal harmful effects on humans and their pets, the public deserves to know when this chemical has been used so they can decide whether or not to potentially expose themselves, their children, or their pets by entering a treatment area.

Signs would be posted facing points of normal entry to the treatment area and be placed within 24 hours of a treatment. These signs should also be removed before the next treatment or by the expiration date of the permit. Signs should be posted so they are secure from normal effects of wind and rain but cause no damage to property. Signs can be copied from a template included with each short term water quality modification.

These signs would also be required at any public boat launch within 1.5 miles of the treatment site and be placed within 25 feet of the shoreline facing both the entrance and egress of the launch. Boat launches also need to include sites commonly used as put-ins or take-outs for non-motorized watercraft.

Notification to Residences and Businesses

The activities of those who live or have businesses near a treatment site may be impacted during treatment activities. These businesses and residences within 1/4 mile along the shoreline would be required to be notified at least a week in advance of any planned treatment to allow adequate time to make any necessary accommodations. Ecology would provide a description of the information required in this type of notice.

Pre- & Post Treatment Reporting

The project sponsor for each treatment would be responsible for apprising Ecology and other resource agency staff of the times and places of each proposed treatment and whether treatment did or did not take place. This would allow public agencies to respond knowledgeably
to public inquiries would also allow investigators from Departments of Agriculture and Ecology to plan site inspections.

Complaints

The applicator and sponsor would be required to have an emergency number where they can be reached should public health or environmental impacts be suspected to be associated with a treatment.

Spray Reports

A record of each treatment is required by the Washington State Pesticide Act to be written and maintained by the applicator. This information will help to assess the effectiveness of treatments over a period of years. The records could be requested by or through state agencies and put in databases to be used for resource management planning or investigation activities.

Permit on Site

The applicator would be required to have a copy of the permit on-site to enable verification, if necessary, that the applicator has knowledge of the mitigation measures contained as conditions in the permit.

Compensation

Areas that would experience unacceptable impacts from erosion due to the loss of ground cover may require post treatment stabilization. Re-vegetation may also be required to enhance wetland values and to reduce the need for additional treatments.

Surfactants

This EIS evaluated only three adjuvants, and of these three, all were non-ionic surfactants. The label for Rodeo requires the use of a non-ionic surfactant. Surfactants may also be used with 2,4-D. After conducting a thorough search for data related to these surfactants, researchers found some data regarding acute toxicity of these surfactants to aquatic organisms but were unable to find data specific to sub-lethal effects of these three specific surfactants. Information related to human health effects was also scant. Of the three surfactants evaluated, data indicates that R-11 and X-77 have much higher acute toxicity to aquatic organisms than does LI-700. Given the minimal information regarding chronic (or sub-lethal) toxicity of these three surfactants, the only surfactant that would be permitted without additional information is LI-700. Use of other surfactants may be permitted if accompanied by monitoring or other scientific information that would assist in determining impacts.

Part two: ADDITIONAL MITIGATION APPLICABLE TO FRESHWATER ENVIRONMENTS: (Purple Loosestrife and other freshwater emergents)

Measures Applicable to both 2,4-D and Glyphosate in Freshwater Environments

Monitoring/Evaluation

Pre- and Post Site Monitoring for Chemical Residue

Risks assessments conducted for this EIS did not take into account the possibility that either 2,4-D or glyphosate might exist in areas to be treated. It is possible that the potential risk to human health or the environment would be increased over that estimated in these risk assessments if 2,4-D or glyphosate residuals exist in water or sediments of areas proposed for treatment. Additionally, it has been shown that 2,4-D persists longer in the presence of

certain insecticides. For these reasons, Ecology may require sampling for certain substances prior to herbicide application in particular areas.

Data regarding persistence of 2,4-D in aquatic environments is highly variable. Additional pre- and post-treatment monitoring may be required, in participation with Ecology, to provide for better permit decisions.

Efficacy

Information is needed regarding the long-term effectiveness of glyphosate and 2,4-D for purple loosestrife control. Short-term efficacy is generally known (the herbicides kill the plants), but we do not know how many treatments per year or how many years of treatment would be required to arrest seed bank viability. This is important because permitters need to weigh decisions to modify water quality standards based upon benefits to the public rendered by the treatment versus potential impacts of treatment. Information regarding treatment expectations should be included in the permit applications, which should include a discussion of efficacy in the long term. If control activities have to continue in the same area year after year, bi-yearly, or tri-yearly, control activities should be reduced to areas where treatment will most benefit the public.

Treatment timing and other parameters should be recorded so that permitters and others interested in efficacy can better understand what works and what does not work. Treatment site records in the form of spray reports would need to be precise in order to determine the long-term effectiveness of treatment.

Buffers

Leaving buffers between treatments and potentially sensitive desirable plants species can protect important existing habitat and food sources for fish and wildlife. To protect rare plant species or communities identified by the Department of Natural Resource Natural Heritage Program, the following minimum buffers would be required: 10 feet for wick applications, 100 feet for all ground spraying and aerial balls, and 200 feet for aerial boom spraying.

Plant Type

The only plants identified for control in this document are those classified as noxious by state law. The applicator should take all known available and reasonable precautions to avoid killing non-noxious species. If requesting use of glyphosate for control of other species, these species need to be identified in any permit application (2,4-D would only be permitted for treatment of noxious species). The above is

stated keeping in mind that purple loosestrife may be treated when intermixed with non-noxious species that may also be killed or otherwise negatively impacted. Please see the wetland mitigation section of the 1992 Aquatic Plant Management EIS for mitigation measures that may be imposed to protect wetlands.

Watershed Permits

Purple loosestrife is most easily identifiable during the flowering stage which is also the most effective time to treat it with herbicides. Permission may be given, through issuance of an STM, to a sponsor for control of purple loosestrife on all lands within their jurisdiction within a specific watershed. For instance, maintenance crews or designated agents of the Department of Transportation often find new infestations of purple loosestrife when performing routine roadside maintenance. If allowed to treat within a few days of finding the loosestrife instead of waiting to obtain a short-term water quality modification, the area of infestation requiring treatment would be smaller and therefore less herbicide would be needed.

Measures Specific to Use of Glyphosate in Freshwater Environments

Timing

Plant Stage

Appropriate timing is necessary for effective treatment. Glyphosate should be applied to adult plants during the window immediately prior to flowering until prior to the first killing frost or mid-September, whichever comes first. Depending on the variability of the each year's climate, these dates may differ. Flowering times will also differ in various locations within the state. Project proponents should identify the approximate time of expected flowering. Locations that have established stands of purple loosestrife should not be treated outside this window to avoid the higher risk that the treatment would be ineffective. Purple loosestrife seedlings are susceptible after emergents. Best results on seedlings is obtaind beore plants are 12 inches tall. Taller plants would require higher rates of glyphosate.

Weather

Glyphosate/adjuvants would be allowed only during dry weather to avoid unnecessary use of herbicides. Heavy dew, rain and water that is beaded on the plants will reduce efficacy of glyphosate.

To minimize unwanted impacts from herbicide drift, this document defers to the EPA label restriction for glyphosate that forbids using the herbicide when winds are greater than 5 mph.

Water Use Restrictions

According to the glyphosate label, no treatment can occur within 1/2 mile upstream of a potable water intake or within 1/2 mile of a potable water intake in any non-flowing surface water (lake, wetland, reservoir). Potable water intakes have been defined by the Department of Agriculture to be any pipe that enters a house. The project sponsor must keep in mind that legal water rights and claim holders are only a portion of those who may be withdrawing surface water for domestic use.

Measures Specific to Use of 2,4-D in Freshwater Environments

Information regarding the potential for 2,4-D to cause cancer is inconclusive. Additionally, 2,4-D is undergoing re-registration though EPA, and several data requirements pertinent to human and environmental health have not yet been completed (see unpublished appendices E and G). For these reasons, Ecology has determined the need to proceed cautiously when making permit decisions related to 2,4-D. In addition to mitigation measures described above, and compliance with state groundwater (WAC 173-200), sediment management (WAC 173-204) and all other applicable local, state, and federal rules and regulations, use of 2,4-D would be limited to the following:

1. Only to target emergent, noxious species; and

2. does not include treatment in drainage ditches within 400 feet of any outfall into a natural stream, river, lake, wetland, or reservoir; or

3. where water is contained (e.g. no outlet); or

4. where buffers are sufficient to prevent 2,4-D from entering flowing natural surface waters (recommended buffer widths are 0 for wick applications, 10 feet for backpack sprayers, 25 feet for power sprayers, 50 feet for aerial ball sprayers, 400 feet for aerial boom sprayers); and

5. no closer than 200 feet from public access sites. If physical restriction to the area for 14 days subsequent to treatment can be orchestrated, publicly accessible areas may be treated; and

6. only when the area to be treated contains grasses and other plants not susceptible to damage by 2,4-D. These plants can take advantage of increased sunlight (due to the reduction of mature purple loosestrife plants), stabilize the soil, and thus have an advantage to compete with purple loosestrife seedlings (otherwise glyphosate would have to be used if chemical control was chosen as the management option); and

7. the dimethyl amine formulation of 2,4-D is used (this is the least toxic to fish and wildlife while the BEE and ester formulations can be highly toxic); and

8. that 2,4-D can only be applied from a liquid tank mix (pellet and granular formulations would not be permitted for use directly in water/wetlands); and

9. DANGER signs should be posted at all areas where the public has entrance to a treated area.

10. Smolting and juvenile fish are more sensitive to chemicals in their environments than adult fishes. There is currently not enough data related to chronic or sub-acute impacts of amine formulations on aquatic organisms to determine potential impacts. For this reason, treatments would only be permitted after June 15 in anadromous-fish bearing waters to avoid treating where smolting fish are present. Departments of Fisheries and Wildlife would be consulted to identify if waters contain anadromous fish, and to identify additional concerns or potential mitigation measures.

11. Aerial spraying should occur only where logistical constraints prevent the use of hand-held or vehicle mounted spray apparatus.

The following information derives from a review of seven 2,4-D amine labels. These label restrictions serve as mitigation and as such would be integrated into STMs as permit conditions, where appropriate. Label language varies among labels, so the following standard language was developed to reduce confusion, increase consistency, and enhance protection of human health and the environment. No condition in any project approval can be less stringent than the requirements of the label for the specific pesticide used.

1. Pesticide labels require specific signing and that signs contain the following language: "Area treated with 2,4-D on [date of application]. Do not enter without appropriate protective clothing until sprays have dried. In case of accidental exposure follow precautionary statements on label." Additional language should be included on any DANGER or CAUTION signs, such as telephone numbers of people to call in case of emergency, and any use restrictions.

2. Label restrictions state: "Do not enter treated areas until after spray has dried." This label provision requires further interpretation for situations in which 2,4-D is applied to water/wetlands.

3. Labels specify that written or oral warnings must be given to workers expected to be in a treatment area. Labels also require that treated areas must be vacated by unprotected persons.

4. Labels warn that 2,4-D may be toxic to invertebrates. Where significant populations of aquatic invertebrates are identified in a proposed treatment area by an appropriate resource agency, the proposal might not be approved unless harmful effects can be avoided through timing or some other mitigation measure.

5. Labels mandate that water not be contaminated with the washwater used to clean the equipment, which can be accomplished by placing mixing/loading equipment on an impervious pad.

6. All labels reviewed contain various restrictions designed to mitigate for drift in the air, including the following:

   A. Do not spray when wind is blowing toward susceptible crops.
   B. Keep boom as low as possible.
   C. Do not apply if winds are over 5 mph.
   D. Use course spray.
   E. Use low nozzle pressure; use 10-40 lbs nozzle pressure.

   The following additional label restrictions designed to prevent drift would pertain to using the herbicide in the water as well as in the air:

   A. Do not allow the chemical to come into contact with desirable plants.
   B. Do not apply when weather conditions favor drift.
   C. Do not let drift to susceptible plants.
   D. Do not let drift expose other persons.

   Applicators must also comply with additional protective rules, developed by the Department of Agriculture, to address off-target drift, which is of major concern with this chemical.

7. The following measures found on the label are designed to reduce human ingestion of 2,4-D compounds in food. These measures may be of particular concern where irrigation systems are treated to control noxious emergent plants, should water in these systems then be used for watering crops.

   A. Do not forage or graze treated fields within 2 weeks after treatment.

   B. For dairy, do not forage or graze treated fields within 7 days after treatment.

   C. Do not harvest hay for 30 days.

   D. Remove meat animals 3 days prior to slaughter.

E. Do not apply through irrigation systems.

The following label language is specific to treatment of irrigation canals and ditch banks.

1. Most of the labels prohibit use of 2,4-D on small canals (defined as 10 cubic feet per second or less on one label) where water will be used for drinking purposes. Because this suggests that potable water intakes should be protected, further mitigation would be considered for larger ditches and for other aquatic systems such as lakes where potable water intakes exist. These restrictions may include the use of buffers for potable or irrigation withdrawals and monitoring for drift/distance concentrations.

2. Two of the seven amine formulations evaluated state that water within treated ditch banks should not be fished. There is no period of time specified for this restriction and the basis for this restriction is not provided. Until or unless information is provided that would explain why this provision should not apply to all formulations, this measure would be carried forward to all permits allowing use of 2,4-D.

3. Label restrictions designed to reduce the amount of the chemical that is sprayed on surface water include:

   A. No cross stream spray to opposite bank.
   B. Boom spray on water held to minimum.
   C. No more than 2 foot over spray on water--average less than 1 foot.
   D. Apply while traveling upstream to avoid accidental concentration of chemical in water.

4. To ensure effectiveness, labels specify that treatment occur when weeds are young & and in early bloom, before bud or early bloom stage.

5. The labels limit the number of treatments to no more than two treatments per season.

The following label language is specific to treatment of aquatic weeds in lakes, ditches, ponds, and marshes.

1. Restrictions on the 2,4-D amine label precludes it from being used to treat submersed aquatic plants.

2. The following three label restrictions will not normally apply to treatment of purple loosestrife but could pertain to plants such as parrotsfeather:

A. Treat when leaves are fully developed above the water line and plants are actively growing.

B. Treat 1/3-1/2 of the area, wait 10-14 days before next treatment to avoid oxygen loss.

C. Proceed outward from the shore in bands to allow fish to move into untreated areas.

3. Labels prohibit contamination of water used for irrigation purposes.

Inerts

EPA defines inerts as:

> "Any potentially added ingredient in a pesticide product [that] is not pesticidally active. This definition does not include impurities." (EPA, Federal Register. April 22, 1987. Volume 52, Number 77)

The confidentiality of inert ingredients is protected under FIFRA. For this reason, we know very little about the specific inert ingredients used in 2,4-D formulations. Eventually, EPA must evaluate the toxicity of inerts, but this information is not currently available. Inerts comprise about 51-52% of most 2,4-D amine formulations (Solution, a water soluble formulation, contains 3% inerts). Given EPA's registration data requirements, it is possible that some data related to 2,4-D as evaluated in this EIS is derived from testing of the active ingredient (2,4-D) but not the full formulation (2,4-D plus inerts).

Ecology hopes to pursue measures to better assess toxicity of full formulations, but at this time, our options appear to be limited. Provision of such information by manufacturers or other knowledgeable persons would be of great value.

Part Three: ADDITIONAL MEASURES APPLICABLE TO USE OF GLYPHOSATE IN ESTUARINE ENVIRONMENTS

Glyphosate (2,4-D is neither registered for use in estuarine areas or effective against grasses)

Efficacy

The experimental results available indicate that the effectiveness of glyphosate on Spartina species ranges from 0% to 100%. If treatment in any given area over five years does not meet the goals established through an integrated management plan, or

if efficacy is less than 25% over a five year treatment period, glyphosate would not be permitted in that area unless more efficient treatment methods cannot be found.

Information regarding efficacy is essential because permitters need to weigh decisions to modify water quality standards based upon benefits to the public rendered by the treatment versus potential impacts of treatment. Information regarding treatment expectations should be included in the permit applications, which should include a discussion of efficacy in the long term. If control activities would be required in the same area year after year, bi-yearly, or tri-yearly, control activities should be reduced to areas where treatment will most benefit the public.

The efficacy of use of glyphosate for *Spartina* needs further evaluation. Project proponents may be asked to incorporate into their treatment plan research related to assessing effectiveness in different situations. Any such requirements would be developed in cooperation with the project sponsor.

Timing

Studies suggest that glyphosate use on *Spartina* must be carefully timed to be effective. Tides, growth stage, and weather, all play a role in determining treatment efficacy.

Weather

Unnecessary use of herbicides and adjuvents could be avoided by using glyphosate/adjuvents during dry weather. If moisture is beaded on the plants to the point of runoff when the herbicide is sprayed on the plant, effectiveness will be greatly diminished.

Rains prior to treatment can wash off accumulated sediment and salt deposits, thus allowing the herbicide more direct contact with the plant and increasing kill. According to EPA label instructions, application must not occur unless humidity is below a specific percentage (see label for specific language).

To minimize unwanted impacts from herbicide drift, this document defers to the EPA label restriction for glyphosate that forbids using the herbicide when winds are greater than 5 mph at the treatment site.

Growth Stage

Glyphosate should be applied when plants are at their most active stage of growth. Depending on the variability of the each year's climate, these dates may range from mid-June to mid-October/first killing frost. *Spartina* would not be allowed to be treated outside this window to avoid the higher risk that

the treatment would be ineffective. When more conclusive information becomes available regarding efficacy during different growth stages, the option of enlarging or reducing this treatment window would be considered.

Tide

Maximum efficacy is gained when glyphosate is on the plant for at least 6 hours prior to tidal inundation. The water of the incoming tides will reduce the pesticidal properties of glyphosate and dilute the chemical. No glyphosate would be allowed to be used when the tidal regime leaves the plants dry for less than 4 hours.

Sensitive Species

Avoidance of unwanted direct or indirect impacts to sensitive species of plants or animals can sometimes be accomplished by refraining from treatment at sensitive life stages. For example, vehicles would not be allowed below the ordinary high water mark before June 14, per Fisheries concerns.

Area

The potential for public contact with glyphosate can be reduced by not treating within 1/2 mile of any boat launch, marina, swim beach, park, or other public access area on weekends, holidays, or locally identified holidays. Usually this 1/2 mile restriction can be avoided by treating only on weekdays. However situations may arise due to weather, tides, or other variables that may make it necessary to treat on high use days. If this is the case, the project proponent should obtain a letter of concurrence with the treatment dates and times from the local government health department.

Placing buffers from potentially sensitive desirable plants species can protect important existing habitat and food sources for fish and wildlife. Prudence dictates that buffers should be required to minimize or eliminate herbicide contact with these plants. (See mitigation monitoring). The buffer distance for aerial spraying from native emergent plants and eelgrass beds should be 100 feet for aerial boom spraying, 50 feet for aerial balls and 25 feet for backpack sprayers. Wick applications should not need buffers to protect sensitive plants. These buffers are similar to those required under the Forest Practices Act.

Protection of state identified rare plant species or communities (as identified by the Department of Natural Resource Natural Heritage Program) requires a minimum buffer of 100 feet for all ground spraying, 200 feet for aerial spraying, and 10 feet for wick applications.

When a project proponent completes an application for a water quality modification, the area for which treatment is requested needs to be based upon field observations of existing infestation(s). The project proponent would be defined as the person, persons, company, agency, etc., with legal obligation to control spartina in the area proposed on the map submitted in the application. The area defined in the application form would be the area considered during permit review. Requests to expand the original treatment area would be treated as separate applications.

Assessment of potential benefits and impacts of a proposed treatment can best be accomplished by limiting the scope of each proposal to one watershed or estuary.

Plant Type

Because of the high value of native wetland plants in Washington's estuarine wetlands, state identified noxious weeds are the only plants that would be allowed to be treated in an estuarine environment. The applicator would be required to take all measures to avoid treating *Zostera* sp. and other non-target species (see buffers, compensation, and monitoring).

Impacts to eelgrass from chemical treatment may be avoided by:

1. Maintaining sufficient spray buffers;

2. Using the wiper method; and

It may also be possible to protect eelgrass by treating on the ebb tide when the lower parts of Spartina and surrounding eelgrass are covered by water, but the top portion of the plant(s) is exposed. The premise is that the water cover would protect eelgrass. To our knowledge this has not been tested, but may be a viable mitigation measure. Before used as mitigation for control projects, experimental applications testing this theory would have to be conducted.

Sedimentation

Pre-treatment monitoring of sediments may be required in ares suspected or known to be depositional areas for toxic substances.

Areas that would experience unacceptable impacts from erosion due to the loss of Spartina may require post treatment stabilization with native vegetation.

Impacts on Non-target Vegetation

Monitoring effects of the treatment on eelgrass would be required. These studies should continue until a sufficient body of evidence exists to make permit decisions to

expand, reduce, or eliminate the buffer zone based upon the impact of glyphosate on eelgrass.

Compensation of some type may be required should eelgrass beds be impacted by treatment.

Compensation may also be required if native emergent vegetation is killed by a treatment.

Driving on eelgrass and other vascular wetland plants during treatment should be minimized.

Multiple Applications

Additional information regarding impacts and persistence associated with multiple or repeat applications may also be required.

Application Techniques

Aerial

Monitoring for efficacy, drift, and impacts to non-targeted species may be required when new application methods are being used, or applications are occurring in situations previously untested.

LABEL REQUIREMENTS

The only salt water situation where the label restriction for potable water intakes would be applicable would be when applying glyphosate near where desalinization withdrawals occur.

MITIGATION PROPOSED BY THE DEPARTMENT OF WILDLIFE

MITIGATION FOR IMPACTS TO RESOURCES RESULTING FROM CONTROL METHODS FOR NOXIOUS EMERGENT WEEDS

Disturbance/Siltation:

Although species such as purple loosestrife are not desirable and must be removed and/or controlled, large-scale removal of riparian vegetation can cause damage to aquatic ecosystems. Riparian vegetation provides stream bank stability, shading and cover. Removing such vegetation destabilizes the banks and warms the water. Destabilized stream banks cannot contain the energy of high stream flows and, depending on the substrate, will either break down and braid out, or trench down into an arroyo. Either alternative results in shallow, high velocity flows lacking adequate cover or suitable habitat for fish.

Conditions which may be applicable to the work proposed for the protection of fish and wildlife:

All disturbed areas shall be revegetated with native plant species or otherwise protected from erosion.

All work operations shall be conducted in such a manner as to cause little or no siltation to adjacent areas.

A silt barrier shall be placed around the work site to contain the disturbed silt. The barrier is to remain in place until the silt has settled and normal water quality has returned.

Turbidity, phosphorous levels, dissolved oxygen levels, total suspended solids, fish mortality and or injury shall be monitored in and around the work site.

Erosion control methods shall be utilized to prevent siltation. These may include, but are not limited to straw bales, filter fabric, temporary sediment ponds, quarry spalls, check dams and immediate mulching of exposed areas.

Channel Change (Permanent/Temporary) or Channel Realignment:

In undertaking certain methods to control noxious emergent weeds along a stream course or waterway it may be necessary to temporarily or permanently divert the water to protect water quality, fish life and aquatic resources. Although it is not generally preferred in undertaking large scale control methods or sediment disturbances it may be a viable option. An additional determination under the State Environmental Policy Act will be required for permanent channel changes.

Conditions which may be applicable to the work proposed for the protection of fish and wildlife:

Permanent new channels shall be similar in length, width, depth, gradient and meander configuration as the old channel.

Realigned and permanent new channels shall provide fish habitat similar to that which previously existed.

During construction, the new channel shall be isolated from the flowing stream by plugs at the upstream and downstream end.

Filling of the old channel shall begin from the upstream closure and the fill material compacted.

Prior to filling, an armored dike or other approved mechanism shall be constructed to divert the flowing stream and isolate the fill area.

All material removed from the new channel shall take place before any filling operations within the existing channel. Material removal shall proceed from midstream toward the bank and be completed prior to filling.

Filling shall begin at the upstream end and proceed downstream.

Excavation and filling may take place simultaneously if excavated materials are to be used in the filling operation.

Upon completion of the new channel excavation and before the diversion of water, a blanket of river-run or pit-run gravel shall be placed throughout the length of the alteration.

The gravel blanket shall have a depth of not less than nine inches and be comprised of rock one-quarter inch to one and one-half inch in

size, with less than 10% of the total volume being smaller than one quarter inch.

OR

The gravel blanket shall have a depth of not less than 12 inches and be comprised of rock one-half inch to three inches in size, with less than 20% of the total volume being smaller than one-half inch.

AND

Rocks of not less than two feet in diameter shall be randomly placed in the channel, alternating between mid-channel and bankward placement no further apart than a distance equal to the channel width.

AND

Large woody debris shall be anchored within the channel or banks, as directed by resource agency representative.

The angle of the structure used to divert water into the new channel shall allow a smooth transition of water flow.

Before water is diverted into a permanent new channel, the banks shall be protected/vegetated to prevent erosion.

Water discharging from the fill shall not adversely affect fish life.

Diversion of flow into a new channel shall be accomplished by:

a) first removing the downstream plug;
b) removing the upstream plug; and
c) closing the upstream end of the channel.

<u>Bottom Screening</u>:

Conditions which may be applicable to the work proposed for the protection of fish and wildlife:

Screens shall be anchored around the perimeter at intervals no greater than one foot.

Debris and/or sediment which has accumulated on the screens is to be removed from the water and disposed of or placed in a manner to prevent it from being washed back into the water by high water or wave action.

Equipment/Materials:

Conditions which may be applicable to the work proposed for the protection of fish and wildlife:

Equipment shall be cleaned of petroleum-based products prior to entering the watercourse.

Extreme care shall be taken to assure no deleterious material such as fresh cement, concrete, lime petroleum products, chemicals, etc., be allowed to enter the water.

All piling, lumber or other material treated with wood preservatives shall be sufficiently aged or cured so that leaching into surrounding waters does not occur. The use of wood treated with creosote or pentachlorophenol (penta) is not allowed.

Dredging:

Conditions which may be applicable to the work proposed for the protection of fish and wildlife:

A boom or similar device shall be installed to contain floatable materials.

Dredged materials shall be disposed of at upland sites approved by resource agency consensus.

Dredging shall stop when distressed or dead fish are observed in the work area and resource agency representatives contacted.

If a hydraulic dredge is used, it shall be operated with the intake on or below the surface of the material being removed. Reverse purging of the intake line shall not be allowed.

If a dragline or clamshell is used, it shall be operated to minimize turbidity. During excavation, each pass with the clamshell or dragline bucket shall be complete. Dredged material shall not be stockpiled in the water.

Upon completion of the dredging, the watercourse bed shall not contain pits, potholes, or large depressions.

Fish/Wildlife Species:

Fish communities in the inshore littoral zone tend to be structurally and spatially diverse when compared to offshore pelagic and benthic communities. The littoral environment provides an area for primary production and grazing as well as sites for spawning, nursery, and feeding.

Wildlife communities utilizing the land-water interface include waterfowl using the area for resting and feeding. Coastal areas are used as part of the migration corridor for shorebirds, seabirds, and waterfowl. Piscivorous birds such as great blue heron, marsh hawk and kingfisher feed on fish in both coastal and inland wetland complexes. Muskrat, raccoon, rabbits, and deer may utilize the terrestrial margins during low-water periods.

Conditions which may be applicable to the work proposed for the protection of fish and wildlife:

If fish are observed in the vegetation which is being removed, they are to be caught and returned to the water.

If at any time fish are observed in distress, a fish kill occurs, or water quality problems develop as a result of the project, construction operations shall cease immediately and the department granting the approval shall be contacted for instructions on modification or further mitigation.

If fish may be endangered as a result of the project, it will be required to capture and safely transport game and food fish to the nearest free flowing water.

For waters that have been identified as supporting western pond turtle (Clemmys marmorata), state threatened and/or spotted frog (Rana pretiosa), state candidate species, a Department of Wildlife representative shall be contacted to establish site specific mitigation to protect these species.

To protect breeding and brooding resident waterfowl, corridors shall be established for movement of machinery and/or vehicles across upland areas. Surveys of the areas proposed for upland movement of machinery and vehicles shall conducted prior to control work. Surveys shall identify areas where nests are established or broods are resting or feeding. Corridors shall be established outside these areas and clearly marked with NGPE fencing or other similar marking.

The lesser sandhill crane (Grus canadensis canadensis), and greater sandhill crane (Grus canadensis tabida) are listed as state endangered species. It is sensitive to disturbance and work activities should be planned around its presence. The lesser sandhill crane is present rarely in western Washington during spring and fall migrations. the greater sandhill crane is common during spring migration and an occasional summer resident in eastern Washington. East-central Washington is the principal flyway route in Washington for the greater sandhill crane. A Department of Wildlife representative shall be contacted to establish appropriate mitigation and work windows to protect this species.

Other species of birds in need of special consideration are the Aleutian Canada goose (Branta canadensis leucopareia), state endangered species; common loon (Gavia immer), yellow-billed cuckoo (Coccyzus americanus) state candidate species. A Department of Wildlife representative shall be contacted to establish appropriate mitigation and work windows to protect these species.

Generally there are other species of marsh birds that will utilize areas in or around purple loosestrife or Spartina for nesting, breeding and forage. Impacts to these species can be abated by consideration of timing and the type of work proposed. Observations of the area prior to work can provide information on species using the area.

For areas that have been identified as supporting pygmy shrew (Sorex hoyi), state candidate species, a Department of Wildlife representative shall be contacted to establish site specific mitigation.

Harbor seals (Phoca vitulina), are protected under the Federal Marine Mammal Protection Act from harassment. Particularly sensitive during pupping and weaning, work activities should be planned to avoid areas where seals are observed or known to be present. Information on pupping areas can be obtained from the National Marine Mammal Lab in Seattle.

Generally there are other species of mammals that will utilize areas in or around purple loosestrife for dens, breeding and forage. Large-scale projects, especially those involving destabilization of banks would most likely have the greatest impact on these species. Impacts to these species can be abated by consideration of timing and the type of work proposed. Observations of the area prior to work can provide information on species using the area.

Timing:

Work below the ordinary high water mark shall not occur from:

May 15 - August 1 =	Closure for warmwater fish spawning and rearing
Oct 1 - March 31 =	Closure for salmonid migration, spawning, smolting, rearing

Consideration should be given for modifying or curtailing work activities during the following times:

Oct 1 - May 15 =	Closure for waterfowl/shorebird migrations in coastal areas.
May 15 - July 1 =	Closure for resident waterfowl nesting and brooding.
Feb 15 - Aug 31 =	Closure for sensitive amphibian or reptile spawning, egg/larval development in fresh water bodies.
Mar 1 - Jun 15 =	Closure for pair waters in eastern Washington waterfowl breeding areas.
Mar 15 - Jul 15 =	Closure for protection of marsh birds.
Apr 1 - Jul 15 =	Closure for protection of mammals (mink, otter, beaver, etc) breeding.
May 1 - Aug 15 =	Closure for harbor seal haulout, pupping and weaning areas. (Coastal areas)
Jun 1 - Oct 31 =	Closure for harbor seal haulout, pupping and weaning areas (Straits and San Juans)
Jul 1 - Nov 15 =	Closure for harbor seal haulout, pupping and weaning areas (Lower Puget Sound)
Jul 1 - Jan 31 =	Closure for harbor seal haulout, pupping and weaning areas (Hood Canal)

Exceptions to these closures can be coordinated through resource agency biologists to achieve both removal of noxious emergent weeds and protection of fish, wildlife and aquatic resources.

STATE OF WASHINGTON
DEPARTMENT OF FISHERIES
HABITAT MANAGEMENT DIVISION

May 4, 1993

DRAFT

TO: **Interested Parties**

FROM: **Tim Flint - Supervisor, Marine Permits**

SUBJECT: **Spartina HPAs for 1993**

The following information (in draft form) was presented by Washington Department of Fisheries (WDF) at a workshop with County Weed Board representatives and other interested parties on March 26, 1993. This information is intended to guide applicants desiring to conduct Spartina control projects **in 1993 only**. WDF indicated at the workshop that HPAs could be issued by control method for a geographical area to the County Weed Board who would oversee individual projects. HPAs can also be issued to individual property owners. If you wish to conduct a Spartina control project in 1993, please contact your County or State Weed Board first. Attached is a list of the WDF Regional Habitat Managers responsible for reviewing HPA applications in your area.

1. What is a Hydraulic Project Approval (HPA)?

An HPA is required under RCW 75.20.100 which states, "In the event that any person or government agency desires to construct any form of hydraulic project or perform other work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state, such person or government agency shall, before commencing construction or work thereon and to ensure the proper protection of fish life, secure the written approval of the department of fisheries or the department of game as to the adequacy of the means proposed for the protection of fish life." For saltwater and intertidal areas, the department of wildlife defers to WDF to issue HPAs.

Controlling Spartina can involve work below the ordinary high waterline (OHW) that can "...change the natural flow or bed of...salt waters of the state..." and therefore, an HPA is required in many cases. Because the EIS for Spartina control is currently under preparation and will probably not be final prior to the 1993 control season, the following interim guidelines for issuance and provisioning of HPAs in 1993 are proposed.

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2. What types of spartina control projects require an HPA?

Control Method	Permit
No Action	None
Chemical	
Hand Application	SEPA & Temp. W.Q. Modification (DOE)
Aerial Application	SEPA & Temp. W.Q. Modification (DOE)
Vehicle Application	HPA (WDF), SEPA and Temporary Water Quality Modification (DOE)
Physical - Small Scale	
Hand Pulling	None
Hand Tool	None
Hand Held Machinery	HPA (WDF)
Covering	HPA (WDF)
Flaming	HPA (WDF) - won't permit in 1993 unless on limited experimental basis with associated monitoring
Physical - Large Scale	
Mowing	HPA (WDF)
Harvest	
Hand	None
Hand Held Machinery	HPA (WDF)
Equipment	HPA (WDF)
Dredging, Filling, Diking or Draining	SEPA (Local Jurisdiction), HPA (WDF), SDP, Temporary Water Quality Modification and sediment sampling (DOE), Corps Permit, and probably others.

3. How do I get an HPA?

Send in a Hydraulic Project Application to:

Washington Department of Fisheries
Habitat Management Division
1111 Washington Street, Southeast
Post Office Box 43155
Olympia, WA 98504-3155

4. What types of provisions for the protection of fish life will generally be contained in HPAs?

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Each HPA is conditioned on an individual basis depending on the fish and shellfish resources and their habitats in need of protection. However, WDF has drafted the following list of provisions that would likely be included in HPAs for the various types of spartina control projects. In addition, other conditions may be applied such as timing restrictions during herring, surf smelt, Pacific sand lance and rock sole spawning.

Vehicle or Equipment Operation Below OHW, Including Chemical Application and Other Activities. An HPA will likely not be required for hovercraft operation.

1. Work below the ordinary high waterline shall not occur from March 1 through June 14 of any year for the protection of migrating juvenile salmonids. **(Coast)**

2. Work below the ordinary high waterline shall not occur from March 15 through June 14 of any year for the protection of migrating juvenile salmonids. **(Puget Sound)**

3. Use of equipment on the beach shall be confined to a specific access corridor to and from the Spartina being eradicated, to the beach area covered by Spartina, and to a limited work corridor around the Spartina.

4. Operation of equipment on eelgrass (Zostera spp) and other wetland vascular plants (except noxious weeds) shall be prohibited.

5. Equipment operation shall be conducted at all times in a manner to cause little or no disturbance or siltation to the adjacent waters.

6. Work shall be conducted so as to avoid further spread of Spartina seed and/or rhizome material to aquatic areas.

7. Eelgrass (Zostera spp) and other wetland vascular plants (except noxious weeds) shall be avoided and protected from disturbance or damage to the greatest extent possible.

8. Project activities shall not occur when the project area is inundated by tidal waters.

9. Deleterious material resulting from equipment operation, including gasoline and oil, shall not be allowed to enter waters of the state.

10. If a fish kill occurs or fish are observed in distress, the project activity shall immediately cease and WDF Habitat Management Division shall be notified immediately.

11. Water quality is not to be degraded to the detriment of fish life as a result of this project.

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Hand Held Machinery Mowing

1. Work below Mean Higher High Water (MHHW, Mean Lower Low Water [MLLW] = 0.0 feet) shall not occur from March 1 through June 14 of any year for the protection of migrating juvenile salmonids. (Coast)

2. Work below Mean Higher High Water (MHHW, Mean Lower Low Water [MLLW] = 0.0 feet) shall not occur from March 15 through June 14 of any year for the protection of migrating juvenile salmonids. (Puget Sound)

3. The permittee (listed above) shall notify the Regional Habitat Manager listed below in writing or by phone at least seven (7) days prior to the start of any work. The following information shall be provided:

   A. Contact person name and phone number.
   B. Proposed date(s) of work.
   C. Type of project.
   D. Specific location of work area including relationship to MHHW.
   E. Approximate size of work area (square feet).
   F. Estimated percent of Spartina versus other vegetation within the proposed work area.
   G. Proximity of nearest eelgrass (Zostera spp) to proposed work area.

4. The permittee (listed above) shall provide a written summary to the Regional Habitat Manager listed below by January 31, 1994 of all work conducted under this Hydraulic Project Approval (HPA) during 1993. This summary shall include:

   A. Date(s) of work.
   B. Type of project.
   C. Precise location and map of work areas including relationship to MHHW.
   D. Approximate size of work area (square feet).
   E. Estimated percent of Spartina versus other vegetation within the work area.
   F. Proximity of nearest eelgrass (Zostera spp) to work area.
   G. Fate of any mowed vegetation.
   H. Effectiveness of control by method and site.

5. Mowing of eelgrass (Zostera spp) shall be prohibited.

6. Mowing operations shall be conducted at all times in a manner to cause little or no disturbance or siltation to the adjacent waters.

7. Work shall be conducted so as to avoid further spread of Spartina seed and/or rhizome material to aquatic areas.

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8. Eelgrass (Zostera spp) and other wetland vascular plants (except noxious weeds) shall be avoided and protected from disturbance or damage to the greatest extent possible.

9. Project activities shall not occur when the project area is inundated by tidal waters.

10. Mowed material shall not be stockpiled on a temporary or permanent basis below the high tide line, except within the perimeter of the mowed area.

11. Mowed materials shall either be disposed of upland such that they do not re-enter surface waters of the state or left within the mowed perimeter to be carried away by the tide. If mowed materials are left below OHW, the permittee assumes responsibility for the fate of and impacts caused by the mowed material. If such material subsequently covers critical habitats, including but not limited to wetland vegetation (except noxious weeds), spawning beds, settlement and rearing areas, and migration corridors to the detriment of fish life, or creates a nuisance, the permittee shall be responsible for removal and restoration of the affected habitat or area. An HPA may be required for such remedial measures.

12. Project activities shall be conducted to minimize siltation of beach areas and bed materials.

13. Deleterious material resulting from mowing, including gasoline and oil, shall not be allowed to enter waters of the state.

14. If a fish kill occurs or fish are observed in distress, the project activity shall immediately cease and WDF Habitat Management Division shall be notified immediately.

15. Water quality is not to be degraded to the detriment of fish life as a result of this project.

<u>Covering</u>

1. Work below the ordinary high waterline shall not occur from March 1 through June 14 of any year for the protection of migrating juvenile salmonids. **(Coast)**

2. Work below the ordinary high waterline shall not occur from March 15 through June 14 of any year for the protection of migrating juvenile salmonids. **(Puget Sound)**

3. The permittee (listed above) shall notify the Regional Habitat Manager listed below in writing or by phone at least seven (7) days prior to the start of any work. The following information shall be provided:

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A. Contact person name and phone number.
B. Proposed date(s) of work.
C. Type of project.
D. Specific location of work area including relationship to MHHW.
E. Approximate size of work area (square feet).
F. Estimated percent of Spartina versus other vegetation within the proposed work area.
G. Proximity of nearest eelgrass (Zostera spp) to proposed work area.

4. The permittee (listed above) shall provide a written summary to the Regional Habitat Manager listed below by January 31, 1994 of all work conducted under this Hydraulic Project Approval (HPA) during 1993. This summary shall include:

A. Date(s) of work.
B. Type of project.
C. Precise location and map of work areas including relationship to MHHW.
D. Approximate size of work area (square feet).
E. Estimated percent of Spartina versus other vegetation within the work area.
F. Proximity of nearest eelgrass (Zostera spp) to work area.
G. Fate of any mowed vegetation.
H. Effectiveness of control by method and site.

5. Covering of eelgrass (Zostera spp) shall be prohibited.

6. Covering operations shall be conducted at all times in a manner to cause little or no disturbance or siltation to the adjacent waters.

7. Work shall be conducted so as to avoid further spread of Spartina seed and/or rhizome material to aquatic areas.

8. Eelgrass (Zostera spp) and other wetland vascular plants (except noxious weeds) shall be avoided and protected from disturbance or damage to the greatest extent possible.

9. Project activities shall not occur when the project area is inundated by tidal waters.

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10. Covering material shall be securely anchored to the substrate such that it does not break loose from storm or tidal action. In addition, the interior of the covering material shall be held to the substrate in a quilted fashion to eliminate the potential for billowing.

11. Covering material shall not be stockpiled on a temporary or permanent basis, below the high tide line except within the perimeter of the area to be covered.

12. At the completion of the covering project, the covering material shall be removed completely from the beach and project area and shall not be allowed to enter waters of the state. Under no circumstances shall any covering material be left in place after the expiration date of this permit.

13. Project activities shall be conducted to minimize siltation of beach areas and bed materials.

14. Debris and deleterious material resulting from covering shall not be allowed to enter waters of the state.

15. If a fish kill occurs or fish are observed in distress, the project activity shall immediately cease and WDF Habitat Management Division shall be notified immediately.

16. Water quality is not to be degraded to the detriment of fish life as a result of this project.

Large Scale Mowing

1. Work below the ordinary high waterline shall not occur from March 1 through June 14 of any year for the protection of migrating juvenile salmonids. **(Coast)**

2. Work below the ordinary high waterline shall not occur from March 15 through June 14 of any year for the protection of migrating juvenile salmonids. **(Puget Sound)**

3. The permittee (listed above) shall notify the Regional Habitat Manager listed below in writing or by phone at least seven (7) days prior to the start of any work. The following information shall be provided:

   A. Contact person name and phone number.
   B. Proposed date(s) of work.
   C. Type of project.
   D. Specific location of work area including relationship to MHHW.
   E. Approximate size of work area (square feet).
   F. Estimated percent of Spartina versus other vegetation within the proposed work area.

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G. Proximity of nearest eelgrass (Zostera spp) to proposed work area.

4. The permittee (listed above) shall provide a written summary to the Regional Habitat Manager listed below by January 31, 1994 of all work conducted under this Hydraulic Project Approval (HPA) during 1993. This summary shall include:

   A. Date(s) of work.
   B. Type of project.
   C. Precise location and map of work areas including relationship to MHHW.
   D. Approximate size of work area (square feet).
   E. Estimated percent of Spartina versus other vegetation within the work area.
   F. Proximity of nearest eelgrass (Zostera spp) to work area.
   G. Fate of any mowed vegetation.
   H. Effectiveness of control by method and site.

5. Use of equipment on the beach shall be confined to a specific access corridor to and from the Spartina being eradicated, to the beach area covered by Spartina, and to a limited work corridor around the Spartina.

6. Mowing of eelgrass (Zostera spp) shall be prohibited.

7. Operation of equipment on eelgrass (Zostera spp) shall be prohibited.

8. Equipment and mowing operations shall be conducted at all times in a manner to cause little or no disturbance or siltation to the adjacent waters.

9. Work shall be conducted so as to avoid further spread of Spartina seed and/or rhizome material to aquatic areas.

10. Eelgrass (Zostera spp) and other wetland vascular plants (except noxious weeds) shall be avoided and protected from disturbance or damage to the greatest extent possible.

11. Mowed material shall not be stockpiled on a temporary or permanent basis, below the high tide line except within the perimeter of the mowed area.

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12. Mowed materials shall either be disposed of upland such that they do not re-enter surface waters of the state, or left within the mowed perimeter to be carried away by the tide. If mowed materials are left below OHW, the permittee assumes responsibility for the fate of and impacts caused by the mowed material. If such material subsequently covers critical habitats, including but not limited to wetland vegetation (except noxious weeds), spawning beds, settlement and rearing areas, and migration corridors to the detriment of fish life, or creates a nuisance, the permittee shall be responsible for removal and restoration of the affected habitat or area. An HPA may be required for such remedial measures.

13. Project activities shall not occur when the project area is inundated by tidal waters.

14. Deleterious material resulting from equipment operation, including gasoline and oil, shall not be allowed to enter waters of the state.

15. If a fish kill occurs or fish are observed in distress, the project activity shall immediately cease and WDF Habitat Management Division shall be notified immediately.

16. Water quality is not to be degraded to the detriment of fish life as a result of this project.

<u>Harvest with Hand Held Machinery</u>

1. Work below Mean Higher High Water (MHHW, Mean Lower Low Water [MLLW] = 0.0 feet) shall not occur from March 1 through June 14 of any year for the protection of migrating juvenile salmonids. **(Coast)**

2. Work below Mean Higher High Water (MHHW, Mean Lower Low Water [MLLW] = 0.0 feet) shall not occur from March 15 through June 14 of any year for the protection of migrating juvenile salmonids. **(Puget Sound)**

3. The permittee (listed above) shall notify the Regional Habitat Manager listed below in writing or by phone at least seven (7) days prior to the start of any work. The following information shall be provided:

   A. Contact person name and phone number.
   B. Proposed date(s) of work.
   C. Type of project.
   D. Specific location of work area including relationship to MHHW.
   E. Approximate size of work area (square feet).
   F. Estimated percent of Spartina versus other vegetation within the proposed work area.

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G. Proximity of nearest eelgrass (Zostera spp) to proposed work area.

4. The permittee (listed above) shall provide a written summary to the Regional Habitat Manager listed below by January 31, 1994 of all work conducted under this Hydraulic Project Approval (HPA) during 1993. This summary shall include:

   A. Date(s) of work.
   B. Type of project.
   C. Precise location and map of work areas including relationship to MHHW.
   D. Approximate size of work area (square feet).
   E. Estimated percent of Spartina versus other vegetation within the work area.
   F. Proximity of nearest eelgrass (Zostera spp) to work area.
   G. Fate of any mowed vegetation.
   H. Effectiveness of control by method and site.

5. Harvesting operations shall be conducted at all times in a manner to cause little or no disturbance or siltation to the adjacent waters.

6. Harvesting of eelgrass (Zostera spp) shall be prohibited.

7. Work shall be conducted so as to avoid further spread of Spartina seed and/or rhizome material to aquatic areas.

8. Eelgrass (Zostera spp) and other wetland vascular plants (except noxious weeds) shall be avoided and protected from disturbance or damage to the greatest extent possible.

9. Project activities shall not occur when the project area is inundated by tidal waters.

10. Harvested material shall not be stockpiled on a temporary or permanent basis below the high tide line, except within the perimeter of the mowed area.

11. Harvested material shall be removed from the beach area and project site prior to tidal inundation and shall not be allowed to enter waters of the state.

12. Project activities shall be conducted to minimize siltation of beach areas and bed materials.

13. Deleterious material resulting from harvesting, including gasoline and oil, shall not be allowed to enter waters of the state.

14. If a fish kill occurs or fish are observed in distress, the project activity shall immediately cease and WDF Habitat Management Division shall be notified immediately.

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15. Water quality is not to be degraded to the detriment of fish life as a result of this project.

Harvesting with Equipment

1. Work below the ordinary high waterline shall not occur from March 1 through June 14 of any year for the protection of migrating juvenile salmonids. **(Coast)**

2. Work below the ordinary high waterline shall not occur from March 15 through June 14 of any year for the protection of migrating juvenile salmonids. **(Puget Sound)**

3. The permittee (listed above) shall notify the Regional Habitat Manager listed below in writing or by phone at least seven (7) days prior to the start of any work. The following information shall be provided:

   A. Contact person name and phone number.
   B. Proposed date(s) of work.
   C. Type of project.
   D. Specific location of work area including relationship to MHHW.
   E. Approximate size of work area (square feet).
   F. Estimated percent of Spartina versus other vegetation within the proposed work area.
   G. Proximity of nearest eelgrass (Zostera spp) to proposed work area.

4. The permittee (listed above) shall provide a written summary to the Regional Habitat Manager listed below by January 31, 1994 of all work conducted under this Hydraulic Project Approval (HPA) during 1993. This summary shall include:

   A. Date(s) of work.
   B. Type of project.
   C. Precise location and map of work areas including relationship to MHHW.
   D. Approximate size of work area (square feet).
   E. Estimated percent of Spartina versus other vegetation within the work area.
   F. Proximity of nearest eelgrass (Zostera spp) to work area.
   G. Fate of any mowed vegetation.
   H. Effectiveness of control by method and site.

5. Use of equipment on the beach shall be confined to a specific access corridor to and from the Spartina being eradicated, to the beach area covered by Spartina, and to a limited work corridor around the Spartina.

6. Harvesting of eelgrass (Zostera spp) shall be prohibited.

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7. Operation of equipment on eelgrass (Zostera spp) shall be prohibited.
8. Equipment and mowing operations shall be conducted at all times in a manner to cause little or no disturbance or siltation to the adjacent waters.

9. Work shall be conducted so as to avoid further spread of Spartina seed and/or rhizome material to aquatic areas.

10. Eelgrass (Zostera spp) and other wetland vascular plants (except noxious weeds) shall be avoided and protected from disturbance or damage to the greatest extent possible.

11. Harvested material shall not be stockpiled on a temporary or permanent basis below the high tide line, except within the perimeter of the mowed area.

12. Harvested material shall be removed from the beach area and project site prior to tidal inundation and shall not be allowed to enter waters of the state.

13. Project activities shall not occur when the project area is inundated by tidal waters.

14. Deleterious material resulting from equipment operation, including gasoline and oil, shall not be allowed to enter waters of the state.

15. If a fish kill occurs or fish are observed in distress, the project activity shall immediately cease and WDF Habitat Management Division shall be notified immediately.

16. Water quality is not to be degraded to the detriment of fish life as a result of this project.

Dredging, Filling, Diking, or Draining

Projects of this nature will be provisioned on a case-by-case basis. Such projects, if extensive, may require an EIS. None of these types of projects would likely be allowed in 1993.

TF:lt

Attachment - WDF Marine Regional Habitat Managers

Department of Fisheries
Habitat Management Division
Regional Habitat Managers
May 1993

MARINE

WRIA	NAME/FAX/PHONE/ADDRESS	DRAINAGE	COUNTY
Marine Area Manager/ Supervisor	**FLINT, TIM** 12 FAX 902-2546 Public/SCAN 902-2579 1111 Washington Street, SE PO Box 43155 Olympia, WA 98504-3155	Marine Waters	All State Marine & Estuarial Waters
Marine	**BOETTNER, JOHN** 20 FAX 876-1894 SCAN 744-4757 Public 895-4757 502 High Street, Suite 1 Port Orchard, WA 98366	Marine Waters Mid-Sound Strait & North Coast	Kitsap Clallam Jefferson
Marine & Mainstem Columbia River to Bonneville	**BURKLE, BOB** 06 FAX 902-2946 Public/SCAN 902-2575 1111 Washington Street, SE PO Box 43155 Olympia, WA 98504-3155	Marine Waters Grays Harbor Willapa Thurston Mainstem Columbia to Bonneville Dam	Thurston Grays Harbor Pacific Wahkiakum Cowlitz Skamania Clark
Marine	**CARMAN, RANDY** 50 FAX 902-2946 Public/SCAN 902-2573 1111 Washington Street, SE PO Box 43155 Olympia, WA 98504-3155	Marine Waters	King E. Pierce
Marine	**RICKARD, NEIL** 23 FAX 902-2946 Public/SCAN 902-2574 1111 Washington Street, SE PO Box 43155 Olympia, WA 98504-3155	Marine Waters	Mason West Pierce
Marine	**WILLIAMS, BRIAN** 64 FAX 334-7241 SCAN 261-3881 Public 339-3881 Hillcrest Plaza #7 91st Avenue NE Everett, WA 98205	Marine Waters of North Sound	Skagit Whatcom Island Snohomish San Juan

APPENDIX 2:

SIMULATED IWM SCENARIOS

APPENDIX 2
HYPOTHETICAL INTEGRATED WEED MANAGEMENT SCENARIOS

The following hypothetical integrated management scenarios have been developed to illustrate possible management strategies. For purposes of constructing these examples, it is assumed that there are no monetary and labor force constraints, and all treatment methods (mechanical/physical, biological, and chemical) are available for use by resource managers. Other factors that might influence decisions, such as method-related environmental impacts, use constraints, and mitigation measures, are taken into consideration.

1.0 PRIORITY-BASED, MANAGEMENT PLANS FOR CORDGRASSES (*SPARTINA* spp.)

1.1 Priority I: Potential New Invader Management

Scenario: A park is located 1 km (0.6 mi) from an established population of *Spartina alterniflora*. The cordgrass colony is flowering and producing viable seed.

Management Plan: Park managers determine that invasion is imminent; a Prevention strategy is adopted. Park employees are trained in *Spartina* identification and control methods. Surveys for cordgrass plants are conducted between April and November, when plants are more readily detected. Intensive surveys are concentrated in areas particularly susceptible to colonization, such as mudflats where currents are likely to deposit seeds, and waterfowl use areas. A public awareness program is implemented and neighboring landowners are encouraged to initiate management procedures. Signs are posted in public access areas to inform users of *Spartina* recognition and detrimental characteristics, and to encourage them to promptly report any discovered plants. A mechanism is established to facilitate reporting of *Spartina* occurrences to park managers.

1.2 Priority II: New Invader Management

Scenario: A small, sparse infestation [100 plants/ha (2.5 ac)] of *Spartina* seedlings and young colonies [(less than 30 cm (12 in) in diameter] have been found in the park.

Management Plan: Prevention and Early Treatment strategies are selected. Prevention activities lead to an awareness of the situation among park personnel and the public. Public information and monitoring activities are initiated. Park personnel solicit public participation during the formulation of an integrated management plan. Potential environmental impacts and specific mitigation measures are discussed and evaluated. Damage and action thresholds are initially determined to be 1 plant/ha (2.5 acre). Objectives of the Early Treatment strategy are to control, contain, and reduce population density during the initial management year (Phases 1 and 2), and to begin eradication during the second and ensuing years (Phase 3).

During Phase 1, combinations of physical and chemical treatments are used to weaken or kill plants and to prevent seed production. Seedlings are removed by pulling and digging by hand. Colonies are controlled by mechanical crushing, mowing with a gas-powered weed trimmer, and glyphosate applications. Backpack-sprayer spot-treatment applications are used

to minimize non-target plant injury during glyphosate treatments. Covering is not used for this infestation because colonies are small and widely distributed. An ongoing monitoring program to assess the efficacy of treatments and environmental impacts is initiated.

During Phase 2, preventive measures and the previously selected suite of management methods are continued to achieve control, containment, and further reduction of cordgrass populations. Monitoring is continued.

During Phase 3, following decline in weed densities to 1 plant/ha (2.5 ac), eradication becomes the objective. Hand pulling/digging and herbicide treatments are used to kill plants. Prevention and monitoring activities are continued.

1.3 Priority III: Established Invader Management

Scenario: A widespread infestation of *Spartina* has developed in the park. One small, 1-ha (2.5-ac) infestation and a larger 40-ha (100-ac) infestation have been targeted for management by park personnel.

Management Plans: Integrated management plans have been previously formulated by park managers to deal with both infestations. Damage and action thresholds for the small infestation (perimeter and core areas) are initially set at 10 and 5 percent vegetative cover per hectare, respectively, or presence of flowering plants. Damage and action thresholds for the large infestation (perimeter and core areas) are set at 40 and 10 percent vegetative cover per hectare, respectively, or presence of flowering plants. Prevention and Correction treatment strategies are selected for the small infestation, whereas Prevention and Maintenance strategies are chosen for the larger infestation. The No Action strategy was eliminated from consideration because high levels of environmental damage are anticipated if the infestations are not treated.

The efficacy of glyphosate applications in killing *Spartina* is estimated during experimental treatments in different areas of the infestation. It is determined that only 80 percent of the plants in the lower intertidal zone are killed following treatment. Treatments are more effective in upper intertidal areas, perhaps because the plants are taller and are emersed for a longer time after herbicide application. This information is used during the planning process to develop management plans for the two infestations.

SMALL INFESTATION

Preventive methods are enacted throughout the treatment period. Management objectives of the Correction strategy are containment and reduction of cordgrass populations within the infestation area. Management objectives vary, depending on location within the infestation. The first priority is management of outlier populations because these contribute to continued spread. Perimeter population management is second priority. The final priority is management of central or core populations.

Outlier populations:

During Phase 1, objectives of the Correction strategy are control and containment. Physical and chemical treatments are used to curtail seed production and to slow colony growth. Hand pulling and digging seedlings and other small plants are conducted from early spring through midsummer. Pre-flowering plants are flamed with a flamer or mowed with a weed trimmer to prevent seed production. Glyphosate is applied in the pre-flowering stage. Plants are sprayed using a backpack sprayer or wicked, depending on presence or absence of surrounding non-target vegetation and other site considerations. Vegetation is monitored to help evaluate treatment method efficacy and to detect any untreated plants.

During Phase 2,containment and reduction of plants remaining after Phase 1 are emphasized. Treatment methods used in Phase 1 are continued, although greater emphasis is placed on digging and chemical management methods. When no more plants are found within the outlier treatment zone, Phase 3 is initiated. Monitoring the vegetation leads to discovery of new outlier plants, resulting in a return to Phase 1 in a few outlying areas.

Perimeter populations:

The long-term goal of perimeter management is to diminish the size of the infestation front. The Correction strategy objectives of containment and reduction are applicable.

During Phase 1, efforts are made to contain populations of *Spartina* around the perimeter of the population. The edges of colonies are cut/mown several times between March and September. Mechanical crushing is done in a few accessible areas. These treatments reduce seed production and contain plant spread.

Glyphosate is applied using backpack sprayers to pre-flowering plants only in the upper intertidal zone of the site. Monitoring is conducted to assess treatment method efficacies and treatments are repeated in selected areas.

Phase 2 objectives are containment and further reduction of perimeter populations. Phase 1 treatment methods are continued during Phase 2, resulting in a reduction in infestation extent. Park managers lower damage and action thresholds as populations decline. Monitoring is continued within the treatment zone. Upon the detection of new plants, the management process would revert to Phase 1.

Core population:

Initially, the primary objective is containment. Park managers determine crushing treatments are appropriate for the site because there is good shore access to the core population. In addition, colonies are monospecific, nearly continuous, and uninterrupted by deep channels. All-terrain vehicles are used yearly, once each in June and August. A weed trimmer is used to mow areas at the edges of some colonies within the core area, where all-terrain vehicles cannot be used because of soft sediments.

Once the core population has been effectively contained, reduction efforts are pursued. Damage and action thresholds are revised as plant density within the core is reduced.

Park personnel determine that two readily accessible areas within the core population can effectively be treated by covering because they are subjected to mild tidal currents and limited wave energy. After mowing to reduce biomass, geotextile fabric is placed over these colonies and securely anchored in the sediments. Surrounding areas continue to be managed with a combination of crushing and mowing treatments. Frequency of mowing treatments is increased, with the intention of reducing the population. Glyphosate is applied using a backpack sprayer to isolated plants in the upper intertidal area. Herbicides are not more widely used because of neighboring citizen and resource agency concerns. Monitoring the core population is ongoing to determine if the methods used are effective in population containment.

LARGE INFESTATION

Prevention and Maintenance strategies are used against the large infestation of *Spartina*. The primary management objective of the Maintenance strategy is population containment. Treatment methods are designed to maintain *Spartina* density below the established damage threshold. Management activities are prioritized based on plant location within the infestation. The first priority is management of outlier populations to restrict continued spread, followed by plant containment within the perimeter and core infestation zones, respectively.

Outlier Populations:

During Phase 1, the primary objective is to halt further expansion of the infestation and to prevent seed production. Skilled volunteer laborers are recruited to assist with physical destruction (hand pulling/digging and flaming) and herbicide applications. Pre-flowering plants are flamed with a flamer or mowed with a weed trimmer to prevent seed production. Glyphosate is applied using backpack sprayers or by wicking plants to kill outlying plants.

During Phase 2, emphasis is placed on containment and further reduction of plants remaining after Phase 1. This is followed by Phase 3, in which eradication of outlier populations is the primary goal. Monitoring is continued within the outlier zone during Phases 2 and 3.

Perimeter Populations:

Phase 1, 2, and 3 management includes the use of mechanical/physical and chemical methods. Crushing twice a year, in combination with mowing monthly during the growing season in areas that can not be accessed for mechanical crushing, is found to substantially impact perimeter populations. Glyphosate is sprayed in selected areas around the outer perimeter. Repeated use of containment methods in this zone gradually pushes the infestation front toward the core population.

The perimeter zone is monitored frequently to assess success of Phases 1, 2, and 3. *Spartina* population density is maintained below established damage thresholds during each phase. Damage and action thresholds are redefined as colonies at the perimeter of the infestation are killed.

Core Population:

Containment, especially reduced seed production, is the first management priority in the core area of the infestation. Several management methods are used because of varying conditions in different parts of the infestation and because volunteers are available for implementing some (but not all) possible measures. It is discovered that controlled burns can be conducted during the pre-flowering stage in some parts of the core population, where plants are exposed to air long enough to dry adequately. In other areas, a combination of crushing with all-terrain vehicles and tractors and mowing with weed trimmers is used to crush or cut plants in the pre-flowering stage. Aerial applications of herbicides are made. Monitoring enables park personnel to assess the efficacy of each method, and treatments are repeated in areas where pre-flowering plants are found.

Phase 1 of the Maintenance strategy is completed when the damage threshold is no longer exceeded. Damage and action thresholds are revised as infestation density decreases. Eventually, the core population is reduced to the point where it is reclassified as a small infestation, at which time the Maintenance strategy is replaced by a Correction strategy. Objectives and treatment methods for containment and reduction become applicable.

2.0 PRIORITY-BASED, MANAGEMENT PLANS FOR PURPLE LOOSESTRIFE (*LYTHRUM SALICARIA*)

2.1 Priority I: Potential New Invader Management

Scenario: A 400-hectare (ha) (1,000-acres [ac]) wildlife refuge (illustrative of a natural environment) not yet infested by purple loosestrife is located 1.6 kilometers (km) (1 mile [mi]) downriver from a well-established population of the noxious weed. The river traverses the center of the refuge.

Management Plan: Based upon a knowledge of the mechanisms that facilitate purple loosestrife spread, refuge managers determine that refuge invasion is imminent. A prevention strategy is adopted. Current and new refuge personnel are trained to identify non-flowering and flowering plants, and they learn the species's biology and management methods. Intensive surveys are conducted between March and November in those areas of the refuge considered to be most vulnerable to initial infestation (leading edge of the refuge property, the banks of the river, any sites subjected to repeated animal- or human-based disturbance, for example). The landowner upriver of the infested property and the jurisdictional county weed control board/district are contacted and urged to initiate management procedures. Signs are posted at public access points to the refuge to inform users of purple loosestrife recognition and detrimental characteristics, and to encourage them to promptly report any discovered plants to refuge personnel. Timely rehabilitation of all disturbed soil areas with site-appropriate, desirable vegetation is undertaken to prevent purple loosestrife or other noxious emergent plant species from establishing on those sites.

2.2 Priority II: New Invader Management

Scenario: Wildlife refuge personnel have discovered infestations of purple loosestrife during their weed survey effort. Both small [less than 2 plants/m^2 (10.8 ft^2)] and large infestations (more than 10 plants/m^2) of the noxious weed are present.

Management Plan: Although infestations of purple loosestrife have been found, prevention continues to be an important strategy. Preventive activities continue to detect additional invading individuals, deter further invasion of refuge lands from outside sources, and create an educational awareness of the current situation among refuge personnel and the public. Refuge personnel solicit public participation during the formulation of an integrated management plan. Environmental impacts expected from the use of the management methods potentially included in the integrated approach and potential specific mitigation measures are discussed and evaluated for the particular infestation sites. Purple loosestrife damage and action thresholds are determined to be one plant/m^2 (10.8 ft^2), extremely low thresholds. For all infestations (small and large), an Early Treatment strategy is selected. Objectives of this multi-phased strategy are to control, contain, and reduce the infestation during the initial management year, achieve containment and further population density reductions the following year, and to begin eradication during the third and ensuing years.

During Phase 1, combinations of physical, biological, and chemical treatments are used. All methods selected must prevent seed production. Pulling by hand, covering with black plastic, and applying 2,4-D and glyphosate are all selected as potentially highly effective methods against seedling and/or pre-flowering plants in both small and large infestations. The herbicide would be used if pulling/digging and covering prove inadequate; backpack sprayer spot treatment and/or wiping applications are determined to be preferable because these minimize non-target plant injury. Planting competitive native and/or non-native species is also implemented once purple loosestrife population density has been diminished through use of the selected treatment methods. It is important to restore the wetland to its pre-invasion condition as quickly as possible. Method efficacy is determined through an ongoing monitoring program.

During Phase 2, emphasis is directed toward continued use of preventive measures and the previously selected suite of management methods to achieve control, containment, and further reduction of purple loosestrife populations. Monitoring is continued.

Once population densities have declined to one or two plants/m^2 (10.8 ft^2) as a consequence of the successful application of the integrated approach, eradication becomes the next objective. Only hand pulling/digging and/or herbicide treatments are used against outlier, perimeter, and core components of the infestation during the eradication phase. Prevention and monitoring activities are continued for the duration of the eradication effort.

2.3 Priority III: Established Invader Management

Scenario: The 400-ha (1,000-ac) wildlife refuge has succumbed to widespread infestation by purple loosestrife. There is an isolated, small 6-ha (15-ac) infestation and a larger 40-ha (100-ac) infestation that have been targeted for management by refuge personnel.

Management Plans: Refuge personnel, with input from concerned citizens, have developed integrated management plans to deal with both infestations. The damage and action thresholds for the small infestation (perimeter and core areas) are initially set at 5 and 3 plants/m^2 (10.8 ft^2), respectively; damage and action thresholds for the large infestation (perimeter and core areas) are 10 and 8 plants/m^2, respectively. Prevention and Correction treatment strategies are selected for the small infestation, whereas Prevention and Maintenance strategies are chosen for the larger infestation. Based upon a knowledge of the noxious weed's present densities, rate of spread, and damage potential, the No Action strategy was eliminated from consideration.

SMALL INFESTATION

The same Preventive methods described in Section 4.3.1.1 are used. During the implementation of the Correction strategy, management objectives are control, containment, and reduction of purple loosestrife populations within the area of infestation. These management objectives are prioritized based on plant location within the infestation. The first priority is management of outlier populations because these contribute to continued spread. Perimeter population management is second priority. The final priority is management of central or core populations.

Outlier populations:

During Phase 1 of the Correction strategy directed against outlier populations, specified objectives are control and containment. Physical and/or chemical treatments are recommended to prevent seed production and/or plant survival. Flaming seedlings during the early spring is determined to be somewhat effective. Hand pulling or digging seedlings or older plants is also conducted from early spring through late summer. To minimize non-target plant injury, individual plants are targeted for backpack sprayer applications of glyphosate or 2,4-D, or wicking applications of glyphosate before flowering. Monitoring is conducted to evaluate treatment method efficacy and to detect any untreated plants.

During Phase 2, emphasis is placed on control/containment and reduction of Phase 1 plant escapees is emphasized. Phase 1 treatment method combinations are continued. When no more plants are found within the outlier treatment zone, Phase 3 or monitoring is initiated and continued. If new outlier plants are discovered, the process would revert to Phase 1.

Perimeter populations:

Perimeter population management is as important as outlier plant elimination. The long-term goal of perimeter management is to diminish the size of the infestation front. The Correction strategy objectives of containment and reduction are appropriate.

During Phase 1, mechanical/physical, chemical, and biological treatment methods are used to contain populations of purple loosestrife within this zone. Flaming small patches or the controlled burning of larger populations of living plants, especially seedlings, proves effective. These activities are conducted during the early spring. Burning removed accumulations of dead stems and permitted better herbicide coverage. The burns also stimulated seed germination, but the resultant flush of seedlings was easily controlled with

herbicides. Cutting/mowing large patches several times between June and August prevented seed production and contained the perimeter of the population. In some locations, vegetation was mowed along with or in lieu of burning to remove old vegetative parts before treating with herbicides.

Glyphosate and/or 2,4-D was used to kill perimeter plants. Depending upon the size of the area treated, wicking, backpack sprayers, boat- or vehicle-mounted sprayers, or helicopters were used to apply the chemicals to pre-flowering purple loosestrife plants. Leaf-, flower-, seed-, and root-feeding insect bioagents were also released to adversely affect perimeter populations, especially plants missed by mechanical/physical and chemical methods, although their greatest value would be against infestation core plants. Monitoring is conducted to assess treatment method efficacies.

Containment and further reduction of perimeter populations using the same Phase 1 treatment methods is continued during Phase 2. Refuge managers readjust the initially established damage and action thresholds as populations decline during Phase 2. Depending upon the age structure and density of perimeter zone plants, several years of management might be required before Phase 3 is realized. However, monitoring is continued within the treatment zone. Upon detection of new plants, the management process would revert to Phase 1.

Core population:

Small infestation management emphasis must first be directed toward elimination of outlier and perimeter populations and then, time and budget permitting, the core. The Correction strategy is used, the primary objective being containment. Once outlier and perimeter infestations have been successfully managed and containment of the core population has been effected by using various combinations of mechanical/physical, chemical, and biological treatment methods, further reduction efforts are pursued by following the phase approach outlined for satellite and perimeter plant management. It is necessary to periodically revise pre-treatment damage and action thresholds as plant density within the core is negatively affected by the management program.

Purple loosestrife seed production or plant survival are affected by covering small, monospecific stands within the core area with black plastic. Burning during the spring results in substantial seedling mortality and is used to enhance subsequent herbicide or covering treatment efficacy. Repeatedly cutting/mowing established plants prevents or reduces seed production and dissemination. Additionally, mowing is used to diminish plant biomass before covering the vegetation with plastic.

Glyphosate and 2,4-D treatments are made against pre-flowering plants using the application methods mentioned for perimeter population suppression.

Planting competitive, site-appropriate species within the core area would protect identified at-risk sites from future noxious weed infestation. Areas previously treated with the non-selective herbicide glyphosate or covered by plastic should also be revegetated with competitive species to prevent purple loosestrife reoccupation. Approved insect biological control agents are released and established, aiding significantly in plant density reduction.

Forced grazing by livestock on pre-flowering purple loosestrife is somewhat valuable in limiting seed production in areas able to accommodate fenced grazing animals.

Ongoing monitoring of the core population would determine if the methods used are effective in population containment.

LARGE INFESTATION

Prevention and Maintenance strategies are used against the large infestation of purple loosestrife. Specific preventive methods are described in Section 4.3.2.1. Management objectives of the Maintenance strategy are population containment and/orreduction. The treatment methods used should maintain purple loosestrife density below the established damage threshold. Management activities are prioritized based on plant location within the infestation. The first priority is management of outlier populations to restrict continued spread, followed by plant suppression within the perimeter and core infestation zones, respectively.

Outlier Populations:

During Phase 1 of the Maintenance strategy directed against outlier populations, the immediate objective is to halt further forward expansion of the demarcated infestation. Physical (hand pulling/digging and flaming) and/or herbicide treatments are used. Where the infestation front is extensive and hand removal and/or flaming are selected as treatment methods of choice, it is necessary to recruit volunteers to accomplish the objective. Spot treatments of glyphosate or 2,4-D applied by backpack- or vehicle-mounted sprayers or glyphosate wicking of plants is used. Monitoring is conducted to evaluate the effectiveness of the containment method.

During Phase 2 and 3 (second year and beyond), monitoring efforts are continued within the outlier zone. If additional plants are found, the process would revert to Phase 1.

Perimeter Populations:

Whenever possible, management efforts are directed against plant populations comprising the perimeter of the infestation. Repeated use of containment and/orreduction methods in this zone gradually pushes the infestation front towards the core population.

Phase 1 management includes mechanical/physical (burning/flaming, cutting/mowing), chemical (herbicides), and biological (insects) methods. Regular surveillance of the perimeter zone is necessary to determine if the containment objective is being or has been achieved during Phases 1, 2, and 3. Purple loosestrife population density must be maintained below the established damage threshold. If treatments are successful in lessening plant growth, it might be necessary to redefine the damage and action thresholds.

Core Population:

The short-term objective for the core population is to reduce as much as possible during each management program year through integration of appropriate mechanical/physical,

chemical, and biological treatments and methods. Bioagents, competitive plants, mowing, and herbicides might be particularly effective reduction methods. Post-treatment monitoring enables refuge personnel to gauge the usefulness of such methods.

Several years are required before Phase 1 of the Maintenance strategy is completed (that time when the damage threshold is no longer exceeded). As monitoring during Phases 1, 2, and 3 indicates a reduced infestation density, existing damage and action thresholds are revised. Refuge managers believe continued compression of the core population would eventually result in its reclassification as a small infestation. When this happens, the Maintenance strategy is replaced by a Correction strategy and all attendant objectives and treatment methods become applicable.

APPENDIX 3:

DRAFT SPARTINA WORK PLAN

Revision - 4

ELEMENTS OF A CONTROL PROGRAM FOR SPARTINA

Prepared by William E. Brookreson, WSDA

Introduction: What follows are thoughts on the basic elements of a management program for dealing with spartina. This is intended to be a starting point rather than a final work plan. It does not include measurable deliverables, specific control timetables or site specific plans. It does not answer all questions. It attempts to layout priorities. I believe that specifics must be developed by technical staff and local citizens who are concerned most with the control of spartina.

The Noxious Emergent Plant PEIS will provide information on the range of environmentally acceptable alternatives. This document is intended to begin to put a structure in place to implement the best of these, get work started in 1993, and ensure that what is done is not wasted. Whatever the results of the PEIS, we need to have alternative approaches ready to implement that are consistent with it.

Assumptions: In putting together any control plan for the Spartina species in Washington, we need to reach an agreement on the assumptions upon which the plan is based. The following assumptions form the basis of the program elements.

1. Spartina alterniflora, Spartina anglica, and Spartina patens are all invasive, aggressive, exotic species that threaten Washington estuarine environments, economically and biologically. Control of these species is necessary and desirable. Any potential benefits of spartina do not equal the costs of allowing its continued spread. This does not mean that, at least in the short term, there may not be a role for harvesting of spartina in a control program.

2. Any program, to be effective will require a long term commitment. There is no "silver bullet." Control of spartina in areas of established infestations, such as Willapa Bay, will be a ten-year or longer program. It is possible, perhaps even probable, that eradication may never be achievable where infestations are widely established. A maintenance program there may be permanent.

3. The entire control program is driven by a commitment to preserving the environment from the impact of spartina. The control program implemented must be environmentally sound, conform to the guidelines in the Noxious Emergent Plant PEIS and be implemented in such a way as to minimize the adverse environmental impacts.

4. No control program will be effective without heavy local involvement and commitment. It is desirable to establish management control of noxious weed eradication or control programs at the local level.

5. No control program will be effective without commitment from the federal and state land managing agencies to fully participate.

6. Funding will always be less than is needed so that it is critical that every dollar be used as effectively as possible.

7. We do not know all that we would like to know about what will be an effective control program. We will not have all the answers when the PEIS is completed. We need to have firm goals and flexible strategies. Research and monitoring will need to be continue.

Elements:

I. Coordination. For a plan to be successful, it will be necessary that there be a high degree of coordination of activity. This can be established in a number of ways.

1. Where there are significant infestations (Willapa, Port Susan, and Padilla Bay), some type of management group needs to be established at the local level. It should include local land owners, state land managers, federal land managers, local government and the local noxious weed control board(s). The group would establish priorities and flesh out the plan for the local control areas. It would be most effective were it established pursuant to statute with some type of assessment authority. I would expect such a group to have a coordinator, an administrator responsible to it to coordinate local activities, volunteer efforts, etc.

2. Where there are only small outlier populations, control coordination may be vested in the county noxious weed control boards (where they are activated) and the Department of Agriculture where they are not activated. That would require the funding for at least a part time position for WSDA but would keep the process simplified until county noxious weed boards are activated. Current staffing is inadequate to effectively complete the task.

3. Affected state agencies need to commit not just to participate but also to cooperate. That will be particularly critical for those that exercise regulatory responsibilities. The permitting process can become an

insurmountable hurdle of paper or be a reasonable oversight process. We must have an up front pledge by the involved agencies to make the permitting process as streamlined and as reasonable as agency mandates allow. This also implies a commitment by those seeking permits to be equally cooperative in supplying information and requesting permits in a timely manner.

4. The local county noxious weed control boards will be key players, where they are activated, because they have the regulatory authority to require control in an area where spartina is designated for control by the State Noxious Weed Control Board or where the local board designates it for control. That designation can be for very specific areas and does not have to be county wide. It will be very helpful, as containment is achieved, to assure that it will be maintained using the regulatory authority where needed.

Coordination of the activities between county noxious weed control boards for statewide activity or activity that crosses jurisdictional lines is achieved through the Washington State Noxious Weed Control Board. The State Board also adopts the noxious weed list that gives the counties the basis for their regulatory activity.

II. Control. The long term goal for all Spartina species should be eradication, recognizing that this may not prove to be achievable. Unlike with purple loosestrife, we do not have evidence that suggests that an equilibrium point can be established where the impacts of spartina can be made acceptable through the use of biological control or natural processes. There is some indication that a planthopper, *Prokelisia marginata*, may have some promise but we do not know about host specificity, survival in Washington, or the degree of impact it may have here under field conditions. Such answers are a number of years away. Additionally, without a complex of bio-control agents, we are unlikely to ever have much real success. Spartina appears likely to continue to expand as long as there is an unfilled niche in the mudflats.

In areas of light or satellite infestations, that goal of eradication should be able to be achieved in 2 to 5 years. In areas of established infestations, such as Willapa Bay, we are looking at ten or more years, if the goal can be achieved at all.

The focus of a management plan needs to be both long term and short term. The long term goal is eradication or, if that is not possible, effective suppression and containment. Short term goals, one to five years, need to be measurable, help define "success" and help define the allocation of resources. Because

the conditions are very different between infested areas, I would define two different sets of short term goals.

1. **Control in newly or lightly infested areas.** For those areas, such as Sequim Bay, Dosewallips River, etc.:

a. **The primary goal should be rapid and aggressive eradication of the infestation.** The larger an infestation becomes, the more costly in becomes in terms of money, time and environmental impact to deal with it. There are numerous examples of the cost of procrastination. There are numerous strategies that can be used on a room sized infestation, that cease to be desirable or possible when it becomes hundreds of acres. The costs will never be as low as they are right now. The only requirement is that the selected strategy be eradicative, not suppressive.

If we are serious about spartina control, for those areas, provide the mandate, the resources and **eradicate** the existing infestations.

Even this aggressive program will stretch over some time. Eradication requires monitoring for success and systematic follow up to be certain that an area is not reinfested. In some areas, where the need is not to restore a natural mudflat, it will also require revegetation with desirable native species as a part of an overall IPM program.

2. **Control in areas with widely established infestations.** Control in areas with widely established populations will be much more complex and longer term. I see the goals, in priority order, being as follows with c and d being both short and long term.

a. **Prevention, stop the spread of the infestation into new areas.** The first step in getting control of the situation in knowing which areas have spartina and which do not and setting up an aggressive monitoring program for the uninfested areas that are at risk to immediately eliminate spartina plants that may show up. Prevention is the least expensive strategy. This will need to be expanded as areas are cleaned up to keep them free from spartina. Monitoring will be a significant, long term cost!

b. **Containment, clean up the lightly infested areas.** As we get a more accurate inventory, we need to define newly and lightly infested areas and those areas most at risk and concentrate our resources on eliminating all pioneer plants in these areas. These are areas where we do not yet have serious siltation problems and habitat degradation. We may

not be able to have all the structure in place by 1993. But the primary and immediate goal should be **no increase in infested acres by 1994!**

c. **Eradicate established satellite infestations.** The second priority in control should be the smaller satellite populations. These should be eradicated as quickly as possible. Again, the goal should be to eradicate small outlier populations before they become a serious seed source, spread rhizominously, or trap excessive sediments.

d. **Containing, suppressing and decreasing large established populations.** The control of the large, established populations will be the most difficult because of the cost, the potential release of trapped sediments and the more destructive means that will have to be employed to have a significant impact. Whatever means is selected, only limited areas will be able to be addressed in any one year and would normally concentrate on the perimeters and work towards the core of the infestation. Successes, failures and costs, both monetary and environmental, in this phase will determine the viability of eradication as a long term goal.

In selecting the strategies to accomplish the goals, no one strategy is likely to be effective in all instances. We are likely to need a combination of control techniques, mechanical and chemical, selected to fit specific sites and conditions. The Noxious Emergent Plant EIS will help to define the range of available strategies.

We must also provide strategies that are cost effective. Mowing with a weed eater, for example, may be a viable strategy for very small infestations but is too labor intensive to use on large infestations. The PEIS will set the limits and help to determine what role chemical control should play. If the PEIS does provide for chemical applications, we cannot stop there. We need to constantly look for more specific application strategies and more selective (C4 pathway inhibition for example) chemicals for that role. Progress here is likely to be slow at best due to the complexity of the registration process for new herbicides. However slow, we should not loose touch with the need to work constantly to diminish any potentially negative environmental impacts!

III. Inventory. An accurate and periodically updated inventory of the Spartina species is critical in any management plan. The maintenance, funding and updating responsibilities for the database need to be established. Currently, such inventory is being maintained by the Department of Natural Resources. We need agreement that they will continue to do that or that, if it is

shifted, who will take it, how it will be funded, and how information will be collected.

Aerial inventory appears to have significant application for Spartina alterniflora to get the basic information on infested areas. On-the-ground work appears, at the present, most feasible for S. anglica and S. patens. As the control program develops, we will need to have the on-the-ground information on lightly infested areas and uninfested areas so that new invaders are eradicated. This would appear to require extensive ground monitoring best conducted by the local control groups with the information fed into the larger system.

Inventory is by nature very dynamic and will never be perfect or complete. It is always changing as new plants are found and old plants eradicated. The information we now have is imperfect but sufficient to get started.

IV. Public education. A strong element of public education to build and maintain public support for any control program is essential. resources available are never likely to be fully adequate to meet the needs. It is critical that a number of public and private agencies coordinate their resources if program goals are to be achieved. There are many groups, such as the conservation groups, that can be key supporters if they understand the threat that spartina poses and the strategies for dealing with it.

Individual landowners can, if provided the information on identification and control, take care of problems on their own property before they become significant. To achieve these ends, we need good, generally available, identification information, control information and general information on impacts showing why control work is important.

Finally, education will be critical to maintain the program over time. A program that may take ten years or more to succeed will require public understanding and financial support.

The logical place to house these activities is with the Washington State Noxious Weed Control Board which has statutory responsibility for education and coordination. It is not constrained by county or property lines and has no conflicting land management priorities. To accomplish this will require additional resources from public or private sources for the Board which currently has only one staff person, the Executive Secretary. The Board has already been active in this area by developing a bulletin for Spartina patens (PNW 416) through a contract with WSU and helping edit the brochure "Spartina, Threat to Washington's Saltwater Habitat."

V. Funding. For any program of control to be successful, long term, stable funding will be critical. The nature of noxious weed control is such that it requires long term commitment. Certainly, we hope that legislative funding through the general fund is a part of the process but it is highly unlikely to be entirely sufficient, especially in areas with established infestations. The funding provided in the 1991-93 biennium through the Department of Natural Resources did not address the problem on private lands. On public lands, control costs need to be built into land manager's budgets.

For private lands, there appear to be at least four alternatives:

1. Monies from the county general funds could be allocated to subsidize work at the local level. Specific authority to make "emergency appropriations" is provided in RCW 17.10.240 (2). Given the budget situation at the county level, this does not appear to be a likely scenario.

2. The County Noxious Weed Control Board could elect to require control of spartina on any or all of the area under its jurisdiction (i.e. all county lands with the exception of federal lands) and require the land owner, both state agencies and private landowners, to control all seed production under the authority of RCW 17.10.140. This is at landowner expense although there is money required for the local board to carry out enforcement until costs can be recovered.

3. Control activities can be built into the county noxious weed control budget and funded by an assessment on land (RCW 17.10.240). RCW 17.10.240 (1) appears to give fairly broad authority to the county legislative authority together with the county noxious weed control board in classifying land for assessment purpose based on "special benefits". This may be possible to do fairly expeditiously with county cooperation. The disadvantage is that it does not cross county lines.

4. Some type of special service district with assessing or taxing authority could be created specifically to deal with spartina control. This would appear to require legislative action and would be difficult to implement for 1993.

Whatever mechanism is selected, if long term funding is not provided, all the money spent will ultimately be wasted if control activity stops before eradication is achieved and the area is reinfested or, if eradication proves not to be possible, a long term maintenance program at an achievable level of suppression is not implemented.

If an area is to be cleared of an infestation, all of the property owners must participate or there will be an instant source of reinfestation. There is considerable rationale for sharing the costs over a broader base than is required by RCW 17.10.140 because control protects the uninfested property owners as well as benefiting those whose property is being treated. That is a policy decision that must be made at the state and county legislative level.

VI. Research. Research into effective control strategies will need to continue. The PEIS will give an idea of what needs to be done at the present but experience in control activity will identify new research needs. Research and monitoring will continue to require commitment of resources and should be a part of the budget allocation. We are unlikely to ever have a "final answer" but we must continue to look for more effective, less impactive ways to deal with the infestation problem.

There are several questions that will have to be answered -- what to prioritize, how to fund it, what level of information do we need, etc. The most critical may be who will oversee and coordinate the research activity -- an agency, a university, or the control group. These decisions will need to be made as we get more players at the table.

APPENDIX 4:

EPA WATERSHED RESTORATION GRANT PROPOSAL

WASHINGTON STATE PROJECT PROPOSAL
FOR EPA WATERSHED RESTORATION GRANTS

CLEAN WATER ACT §319

APRIL 23, 1993

PROJECT LEVEL DESCRIPTION

Project #

Project Name: Noxious Weed Control Project

Project Description: Form three crews (two crews during the remainder of 1993) of 4-6 persons each for deployment into areas threatened or infested by the noxious weeds *Spartina* (cordgrass) or Purple Loosestrife in order to control, contain or eradicate these noxious plants in sensitive or high-value resource areas. These crews will be organized and administered by the Washington Conservation Corps and be comprised of under or unemployed persons from areas of high unemployment. The crews will work closely with the appropriate county noxious weed board staff and be active in the field from approximately April through September, depending on the growing season, control methods and site conditions.

One crew would be assigned to the west coast of the Olympic Peninsula with a major focus on containing *Spartina* within Willapa Bay and, where possible, eradicating this plant from newly established sites along the coast. A second crew would be deployed in the northern Puget Sound and focus on containing and, where possible, eradicating *Spartina* within this area. During periods when tidal cycles or other climatic conditions limit or preclude work, these two crews would also target containing and, where possible, eradicating Purple Loosestrife populations within western Washington. During the second year of the project, a third crew would be formed and deployed on the east side of the Cascades and target the containment or eradication of Purple Loosestrife populations in or adjacent to sensitive or high-value resource areas.

Working with trained professional staff from the local weed board, the state weed board or one of several state agencies, the crews will utilize various control methods, including handpulling, deploying covering material, and mowing with "weed whackers." Certain crew members could eventually apply for and receive licenses as aquatic pesticide applicators in order to use chemical control methods if and where appropriate. All control methods would be employed consistent with the rules and regulations of the state and appropriate counties, including the 1992 Aquatic Plant Management Supplemental Environmental Impact Statement and the pending Noxious Emergent Plant Management Environmental Impact Statement.

Project Purpose: The primary purpose of this project is to protect sensitive and high-value resource areas from infestation by these noxious plant species, either by containing existing populations in order to prevent the spread of these plants into adjacent resource areas, or by eradicating where possible new infestations.

The secondary purpose of the project is to provide jobs for under or unemployed persons, including training in plant identification and noxious plant control methods.

Project Elements Relating to Public Education and Public Involvement: As part of their work activities, the crews will be making contact with private land owners that have these noxious plants growing on their

property. Brochures and other educational information will be given to the crews for distribution to land owners prior to initiating control activities on private property and to members of the general public they may encounter during control activities.

Plans for Monitoring Project Results: The short-term results will be immediately obvious in that these noxious plants will be removed from or prevented from becoming established in specific sensitive or high-value resource areas. The longer term effectiveness of this project will be monitored by the state Noxious Weed Board, in conjunction with the local weed boards and state natural resource agencies, as part of the ongoing inventory of these noxious plants. The project will be considered a success if the inventory of these noxious plants indicate that they were prevented from infesting targetted sensitive or high value resource areas for the duration of the project, or that these plants were successfully eradicated from newly infested areas.

Waterbody Type: Coastal and Puget Sound estuarine areas for *Spartina*, freshwater wetland areas for Purple Loosestrife.

Priority §319 Watersheds: *Spartina* infestations currently exist or threaten several deltas within or adjacent to priority watersheds. These include the Chehalis River, Stillaguamish River and Quilcene Bay. Purple Loosestrife infestations have impacted or threaten wetlands within numerous priority watersheds, including within at least 31 of the state's 39 counties. Most priority watersheds within the Columbia Basin have documented infestations, as well as the Issaquah/Lake Sammamish and Stillaguamish Basins on the west side of the cascades.

Job Types: This project will create 10 to 12 jobs the first year, and a total of 15 to 18 jobs the second year. The jobs will be seasonal (April to September) for this project, however it has been proposed that these positions be administered by WCC. This increases the potential for year-round employment, plus allows for the development of other skills through involvement with other projects during the winter months. Initially most of these jobs would be at or near minimum wage, with a lead worker and perhaps those obtaining aquatic pesticide licensing in the second year receiving higher wages.

These workers will learn plant identification skills, control methods for managing aquatic plants, and some will hopefully obtain aquatic pesticide licenses. These skills should improve their employment perspectives with local weed boards, state and local government agencies involved with managing aquatic plants, and aquatic plant management and aquatic resource consultants.

FTE's: The actual configuration of the crews will be determined by the particular control method(s) being employed and the characteristics of a particular site. Basic crews for the west side of the state will consist of four laborers and a lead person. Two additional crew members will be "floaters" and either split between the two crews, or assigned to one crew when necessary based on the complexity and scope of a particular control action. In the second calendar year, a third crew of five laborers and one lead will be added and assigned to the east side of the state for purple loosestrife control. Each crew will also have a WCC supervisor.

NOTE: The following figures are based on responses from local noxious weed boards to a survey of needs conducted by the state noxious weed board.

FY 94

July to September (3 months):

Laborers:	10 FTE's/5000 hrs
Leads:	2 FTE's/1000 hrs
Supervisors:	2 FTE's/1000 hrs

April to June (3 months):

Laborers:	15 FTE's/7500 hrs
Leads:	3 FTE's/1500 hrs
Supervisors:	3 FTE's/1500 hrs

FY 95

July to September (3 months):

Laborers:	15 FTE's/7500 hrs
Leads:	3 FTE's/1500 hrs
Supervisors:	3 FTE's/1500 hrs

Total: 9 months, 28,000 hrs.

Resource Protection: This project will protect, restore and enhance habitat. Noxious emergent plants change the structure of the habitat they are infesting, often resulting in secondary water quality impacts associated with sedimentation, channelization and increased erosion, stagnation and resulting increases in temperature and decreases in dissolved oxygen. Therefore, this project will indirectly protect, restore and enhance water quality at some or most of the project sites.

Type of Habitat: This project will protect freshwater and estuarine wetlands, streambanks, shorelines, seagrass beds and other aquatic related habitats (shellfish beds, bird migration and nesting areas, irrigation canals and ditches, salmon and herring spawning areas).

Project Coordination with Federal, State, local or private activities: This project will coordinate with all levels of government, including private landowners and industry (shellfish). *Spartina* and purple loosestrife occur on federal lands managed by the Fish and Wildlife Service, Bureau of Reclamation, and Forest Service, and on state lands managed by the departments of Natural Resources and Wildlife. County noxious weed boards have the responsibility of overseeing control of these noxious plants within their jurisdictions, therefore the crews will work closely with staff from the local boards. In addition, much of the infested area is under private ownership or on land leased to private citizens for agri or aquaculture activities, requiring coordination with the property owner or occupant.

CONTACTS

Project contact:	Steve Saunders
Duties:	Water Quality Standards Unit Supervisor
Agency/Entity:	Department of Ecology
Address:	P.O. Box 47600, Olympia, WA 98504-8711
Phone:	(206) 438-7086
Local contact:	Catherine Hovanic
Duties:	Executive Secretary
Agency/Entity:	State Noxious Weed Board
Address:	1851 So. Central Place, Kent, WA 98031-7507
Phone:	(206) 872-6480

BUDGET

FY 94

Wages and Benefits:	
Laborers (12,500 hrs x $5.49/hr)	$68,625
Leads (2500 hrs x $7.03/hr)	$17,575
WCC supervisers (2500 hrs x $21.76/hr)	$54,400
Administrative Costs (10% of W & B)	$14,060
Travel: (transportation, lodging, etc.)	$35,000
Goods and Services: (tools, uniforms, etc.)	$18,000
Subtotal	$207,660

FY 95

Wages and Benefits:	
Laborers (7,500 hrs x $5.49/hr)	$41,175
Leads (1500 hrs x $7.03/hr)	$10,545
WCC supervisers (1500 hrs x $21.76/hr)	$32,640
Administrative Costs (10% of W & B)	$8,436
Travel: (transportation, lodging, etc.)	$20,000
Goods and Services: (tools, uniforms, etc.)	$10,000
Subtotal	$122,796
PROJECT TOTAL	$330,456

TASK LEVEL DESCRIPTION

Task #1

Descripton: Working with the local noxious weed boards, the two west side crews will implement various methods for controlling *Spartina*, including pulling or mowing clones and small established colonies, burying with plastic or fabric, or applying aquatic herbicides via wicking or backpack sprayers (assumes licensed applicator present) as appropriate.

Outputs: *Spartina* population eradicated from newly infested areas, and contained from spreading into sensitive, high-value resource areas adjacent to existing infestations through approximately 15,000 hours of control activity by the west side crews. Targetted areas to include Willapa Bay, Grays Harbor, Port Susan, Dosewallips State Park, Padilla Bay, Skagit Bay, Sequim Bay, Kala Point and Thorndyke Bay. Crews will produce maps identifying areas of project activity. Project success will be reflected in the containment or reduction of infestations as reflected on updated inventories currently being compiled and maintained by the local and state noxious weed boards and Department of Natural Resources.

Completion Date: September30, 1994

Cost: $150,000

Task #2

Description: Working with the local noxious weed boards, the two west side crews will also implement various methods for controlling purple loosestrife, including pulling, digging, covering with plastic or fiber, removal of flower tops (seeds), mowing, burning, or applying aquatic herbicides via wicking, backpack sprayers or injectors (assumes licensed applicator present) as appropriate.

Outputs: Purple loosestrife populations eradicated from newly infested areas, and contained from spreading into sensitive, high-value resource areas adjacent to existing infestations through approximately 6,000 hours of control activity by the west side crews. Targetted areas to include Lewis County, Whatcom County, Clark County, Thurston County, and Cowlitz County. Crews will produce maps identifying project activities. Project success will be reflected in the containment or reduction of infestations as reflected on updated inventories currently being compiled and maintained by the local and state noxious weed boards and Department of Wildlife.

Completion Date: September 30, 1994

Cost: $80,000

Task #3

Description: Working with the local noxious weed boards, the east side crew will implement various methods for controlling purple loosestrife, including pulling, digging, covering with plastic or fiber, removal of flower tops (seeds), mowing, burning, or applying aquatic herbicides via wicking, backpack sprayers or injectors (assumes licensed applicator present) as appropriate.

Outputs: Purple loosestrife populations eradicated from newly infested areas, and contained from spreading into sensitive, high-value resource areas adjacent to existing infestations through approximately 7,000 hours of control activity by the east side crew. Targetted areas to include Yakima County, Okanogan County, Garfield County, Adams County, Pend Oreille County and Grant County. Crews will produce maps identifying project activities. Project success will be reflected in the containment or reduction of infestations as reflected on updated inventories currently being compiled and maintained by the local and state noxious weed boards and Department of Wildlife.

Completion Date: September 30, 1994

Cost: $100,000

APPENDIX 5:

RESPONSIVENESS SUMMARY

Introduction

This Responsiveness Summary summarizes comments submitted by 39 separate commenters, which are listed in the "List of Commenters" following this Introduction. Paraphrased comments are followed by responses authored collectively by the EIS consultant and co-lead agencies. Comments addressing issues within similar subject areas are grouped into the following broad categories.

A. Existing Conditions

B. No Action Alternative

C. Physical Control Only Alternative

D. Mechanical Control Only Alternative

E. Biological Control Only Alternative

F. Chemical Control Only Alternative

G. Integrated Weed Management Alternative

H. Implementation of Management Alternatives

I. Regulatory Authority

J. Miscellaneous or Addressing More Than One Alternative

K. Attachments

Authors of specific comments can be identified using the comment numbers enclosed in parenthesis following each comment. These numbers can also be used to locate specific comments in the copies of comment letters that are contained in Appendix L. You will note that the comment letters consist of two sets of numbers divided by a period (1.1). The first number in the series denotes the letter from which the comment was excerpted ("letter number"), and the second, a specific comment within a comment letter.

To identify the author, simply match the "letter number" with the corresponding author on the "List of Commenters". To locate a specific comment to the appropriate comment letter (in Appendix L), just match the comment numbers with the corresponding numbers located on these letters.

Commenters

Where provided, affiliation is noted in parenthesis.

1. Mr. Bill Barron
(Save Long Lake Association, Kitsap Co.)

2. Mr. Adrian Brown

3. Ms. Care deLeeuw

4. Dorothy Leonard
(The Willapa Alliance)

5. Kathleen Sayce

6. Jack Davis

7. Joe Cole

8. Larry Warnberg
(Oyster Farmer)

9.a. Kim Patten, Ph.D.
(Associate Horticulturist, Washington State University, Long Beach Research and Extension Unit)

9.b. Kim Patten, Ph.D.

10. Boyce Thorne-Miller
(Director of Science, Ocean Advocates)

11. Elliot Marks
(Vice President and Washington Director, The Nature Conservancy)

12. J. McCarthy

13. Robert J. Leonard
Coordinator, Noxious Weed Control Board of Grant County

14. John A. Harrington, Ph.D, Professor of Geography; and
Lisa M.B. Harrington, Ph.D, Assistant Professor Geology/Geography

(Department of Geography/Geology, Indiana State University)

15. Linda Meister

16. Trisha A Keenan

17. E. Zahn

18. Richard L. Wilson, Ph.D.
President, Bay Center Mariculture

19. Janie Pulsifer

20. Pat BoYes
(Cooperative Extension, Washington State University, Pacific County)

21. Tim Wilson
(Pacific County Noxious Weed Control Board)

22. Edward and Fritzi Cohen

23. Ron Crockett
(Monsanto)

24. Michael J. McKee
(Monsanto)

25. Brian Matura
(Monsanto)

26. Larry Hammond
(Industry Task Force II on 2,4-D Research Data)

27. Vanelle Carrithers
(DowElanco)

28. Richard Parkin
(Chief, Pesticide Division, EPA)

29. Jennifer Hagen; Craig Jacobson
(Shoalwater Bay Tribe)

30. Pat Hamilton; Robert Wilson, Jon Kaino, Jr.
(Pacific County Commissioners)

31. Mark Gunst

32. Marjorie C. Williams

33. Jane Martin

34. Michael Davis

35. David Ortman
(Friends of the Earth)

36. Petition, Multiple Signatures

37. Andrew R. Wiegardt

38. Robert Michael Pyle, Ph.D.
(former Northwest Land Steward, The Nature Conservancy)

39. William E. Martin
(Regional Director, U.S.F.W.S.)

A. Existing Conditions

C. A1 No photos or illustration of various noxious weeds are provided. (35.13)

R. A1 **Though the EIS does not contain these visual aids, brochures and other descriptive information is available from a variety of sources including local noxious weed boards, extension agents, and the WSNWCB (please see Attachment 2 to this Responsiveness Summary for a list of contacts).**

C. A2 What distinguishes the following from each other:

Lythrum salicaria, *Lythrum virgatum*, *Lysimachia vulgaris*, and loosestrife? (1.1.)

R. A2 **L. virgatum (wand loosestrife) and L. salicaria (purple loosestrife) are both purple and are very difficult to distinguish visually. L. virgatum is glabrous throughout with leaves narrower and acute at the base while L. salicaria is generally pubescent with leaves remaining broader at the base. Because both of these species are considered noxious and inhabit the same habitat, distinction between the two is not critical in the field.**

Lysimachia vulgaris (garden loosestrife) is easily distinguished from the Lythrum species because it is yellow flowered.

C. A3 It should be stated clearly that not all alien species cause problems, and those that are too aggressive are generally recognized early on as was *Spartina*. (5.13.a.)

R. A3 **Comment noted. The introduction clearly describes the noxious weed definition for Washington and explains that the EIS only addresses noxious emergent weeds.**

Regrettably, many aggressive species are not recognized "early" as a threat. The sad truth is that most weed infestations spread to considerable proportions before their impact on the native flora or agricultural crops is recognized. The impact on saltmarshes in Washington from *Spartina* was not recognized until the infestation was 50+ years old. It is a true statement that not all alien species are a threat to resources in Washington. Risk analysis based on weed biology and other factors is the best indicator of impact to our resources.

C. A4 *Phragmites communis*, a native freshwater species that invades saltmarshes should be mentioned as a potential problem species. (5.24)

R. A4 **As stated, *Phragmites communis* is a native species to Washington and therefore by definition cannot be classified as a noxious weed. Phragmites can be an aggressive and invasive species in some sites. While too coarse to provide forage it does provide cover and roosting sites for birds. Though it may not be the desirable dominant species for some areas, it cannot be considered under the scope of this EIS because of its native status.**

C. A5 Based on *Spartina* clone sightings in 1911, it is likely that *Spartina* first arrived in Willapa with initial shipments of Eastern oysters (shipping occurred from 1894 to the 1910's), however *Spartina* could have been introduced any time during this period. Later or additional introductions are possible and could be distinguished by genetic testing. (5.19)

R. A5 **See Section 2.2, paragraph 2.**

C. A6 What is the factual source of Janie Civille's estimate of a 36% increase of *Spartina* from 1989 to 1992? (35.19)

R. A6 **Aerial photographs from 1989 and 1992 were examined for *Spartina* clones. Recognizable clones were outlined and then digitized into DNR's Geographic Imaging System (GIS). The GIS is capable of calculating the amount of area within each digitized clone (polygon), then the polygon areas from both years were compared. The 36 percent value is a low estimate for two reasons. First, the resolution of the photographs does not detect clones less than 6 feet in diameter. Fisheries has conducted groundtruthing examinations this summer, and has found far more acres of small seedlings than is indicated by inventory. And second, the GIS calculated acres of *Spartina* plants alone, not the number of mudflat acres affected by *Spartina*.**

C. A7

a *Spartina* grows over a wide range of tidal heights (from above Mean Higher High Water to near Mean Lower Low Water), which brings it in direct competition with both intertidal and salt-marsh species. (5.20)

b *Spartina* is displacing native salt marsh and eelgrass. (39.38)

R. A7 **Direct field observation by expert plant ecologists at DNR (Linda Kunze, Janice Friebaum) and other agencies (F&WS) demonstrates that *Spartina* can occur beyond the limits of its primary range.**

Displacement of salt marsh vegetation and eelgrass beds is discussed in the impacts section of the EIS. See Section 4.1.1, paragraph 14 for existing discussion. See Section 2.2, paragraph 1 for text changes.

***Spartina* can be expected to exhibit its strongest competitive advantage within its reported preferred tidal range. Extensions beyond the extremes of this preferred range probably occur. *Spartina* is less likely to exhibit its overall strongest competitive advantage at zonal extremes and concern should be prioritized within that context. See comment A8**

C. A8 *Spartina* will probably grow below Mean Lower Low Water in Willapa Bay within the next few years. (5.21)

R. A8 **There are three species of *Spartina* of concern statewide. They have different zonal ranges and different abilities to compete with specific intertidal species. Each *Spartina* species is most competitive within its primary zonal range. Direct competition with and displacement of other intertidal species has been observed in some areas. In other areas these species appear to be holding their own. The need to protect intertidal species proximate to *Spartina* will, however, continue to complicate *Spartina* control.**

C. A9 *Spartina* dominates native and introduced intertidal species (eelgrasses, and green and brown macroalgae) as well as native saltmarsh species. (5.22)

R. A9 **DNR reports that this is clearly observable in the Leadbetter Point saltmarsh, and the Dosewallips State Park's saltmarsh areas. Rapid growth of *Spartina* through the native and japanese eelgrasses can be documented on aerial photographs.**

C. A10 The competition between *Spartina* and eelgrass is not very well described in the EIS. Given that *Spartina* is an emergent and eelgrass a submergent, there is obviously a zone of overlap where both species live, but at some lower shoreline level eelgrass will out-compete *Spartina*. This demarcation should become more pronounced as *Spartina* increases shoreline slope. Eelgrass survival and amount necessary for a healthy ecosystem for each control area should be considered in any management plan. (10.7)

R. A10 **This observation may be true in some areas for the native eelgrass, which grows at lower tidal elevation than the japanese eelgrass. The native species (Z. marina), also tends to grow in pools and puddles of**

water in the tide flats, and does not tolerate the full exposure and drying during the low tides as well as the japanese eelgrass.

WDF manages for the protection of both native (*Zostera marina*) and introduced (*Z. japonica*) eelgrass.

C. A11 Per Cathy Maxwell, purple loosestrife has been discovered along the Columbia River in Pacific and Wahkiakum counties (5.23)

R. A11 **See Section 2.3, paragraph 1.**

C. A12 It should be noted (section 2,3) that while lining of canals is anticipated, only a very small percentage of PL infested area will be affected (a few hundred acres to be lined compared to hundreds of thousands of infested acres). (13.1)

R. A12 **See Section 2.3, paragraph 3.**

C. A13 Is an acreage estimate of all known Purple Loosestrife infested lands available? (13.2)

R. A13 **The exact acreage is not known. A rough estimate of purple loosestrife in Washington is that at least 30,000 acres are infested according to Greg Haubrich, WSDA. Density and impacts vary greatly among sites. The Department of Wildlife has been compiling a database over that past year, but the sites need to be field verified. Future estimates should be more accurate.**

C. A14 It should be noted that birds and some mammals apparently spread loosestrife seed. (13.3)

R. A14 **See Section 4.2.3, paragraph 1.**

C. A15 Purple loosestrife (PL) regularly invades well established stands of native vegetation, and several non-native species that may out-compete PL are in and of themselves problematic. This would indicate difficulty in finding a desirable species to enable forced succession (section 4.4.2). (13.4)

R. A15 **We agree that forced succession without human intervention would be difficult and that desirable species that would out-compete loosestrife are not likely to be found. However by removing established loosestrife plants (either manually or chemically) a site is created that may enable desirable species succession. The presence of a seed bank**

and the longevity of loosestrife seed can further exacerbate the situation.

Any management plan designed to control loosestrife will benefit from human inputs to introduce and maintain the competitive balance in favor of the successional plants at the detriment of loosestrife.

C. A16 There is a clear need, through IVM, for establishing the most desirable and competitive species in areas exposed by treatment. (13.5)

R. A16 **Revegetation or rehabilitation of treated sites is very important in assuring that the niche recently vacated by the target species is not reinfested by that or other undesirable species. We support the seeding of desirable species in areas where all vegetation has been removed as a result of control activities. The species that is selected will depend on site specific characteristics. Several agencies, such as the Washington State Departments of Wildlife and Agriculture, may be able to help with this selection.**

C. A17 This discussion should explain that estuarine soils do not have much to do with volcanic material because they are alluvial, depositional, and highly worked; and Montane and eastern soils can have large volcanic components. (5.16)

R. A17 **Comment noted.**

C. A18 It is generally held that the Pleistocene ended 11,000 years bp rather than 14,000 years bp (page 10, last line). (5.18)

R. A18 **Comment noted.**

C. A19 What relationship does this very general discussion have on the *Spartina* problem? (18.14)

R. A19 **Addressed in this EIS are several noxious emergent species (not just Spartina) that occur throughout Washington State. This general overview is provided as background information, and to identify various physical features of Washington State that might influence management choices.**

C. A20 The Executive Summary and Existing Conditions sections should more clearly identify the severity of problems caused by noxious weeds (currently not clearly identified until the "No Action Alternative Section") (39.2)

R. A20 **Impacts of noxious weeds are adequately summarized in the Executive Summary and in the existing conditions section. Additional repetition is not needed.**

B. No Action Alternative

C. B1 No Action can be initially rejected. (18.1, 20.2)

R. B1 **Decisions regarding specific alternatives will be decided in the context of Integrated Management and/or specific permit decisions. It is conceivable that this alternative may be appropriate in some locations for some noxious emergent vegetation, where the specific classification level within the noxious weed laws does not require control.**

C. B2 The lack of a serious ecologic evaluation of No Action is a serious deficiency leaving an impression that it will not invoke future environmental costs. (5.26)

R. B2 **Impacts to the environment due to *Spartina* infestations are only briefly summarized in this section. The reader is referred to Section 4.1.1, which includes more detailed discussion.**

C. B3 State clearly that *Spartina* will negatively impact migratory waterfowl, shorebirds, juvenile fish including salmonids, juvenile and adult crab, and shellfish; and will positively impact some smaller crabs, snails, and shellfish.

The document is biased in that it lists all migratory birds under one category, but separately names resident species that utilize *Spartina*. The Willapa Refuge can supply a list of migratory birds that have been displaced from feeding and roosting habitats. (5.27)

R. B3 **Impacts to the environment due to *Spartina* infestations are only briefly summarized in this section. The reader is referred to Section 4.1.1, which includes more detailed discussion. See Section 3.1.2, paragraph 4 of EIS for additional response.**

What is known is that *Spartina* infestation causes habitat changes. The effect of these changes can, in some cases, be inferred. However, with aquatic species, especially, these effects have not been well documented or agreed upon as to their significance.

C. B4 Add trapping of sediment by *Spartina* and expansion of rodents in salt marshes as negative impact of No Action. (5.32)

R. B4. **See Table 12 of the EIS for response to comment on sediment trapping. We are unable to verify that expansion of rodents into salt marshes is a negative impact of No Action.**

C. B5 What would happen if *Spartina* did not trap silt in Willapa Bay? (22.6)

R. B5. **Sediments would be transported to greater depths in Willapa Bay. Other potential effects are currently not known. Any silt currently trapped by *Spartina* would instead be added to and dispersed as a part of the ambient silt load. It is further assumed that the sediment would either be carried out with the tidal cycles, or a gradual increase in sediment levels on mudflats would occur. Most likely, a combination of the two would occur. This is how alluvial plains and mudflats develop.**

In any case, the relatively rapid habitat changes associated with *Spartina*'s ability to trap silt are not generally believed to be desirable.

C. B6 Please cite Mary Landin rather than Kathleen Sayce regarding impacts related to mosquitos (page 75). (5.3)

R. B6. **See Section 4.1.1, paragraph 9.**

C. B7 Table 12, page 73 needs to be corrected to reflect the following:

a Positive side:

Loss of feeding areas would override any benefit to waterfowl from increased cover.

No proof that *Spartina* provides better habitat than eelgrass for any size fish.

Shoreline stabilization is not the actual impact of *Spartina* growth and spread (widespread erosion not occurring on northwest coastal estuaries thus erosion should not be assumed).

Deposition of sediment in *Spartina* does not prevent its deposition elsewhere (if so, dredging in Willapa Bay would be decreasing instead of increasing). Most estuaries do not have an excess nutrient problem. Trapping of nitrogen by *Spartina* decreases phytoplankton productivity in open water.

b Negative side:

In discussion of marsh and eelgrass communities, replace concept of "displace" with "decrease."

Biological diversity will decline as grass creates monoculture.

Nutrient flow disruption (especially silicates and nitrogen) will reduce planktonic food chain productivity and thus the animals that feed in these chains. (5.43)

R. B7. **Table 12 lists positive and negative impacts even if these may be negated by other impacts. Thus, both the potential positive effect (increased cover for waterfowl) and negative impact (loss of feeding habitat) are listed, even though it is quite possible that loss of feeding areas would outweigh increases in available cover. *Spartina* would provide increased cover for some fish, especially if it displaced bare mud flats. In some situations, *Spartina* may stabilize shorelines. For example, *S. alterniflora* was introduced to Padilla Bay to stabilize a long, narrow island (see Appendix A, p. 8). Loss of biodiversity is already included as a negative impact. See Table 12 for additional responses.**

We believe that statements in the text are accurate as general indicators. Their significance and agreement as to their meaning and relevance will certainly vary with site specific conditions.

C. B8 The suggestion that *Spartina* might reduce estuarine nutrient input (page 78) is unfounded. *Spartina* may be positive given excess nutrients in many estuaries that could be filtered thus promoting growth of eelgrass and macroalgae in deeper water (excess nutrients favor microalgae at the expense of these plants). *Spartina* debris may contribute to the important detritus-based estuarine food chain. (10.12)

R. B8 **See Table 12 and Section 4.1.1, paragraph 25.**

We believe that the text, as written, reflects a valid concern for Washington estuarine areas where *Spartina* occurs. Overall, the negative aspects of *Spartina* infestation are felt to outweigh the positive ones.

The food chain in Willapa is not detritus-based. It is an algal and phytoplankton, spring bloom system. The food chain, like the Bay, is young. The older, more eutrophic systems are detritus-based, with the timing of the nutrient input in the fall, after the plant biomass has died back and is decaying. However, even in spring bloom systems,

an argument can be made for the importance of the detrital input component (especially for individual species).

C. B9 In areas with dense eelgrass stands that produce wracks of debris, *Spartina* wrack may not significantly increase degradation of navigable waters or fouling of fishing nets (page 80). (10.13)

R. B9 **Comment noted.**

C. B10 Please add as an adverse impact loss of the significant daily change of the viewscape due to *Spartina* and subsequent loss of the substantial psychological benefits of this changing view. (14.6)

R. B10. **See Section 4.1.1, paragraph 28.**

C. B11 Extensive meadows, not *Spartina* clumps, increase standing water. (5.44)

R. B11. **See Section 4.1.1, paragraph 9.**

C. B12 Page 76 and other locations throughout document: Text may be more clear by replacing the phrase "unvegetated tidal flats" to "open intertidal area" (meaning without emergent vegetation but containing eelgrass and invertebrates). Areas with emergent vegetation should be labeled "salt marsh." (5.45)

R. B12. **See Section 4.1.1, paragraph 13.**

C. B13 Make clear that *Spartina* is not likely to persist in isolated clumps -- isolated clumps would be short term (page 77, 3rd para.). Add short term impacts of increased predation by wading birds of fish using the outer 1-2 feet of clump. (5.46)

R. B13 **The last sentence of the referenced paragraph already states that *Spartina* clumps eventually grow together into closed stands. We are unable to verify the statement regarding increased predation of juvenile fish at edges of *Spartina* clumps.**

C. B14 Enhance the discussion of juvenile fishes with a discussion of fish use of salt marshes, salt marsh edges, eelgrass (introduced and native), shallow channels and pools, and deeper channels (some of these habitats are obviously more valuable than others). (5.47)

R. B14 **The importance each of these habitat types for salmonid and other fish and shellfish production is well noted. The value of each type for**

aquatic life is also interdependent on other types. Current WDF policy requires that changes to all habitats that may affect fish life be sequentially avoided and/or minimized or compensated for during any project. Often this is accomplished through management of species of special concern (e.g. eelgrass). This approach is expected to encompass protection needs for associated habitats and species, as well.

C. B15 Increased mosquito borne disease should be included as a human health impact of no action. Impacts to butterflies and other lepidopteran populations from mosquito control activities is also a potential impact. (5.48, 14.7)

R. B15 **This potential impact is not verifiable given available data.**

C. B16 Normal cultivation of shellfish beds does not prevent *Spartina* infestation. Clam and oyster beds in Willapa Bay have already been lost. *Spartina* is capable of growing to MLLW and as much a 1 meter below, which could result in impacts to 70% of currently cultivated shellfish grounds (see also 5.20). (5.49)

R. B16 **See Section 4.1.1, paragraph 29 or the EIS for response. While the potential exists, losses of actively cultivated commercial shellfish beds from *Spartina* expansion have not been documented. *Spartina* is actively removed from many of these areas in the course of cultivation. It can be expected, however, that marginal production or seed areas with relatively low levels of cultivation activity may be impacted.**

C. B17 Site-specific evaluations of the positive and negative effects of No Action should be done before determining that control is needed. For example, a buffer zone of *Spartina* may mitigate increased loads of sediments, nutrients, or contaminants from upstream agriculture, silviculture, construction, etc.(10.5)

R. B17 **As contemplated in the EIS, "no action" would be evaluated in the context of Integrated Management.**

C. B18 Impacts of purple loosestrife and *Spartina* should be stated definitively even though there is little published literature regarding these impacts. The official position of the USFWS is that *Spartina* and loosestrife infestations have and will affect physical, chemical, and biotic characteristics of estuaries and freshwater wetlands. *Spartina* may initially provide habitat diversity and ultimately trap sediment and convert

mudflats to marsh. Bio-filtration of road runoff and irrigation return are positive impacts of purple loosestrife that are also provided by native vegetation that provides important habitat. Published studies are not necessary to substantiate obvious impacts. (39.3)

R. B18 **Throughout the document there are references to unpublished studies, including personal observations from knowledgeable individuals, as well as unpublished written reports. There was a concerted effort to have a balanced outlook and to objectively report available information, while avoiding use of unnecessary detail or repetition in the report.**

Studies that have not been published should be referenced as such. Personal communications and anecdotal information should be regarded with the appropriate skepticism. We do not agree that the statements should be absolute.

C. B19 Pages 88 and 89 repeat the same need (rate of native salt marsh and eelgrass displacement and GIS for *Spartina* distribution and populations changes). (39.17)

R. B19 **These are distinct issues, not all *Spartina* colonies displace native saltmarsh and eelgrass communities.**

C. B20 Please revise Table 12 to reflect the following:

a It is not correct to generalize that *Spartina* provides beneficial cover for fish and wildlife: clones may provide habitat diversity but monotypic stands are detrimental to fish and wildlife.

b Information conflicts in that increased cover is presented as a positive impact and loss of habitat as a negative impact. (39.36)

R. B20 **a See Table 12.**

b Increased cover is a benefit for species able to utilize *Spartina* marshes but unable to use previous habitat for cover (especially mudflats); species dependent on native habitats will be adversely impacted. Impacts include a change in species utilization of affected areas, which involves benefits to some species at the expense of other species.

C. B21 Reference Simonstad's Sea Grant study that will compare communities within clones with those in un-vegetated mudflats (page 75) (3.37)

R. B21 **The Sea Grant study of Simonstad et al. has not yet been conducted and it is inappropriate to refer to it in Section 4.1.1. It is described in Section 4.1.4, paragraph 8.**

C. B23 Provide a separate heading for mammals (page 77). (39.39)

R. B23 **Change incorporated, see Section 4.1.1.**

C. B24 *Spartina* production is contrary to estuarine preservation, so there is no need to evaluate other uses (page 90). (39.40)

R. B24 **We agree that evaluation of other uses is not needed in the EIS. However, it is the position of all co-lead agencies that *Spartina* be permitted to be harvested as long as the use does not spread seeds and create new infestations.**

C. Physical Control Only Alternative

C. C1 Shadecloth should only be used where monitoring is easy and public access is difficult to discourage vandals from unpegging cloths. (5.28)

R. C1 **Though bottom barriers or covers have been used for years throughout the state in freshwater systems, we have not received reports of vandalism associated with covers. For this reason, it would seem premature to assume that vandalism would occur. Regular monitoring of covers is advised to ensure that covers remain in place.**

For example, recent inspection of covers at the Dosewallips State Park (8/28/93), revealed the difficulty in keeping barriers intact and in place. Heavy phone wire cables (~.5" thick) were criss-crossed every three feet between stakes (at least 1' deep) over geotextile fabric, and the covers were still displaced. This was in a high salt marsh area that does not receive the full impact of a winter storm's wave energy, the way a mudflat would. The *Spartina patens* was still growing after two years of covering, wherever the edges or overlaps had gaped open. This population is under the constant surveillance of the Parks staff.

C. C2 Covering seems ideally suited for early invasions and later stages of large scale removal, with complete eradication possible over 2 years (per San Francisco study, which might provide additional information for EIS). (10.17)

R. C2 **Comment noted. This information is reflected in Tables 1 and 9 of the EIS.**

It is important to note that covering may be appropriate for small areas where there are only a few clones of a small size. Covering large areas kills everything under the covers, not just the *Spartina*. Salt marsh vegetation at the Dosewallips that was covered with the *S. patens* was completely destroyed along with the target species. For this reason, it may not be advisable to use covers in large areas. Additionally, covering is expensive and labor intensive.

C. C3 The EIS is inadequate in that it provides no perspective for "small to medium" in the discussion of covering. (35.20)

R. C3 **References to small- or medium-sized clones are intentionally vague because definitions of these size classes would vary depending on choice of covering material and magnitude of wave action (which could tear covers). Practical limits should be determined on a case-by-case basis. A 450 m^2 patch of *Spartina* was successfully covered in a sheltered area of Humboldt Bay (see Appendix D).**

C. C4 A substantial amount of water required to flood *Spartina* as it seems likely that growth occurs below MLLW. (5.29, see also 5.21)

R. C4 **See Section 3.2.2, paragraph 6.**

C. C5 It should be stated first that the primary purpose of flaming would be to reduce seed set. (5.30)

R. C5 **See Section 3.2.2, paragraph 7.**

C. C6 How are *Spartina* impacts to oyster larvae from loss of phytoplankton and nitrogen outweighed in the long-term by short-term impacts from turbidity (page 97, page 107, page 127)? (5.64)

R. C6 **Identification of impacts and development of possible mitigation methods are among the most important aspects of an EIS. This EIS does not contend that short-term turbidity is a problem that outweighs those related to *Spartina*. Rather it identifies, to the extent that information is available, impacts associated with the No Action alternative (which assesses impacts of *Spartina*) and those of various control methods. Identifying impacts allows for thoughtful discussion of possible mitigation measures and for informed decision making.**

To suggest that turbidity is an impact is not to suggest that this impact will necessarily eliminate from further consideration methods that might result in turbidity. It is to suggest that either one must develop methods to mitigate this impact, choose to proceed with a good understanding of the potential impacts that might result from the decision to proceed, or choose not to proceed because the impacts outweigh the benefits of taking a particular action.

It is also important to recognize that impacts related to *Spartina* are not well documented, and that there are a variety of opposing views on this subject. For this reason, we must consciously discriminate speculation from factual information. This does not mean that we can ignore observations of those closest to the problem. It does mean that we need to proceed cautiously in light of incomplete information. We cannot conclude, for example, that *Spartina* results in loss of phytoplankton and nitrogen with subsequent impacts on oyster larvae. We can however, consider this as a possible impact of *Spartina* and make decisions accordingly.

C. C7 Should note the short life of *Spartina* seeds (9 months to one year) based upon Atlantic *Spartina* populations (page 98). (5.50)

R. C7 **See Section 4.2.2, paragraph 1.**

C. C8 Should note non-native eelgrass is species most likely to be impacted and that impacts to either species would be short-term (page 98). 5.51

R. C8 **See Section 4.2.2, paragraph 1. WDF manages for the protection of both native (*Zostera marina*) and introduced (*Z. japonica*) eelgrass and other native intertidal species. Impacts to these species are to be sequentially avoided and/or minimized or compensated for during any project.**

C. C9 Please correct text to reflect that salinity in a diked area would increase unless there was freshwater input (page 100). (5.53)

R. C9 **See Section 4.2.2, paragraph 11.**

C. C10 Please correct text to reflect that burning *Spartina* would return nutrients (primarily silicates and carbon) to the water. Nitrogen and sulfur compounds would likely vaporize (page 100). (5.53)

R. C10 **See Section 4.2.2, paragraph 13.**

C. C11 Would removal of burned material below tideline be required (page 100)? (5.54)

R. C11 **Both Fisheries and Ecology would address this concern on a case by case basis until experience is gained. Removal of partially burned material below the high tide line could be required for large areas. In areas where water circulation is severely restricted, such as certain inlets, impacts from nutrient release could be more severe than in more open water.**

C. C12 Mitigation section (page 101, 3rd para.) should specify planting of native species to replace lost bee forage caused by purple loosestrife removal. Species replanted should encourage native bumblebees over naturalized honeybees. (5.54)

R. C12 **Purple loosestrife does provide a source of nectar for honeybees during a time of the year when other sources are not as readily available. This benefit does not outweigh the serious threat posed by purple loosestrife to wetlands. As habitat improves through noxious weed management activities, so should forage for native bee species.**

With regard to the discussion of native versus non native, we'd like to point out that just as some commercially produced oysters are not native to Washington State, honeybees used for commercial honey production may not be native. Decisions regarding a preference of native versus naturalized honeybees is beyond the scope of this EIS.

C. C13 Why is not hand removal considered a highly preferred option given that impacts can be mitigated and that "labor-intensive" may be seen as a positive attribute. (10.14, 17.2, 22.10)

R. C13 **Hand-removal is considered a viable alternative within the context of integrated management, with advantages and limitations summarized in Tables 9 and 10. Hand removal is highly preferred, as described in the EIS, for control of very limited infestations and preferably of seedlings or plants that are not well established.**

Hand removal is often effective for annual or biennial plants. Agriculture has been involved with successful hand removal of crupina (annual) and musk thistle (biennial). Removal by hand of perennial species is extremely difficult, and both Loosestrife and *Spartina* are perennial. The technique requires many site visits and is expensive because it is based on root system starvation. Given the

likely reality of limited funding, the use of hand removal as a control measure may be limited because it is labor intensive in nature.

For *Spartina*, hand pulling may be practical in areas with a walkable substrate and a colony of very young seedlings. Attempts at pulling even a small clump (< 7") in diameter, revealed that even when this small these plants may be firmly anchored. Shattering the rhizomes only produces more clones and plants. Seedlings under 4 or 5 inches can be gently eased out, and single stems come out even more easily. As reported in the technical documents, a one meter wide clone had a cubic meter of rhizomes. Digging this clone from the sediment took 6 people all day. A softer mudflat that is still walkable (such as the Palix) would provide a great opportunity for a volunteer seedling pull. The DNR hopes to conduct such an effort.

Labor intensive may be viewed as a positive attribute in that where funds are available, use of brush cutters or hand removal may provide employment opportunities where jobs are scarce. For example, Washington Conservation Corps (WCC) crews were hired this summer to remove *Spartina* using brush cutters and though the work was arduous, the crews both received a reasonable wage and felt satisfaction in the job that they accomplished. *Spartina* removal was accomplished with minimal observable environmental impacts. The crews are now experienced and will be a valuable asset for future projects.

Hand removal of Purple Loosestrife also provides the same employment opportunities for WCC crews and others.

C. C14 Natural open mudflats are subject to sedimentation and erosion and naturally rely upon frequent replenishment of marine biota, thus plant removal and resulting soil loss could be of little lasting consequence. Description of the vast loss of mud from hand removal is misleading. (10.15)

R. C14 **See Section 4.2.2, paragraph 5. WDF would require that any significant depressions be filled so as not to cause trapping and loss of fish life between tides. The volume and nature of material to be moved also becomes a practical constraint for the method.**

C. C15 Hand removal of *Spartina* is not feasible by boat (page 20). (39.23)

R. C15 **Comment noted.**

C. C16 Add to Table 1:

a Hand pulling, use constraints: seedlings small enough to pull; and

b Covering, significant environmental impact: inability to remove covers due to sedimentation. (39.24)

R. C16. **Change incorporated, see Table 1.**

C. C17 Dragging a canoe across mudflats disturbs sediments (per USFWS experience) (page 24). (39.25)

R. C17 **Comment noted.**

C. C18 Covering may be effective for small clones but not larger patches (page 24). Include information from Willapa Refuge and San Francisco Bay [Mike Joselyn (415/435-7126)]. (39.26)

R. C18 **The Willapa National Wildlife Refuge studies are discussed in Appendix D, Section 2.1.2.1. Results of studies on methods involving covering *Spartina* in San Francisco Bay were not available at the time the EIS was written.**

D. Mechanical Control Only Alternative

C. D1 Harvesting should not be listed as a control method (respond to rationale provided in comment letter). (5.31)

This comment is repeated for several sections of text including:

Page 27, table
Page 29
Page 33
Page 90
Page 106
Page 109

R. D1 **Control is defined in the noxious weed law and associated rule as the prevention of all seed production. Using this definition, harvesting is a control method if it prevents seed production and use of this control technology is at the discretion of the landowner. It should also be recognized that all landowners may not wish to harvest *Spartina* as a control method and that harvesting is not the logical approach to controlling small, isolated, infestations.**

Any such activity must not allow seed transport off-site, which is specifically prohibited by quarantine.

C. D2 We know mowing and hand-digging can be effective control. The cost of mowing is already being offset by harvesting *Spartina* for pulp and paper products. The argument that mechanical methods are too expensive ignores productive possibilities. (8.5)

R. D2 **You are correct in stating that we did not evaluate how income related to harvesting may offset mechanical control costs. Though this may be a valid consideration, a thorough evaluation of economics is beyond the scope of this EIS. This would be another of the many economic factors to consider when evaluating alternatives through an integrated plant management plan.**

Preliminary estimates of costs for use of DNR's first extensive (90 acre) mowing control project are approximately $277.00 per acre. This project entailed use of WCC crews (10 hour days, 5 days per week for three weeks) and DNR and USFWS staff biologists.

Mowing is certainly a viable alternative, especially when tractors or ATVs with mowing heads are included along with a substrate firm enough to support a crew and/or equipment. The Long Beach Peninsula and the colonies near Port Townsend, the Hood Canal, and in Grays Harbor all have a fairly firm, sandy substrate. The eastern and southern parts of Willapa, however, are very soupy, and extremely dangerous and frustrating to work on. These areas are most likely not suitable for these alternatives.

C. D3 Harvesting should be seriously considered where *Spartina* limited stands may benefit the ecosystem or where infestations need to be limited and eradication is not possible. Other, more destructive alternatives such as mowing, crushing, and hand pulling, would be required along the periphery of these areas to prevent spread. (10.23)

R. D3 **We have no documented evidence that *Spartina* is of benefit to Washington ecosystems.**

C. D4 Harvesting should continue to be considered a viable alternative. (29.4)

R. D4 **Harvesting is supported by all co-lead agencies. Agriculture has supported harvesting by issuing a permit under the wetland and aquatic weed quarantine to allow such activity.**

C. D5 Crushing, mowing, and harvesting all offer great potential for *Spartina* control, and use constraints and impacts (Table 3) are not particularly troublesome. (10.18)

R. D5 **Comment noted. The EIS discusses some limitations of these methods.**

C. D6 Prevention of seed set with one mowing cannot be assumed. Clones that initiate mowing prior to July 15 may require two mowings per season. (5.32)

R. D6 **See Section 3.3.2, paragraph 12. This statement is accurate. Early mowing allows regrowth that may still be able to bloom. Grasses produce flowers and seeds according to the length of day and temperature. A single mowing late in summer may stop the seed set, if the days have begun to shorten and seed set has not yet begun. However, beginning early in the season, and repeating the mowing often will deplete the root reserves much more quickly, leading to a quicker kill, which is desirable. Several mowings throughout the season are also much easier to accomplish, and release smaller quantities of grass material into the water.**

C. D7 Have shrew, vole, and mice populations been reduced to the point that impacts to these species outweigh the need to control *Spartina* (see page 105, para. 2)? (5.55)

R. D7 **The EIS does not suggest that reduction in shrew, vole, and mice populations due to implementation of control methods outweighs the need to control *Spartina*. It is important to note potential impacts to affected biota in order to make informed management decisions.**

C. D8 Oyster and clam beds have repeatedly recovered from traffic and constant cultivation. Why forbid traffic in these areas (see page 107, 4.3.2)? (5.67)

R. D8 **Current WDF policy requires that changes to all habitats that may affect fish and shellfish life be sequentially avoided and/or minimized or compensated for during any project. Compaction is certainly one problem to be avoided. In addition, associated turbidity increases, creation of depressions that trap juvenile fish, and loss of existing plant and aquatic life on an interim and cumulative basis are others.**

C. D9 Implications of the following differences between natural *Spartina* releases and those from mowing need to be addressed (page 109, page 125). (5.65)

1 Time (ongoing year end drift vs monthly releases)
2 Type of material (culms and leaves vs tender, fresh material)
3 Decomposition period
4 Nutrient levels

R. D9 **There are no experimental data available on differences between natural *Spartina* releases and those due to mowing. Observations by J. Civille, which are cited in the EIS, indicate that smothering of native vegetation by plant litter would be reduced under a mowing regime that distributes releases more evenly through the year. WDF has proposed mitigation that would require collection of mowed material where it becomes problematic.**

We agree that continued planned information gathering should be a part of any *Spartina* management program. Such information is essential to both *Spartina* control and resource protection.

C. D10 Digging out *Spartina* rhizomes is not necessary because properly executed control should result in a dead clump with no viable rhizomes. At most the ground should be scraped to restore the original profile. Dredging live root material could spread *Spartina*, so is not recommended. (5.67, 10.16)

R. D10 **There are no experimental data available on the ability of *Spartina* rhizome fragments of various sizes to survive following digging operations that remove the majority of the clone. *Spartina* rhizomes are able to produce aerial stems and survive digging if sufficient living material remains. Indeed, digging at one site in England over several seasons was abandoned because of difficulties in preventing re-establishment from residual rhizomes (see Appendix D, Section 2.1.1.1). By definition, properly executed control would kill plants, but this would require removal of rhizomes. We agree that removing live root material is not recommended. Comment noted on scraping.**

As experience is gained, the protocol for each method that best achieves the combined needs of *Spartina* control and resource protection will be refined. This reaffirms the need for continued information gathering and reporting to be a part of *Spartina* control. This will best be addressed in the context of Integrated Weed Management.

C. D11 Sedimentation and erosion from mechanical control may be no more stressful than changes caused by *Spartina*, though this must be assessed for specific sites. (10.19)

R. D11 **People developing management plans and issuing permits will evaluate the potential for impacts from each alternative and weigh the potential environmental benefits against known or suspected impacts. Factors such as this one should be incorporated into these decisions. If mechanical control is used, it will likely affect sedimentation/erosion on a short-term basis. Indeed, this may be less stressful to the entire ecosystem than continued spread of *Spartina*.**

It is believed that erosion losses from relatively level tide "flats" would be minor. As an example, dead clone remnants in front of the Willapa Wildlife Refuge remain at an elevated profile, despite being mowed many times over the past few years. *Triglochin maritima*, common to elevated, salt marsh areas, is now growing on the hump.

C. D12 a All areas of Willapa Bay are accessible to non-chemical control. (8.4)

b There are many areas of Willapa Bay that are inaccessible or too difficult to mow. (9.a.1.)

R. D12 **The Bay varies greatly in substrate, from hard, sandy beaches along Long Beach Peninsula, to flocculent muck at Seal Slough, Pot Shot Slough, the southern perimeter (Reikkola Unit of the refuge), and Diamond Point. Areas that are easy to access and mow may be appropriate for such a program, though the rate of removal using this method alone is an important consideration.**

C. D14 Please explain how crushing would spread rhizomes (Table 3). (10.20)

R. D14 **Crushing with mechanical equipment can dislodge plant fragments in areas where rhizomes and roots are exposed, such as in areas where channels have formed at edges of colonies. This would occur only in rare situations and its reference has been removed from Table 3.**

C. D15 Large machinery is impractical due to inability of heavy machinery to operate in soft substrates, that it must be specially designed, and that it would have high maintenance costs (Table 3, page 27). (39.27)

R. D15 **See Table 3 for text changes. Section 3.3.2, which specifically discusses *Spartina* control, states that crushing would not be practical on soft substrates.**

C. D16 Crushing should be done early in the growing season, especially for multiple treatments (Table 3). (39.28)

R. D16 **See Table 3 and Section 3.3.2, paragraph 11.**

C. D17 It is inappropriate to say that crushing will kill *Spartina* as no research has been conducted in the Pacific Northwest (page 32). (39.29)

R. D17 **Studies on efficacy of crushing have been conducted in Willapa Bay, including one that demonstrated clone mortality. See Appendix K.**

C. D18 Number of *Spartina* mowings required may depend on substrate type: DNR found 3-5 mowings were required to kill *Spartina* on hard, sandy, substrates; USFWS found that 8 monthly mowings were required on soft mudflats. Reference USFWS study in this section (page 32). (39.30)

R. D18 **Comment noted.**

C. D19 Rapid, large-scale, sediment deposition is unlikely due to *Spartina*'s extensive rhizome network (Refuge area mowed in 1992 still elevated from entrapped sediments) (page 107). (39.41)

R. D19 **The EIS does not state that sediment redeposition would be large-scale or rapid.**

E. Biological Control Only Alternative

C. E1 Based on information available at this time, the best one could expect of biological controls is reducing or stopping seed set and possibly impacting or eradicating seedlings, but not reduction of species to an acceptable level as stated in the executive summary (biological controls only section, page xv, 2nd sentence; see also page 112, 4.4). Available information would not indicate reduction of clone sizes (especially larger plants). (5.9)

R. E1 **Biological control measures have been effective for controlling several species of noxious weeds to the extent that they do not represent serious environmental threats. For example, biological control of tansy ragwort by cinnabar moths, ragwort flea beetles, and ragwort seed flies, has been extremely effective in many areas. Control of *Spartina* to an acceptable level is a reasonable goal, even though no effective agents have yet been identified that would accomplish this goal.**

C. E2 It is apparent that no good biological control options are available at this time but may be in the future. (10.24, 18.7)

R. E2 **Comment noted.**

C. E3 I urge funding of biological testing as part of IPM, though this alternative does not lend itself to use for immediate control. (20.2)

R. E3 **Comment noted.**

C. E4 Introduction of any other non-endemic species should only be done with extreme caution. (18.8, 28.6)

R. E4 **The Regulatory section of the EIS outlines the regulatory framework within which biological control is approved. This rigorous process protects against approval and subsequent use of non-endemic species that would adversely impact human health and/or the environment.**

C. E5 It seems rather silly to put cows and other domestic herbivores out on the delicate intertidal area. (18.9)

R. E5 **Please note that the EIS does not recommend use of livestock in the intertidal area.**

C. E6 Please consider bio-remediation as an alternative to pesticides. (16.1)

R. E6 **Bioremediation employs microbes, such as certain bacteria and fungi for removing or neutralizing pollutants. It does not apply to noxious weed control.**

C. E7 For *Spartina*, add as an information need impacts of seed fungi and Prokelisia marginata (stem boring invertebrate) on plants, wildlife, and humans. (39.18)

R. E7 **See Section 4.4.4, paragraph 2.**

C. E8 Littorina littoera (snail) may be a questionable biological control agent given that it is used on the East Coast as an indicator of healthy *Spartina*. (39.19)

R. E8 **We are unable to verify this information. Bertness (see Appendix H, Section 2.1.3.1) states that this snail significantly limits distribution of *S. alterniflora* on rocky beaches.**

C. E9 Please correct Table 5 to reflect the following:

a Use constraint, grazing: inaccessibility to treatment area (deep sloughs in many salt marshes would preclude use of cattle);

b Grazing should not be advocated in tidal marshes due to water quality concerns. (39.31)

R. E9 **See Table 5 for text change concerning access to treatment areas. Table 5 states that grazing is not recommended.**

C. E10 Please describe studies with seed fungi and Strong's work with *Prokelisia* in Bodega Bay (page 40). (39.32)

R. E10 **This information was not available at the time the EIS was written.**

F. Chemical Control Only Alternative

C. F1 Please explain the basis for concluding that Rodeo® is more effective than 2,4-D in controlling Purple loosestrife as indicated in the executive summary that states that Rodeo® is the most effective pesticide available (page xv). (35.9)

R. F1 **See Executive Summary, Chemical Methods, paragraphs 1 and 2.**

C. F2 Please delete text (page xvi) that states "The environmental concentrations of surfactant that would result from applications of a glyphosate/surfactant mixture are not expected to have.." given that surfactants do not undergo federal toxicity review and no product specific biodegradation studies specific to LI-700®, X-77, or R-11 have been conducted. (35.10)

R. F2 **See Executive Summary, Chemical Methods, paragraph 4.**

C. F3 Please explain the difference between Rodeo®/non-ionic surfactant, and Round-up® (page 5). (35.15)

R. F3 **Roundup® is an herbicide that contains glyphosate and a surfactant in its formulation. Rodeo® is an herbicide that contains glyphosate but no surfactant. A non-ionic surfactant must be added to Rodeo® prior to application. Roundup® is not registered for aquatic use in Washington State and is therefore not evaluated in the EIS.**

The surfactant contained in Roundup® is Entry 2® (personal communication, Monsanto Helpline, October 20, 1993), which is an

ethoxylated tallow amine. The surfactants that are used with Rodeo® and which were evaluated in the EIS are R-11® and X-77 Spreader® (both nonionic alkylphenol ethoxylates) and LI-700® (an ionic mixture of lecithin and methylacetic acid).

C. F4 Please amend Table 7 (page 44) to reflect the fact that we do not know the bio-concentration factor of glyphosate/surfactant, and that biodegradation factors and half-life for this combination is not known. (35.21)

R. F4 **See Section 3.5.1, paragraphs 5 and 7. (Detailed discussion in Appendix E [Environmental Effects].)**

C. F5 Is use of spray balls near human populations a suggestion or requirement, at what distance from a population should this method be used, and would the public be involved in this decision (page 51)? (29.9)

R. F5 **The use of spray balls near human populations is just one of the many application options available to applicators. As mentioned in EIS Section 3.5.2, Application Instructions and Methods, all forms of herbicides must be applied as specified on the herbicide label and in accordance with Washington state rules and the permit issued to the applicator. Public notification is always a permit requirement.**

The Simplex ball, which is in essence a pesticide delivery "ball" that hangs from helicopter on a hose, may be a highly useful application method. Potentially, this method would allow very specific application over large areas within a reasonable time frame. This method could provide easy access to areas currently unreachable by hand or hovercraft. This method may also allow coverage over a large area within optimum tidal and weather conditions. Because the ball can be maneuvered such that it rests immediately above the target plants, application rates lower than the higher broadcast aerial rates may be effective. The apparatus from which this hangs is common to many helicopters, however, we are uncertain about the cost of the Simplex ball.

C. F6 Is cutting and daubing for Purple Loosestrife control a realistic alternative? Can I get information about this alternative elsewhere? (1.3)

R. F6 **Cutting and daubing for purple loosestrife control can be a realistic alternative when dealing with infestations that are of limited size or have special characteristics (are intermixed with threatened or endangered species, for example). Cutting and daubing has been used**

by the Department of Wildlife in treatments in the Grant County area for PLS. Information on the use of this technique can be obtained from Chuck Perry, Washington Department of Wildlife or Robert Leonard, Coordinator of the Grant County Noxious Weed Control Board. For more information and restrictions, see also the Rodeo® label.

C. F7 Mature Purple Loosestrife plants are killed by Rodeo®, but seedlings arising after mature plants are killed also need to be controlled (Section 3.5.4, page 54). Unless the area is replanted, glyphosate use would be required until the seed bank is exhausted. Because it is misleading, please replace the statement that the long term control using glyphosate is unknown. (23.2)

R. F7 **See Section 3.5.4, paragraph 3.**

C. F8 For algae blooms, the Rodeo® label recommends strip spraying to mitigate for oxygen depletion. (23.3)

R. F8 **See Section 4.5.1, paragraph 5 and Table 18.**

C. F9 Mitigation for mammals could include replanting the area. (23.4)

R. F9 **In Section 4.5.1, paragraph 9, the mitigation suggestion of replanting the treated area is addressed.**

C. F10 Mitigation guidelines should be consistent with, and not more restrictive than, newly established EPA guidelines for worker protection. (23.5)

R. F10 **See Section 4.5.1, Table 18. While EPA and Ecology regulations are both designed to protect both human health and the environment, the underlying mandates for specific regulations may not be the same. The EIS guidelines and Ecology's proposed mitigation measures are based upon information available in this EIS and requirements found in the water quality standards. Because both known impacts and uncertainties must addressed, our decision to proceed cautiously in the face of uncertainties may result in guidelines more restrictive than EPA guidelines for worker protection.**

Also, workers are among the people who may be exposed to aquatic pesticides, but exposure pathways differ among exposed groups. Risk factors developed for workers may not apply to all of these groups. For example, recreationlists may be submersed in treated water whereas workers would not.

Additionally, these worker protection standards are not yet completely developed.

C. F11 The document needs to address mixer and applicator guidelines and reference that the product label must be followed. (23.6)

R. F11 **See Section 3.5.2, paragraph 1.**

C. F12 Factors should include inherent sensitivity to glyphosate (may or may not be tied to uptake and relocation) (page 125). (23.7)

R. F12 **See Section 4.5.1, paragraph 6.**

C. F13 A new published study is available regarding impacts of aerial application of glyphosate to coastal small mammals including amphibians. Research, which involved post-spray tagging and monitoring and dosing in the lab, was conducted by Mike Newton et. al.(Oregon State University). No acute or chronic effects were demonstrated. (23.8)

R. F13 **Ebasco conducted a literature search and was unable to find a citation of the recent Newton study.**

C. F14 Applying Rodeo® with a rope or wick enables target-specific applications but it is difficult to determine coverage without using an agricultural dye. The EIS will be incomplete unless it assesses dyes to determine which is safest and is labeled for aquatic use. (9.b.1)

R. F14 **You have alerted us to a use of dyes about which we were previously unaware. However, dyes were not specifically identified during scoping and thus were not addressed in this EIS. Ecology is currently prioritizing a list of issues that need to be addressed and dyes proposed for use for aquatic plant control are among issues on this list. The fact that dyes perform an important function in *Spartina* control underscores the necessity to evaluate their toxicity and potential use in waters of the state. Use of tracer dyes are also a possible mitigation tool. This new information will be factored into our assessment of priorities.**

C. F15 We note that the EIS identifies several data gaps. (22.1)

R. F15 **The EIS was designed to identify data gaps so that our decisions could encompass uncertainties. This allows for a conscious decision regarding consequences of taking a particular action (choosing one alternative over another).**

C. F16 What would be the effects of application of surfactants on a large scale? (37.30)

R. F16 **Appendix E (Environmental Effects of Glyphosate and 2,4-D) contains a detailed discussion of the available data on surfactant toxicity. As stated in the appendix, currently available information indicates that it is unlikely that, when applied as directed, surfactant concentrations in the receiving environment will exceed acute toxicity thresholds for organisms. However, as indicated in the EIS, information about the potential effects of glyphosate and surfactants on the marine microlayer and the long-term effects on organisms is not available.**

C. F17 To what extent is Monsanto's economic interest taken into account as the state reviews the Monsanto study which is the only study showing significant effectiveness of Rodeo®. (22.3, 35.26)

R. F17 **The economic interests of herbicide manufacturers were not a consideration in reviewing effectiveness studies. The efficacy has been observed in the field by staff from the pesticide management division of the Washington State Department of Agriculture (Robert Merkel and others). We have also confirmed the effectiveness with weed control officials from New Zealand where Rodeo® has been used effectively for *Spartina* control. Both studies and practical applications have shown varied results; we know some but not all the reasons for the variations. The possibility also exists that Monsanto is making the best applications because of their knowledge of the product.**

Information originates from a variety of sources. Each is judged on its merit. Generally, however, preference is given, in order, to findings from published peer reviewed studies, written non peer reviewed studies and personal communications. Obviously, there are both exceptions and gradations between, as well.

C. F18 Use of chemicals should not be permitted by Ecology until risks to human health have been assessed, including risks to human health and the environment. This should include an assessment of inerts, surfactants, and other companion chemicals that might be used. (2.2.)

R. F18 **This EIS does assess risks of 2,4-D and glyphosate to human health and the environment. Inerts, surfactants, and other companion chemicals (adjuvants) are also evaluated to the extent that available information allows. As explained in the EIS, because inert ingredients are considered trade secrets under FIFRA, mechanisms**

for obtaining information are limited. However, the EIS identifies water as the only inert ingredient in Rodeo®, which would not add to Rodeo® toxicity.

The Industry Task Force II on 2,4-D Research Data (1993, Hammond, Personal Communication) reports that a typical amine formulation (3.8 lbs. per gallon) is comprised of approximately 45% to 48% percent 2,4-D, and 52% - 55% inerts. Water is the main inert ingredient, comprising about 97-99% of the total inerts. The other 1-3% of inerts are usually made up of adjuvants that help the mixture stay in solution and/or improve spreader/sticker.

As stated in Ecology's mitigation section (Appendix One) we will work with 2,4-D manufacturers to get more specific information about the many 2,4-D formulations on the market.

C. F19 Rodeo® is not a good solution to the *Spartina* problem. Stop the spray in Willapa Bay. [3.1., 12.1, 16.2, 17.1, 19.1. 31.1, 32.1, 33.1, 34.1, 36.1 (48 signatures), 37.1)]

R. F19 **We are facing an ecological dilemma. On one hand, as described in the No Action alternative and as reported first hand by natural resource specialists and many others, *Spartina* has the potential to dramatically alter estuarine ecosystems. On the other hand, all alternatives evaluated in the EIS may potentially result in some level of adverse environmental impacts. Any option poses its own set of advantages and disadvantages. Rodeo®, along with other alternatives presented, should be considered viable management options.**

The only way that we can see to handle this particularly complicated problem is to evaluate each option for each site to determine which will cause the least impact in a given area. Where this involves proposed use of Rodeo®, specific permit requests would be reviewed to determine whether a permit should be issued, issued with conditions to reduce anticipated impacts, or denied. It will also be necessary to evaluate the feasibility and cost of each option at each site.

C. F20 Previous studies indicating inconsistent results of glyphosate leaves a serious flaw in control strategies, making it ludicrous to launch a wide scale spray program without more knowledge. (9.a.4)

R. F20 **In the control of *Spartina*, no silver bullets have been identified. No method, be it physical, mechanical, or chemical has a 100%**

effectiveness. Glyphosate has shown some inconsistency in results. That must be expected in a chemical with the low toxicity of glyphosate. We do, in fact, know from practical application for weed control in New Zealand for example, that glyphosate can be an effective tool for control of *Spartina* in certain situations. Certainly, we need to continue to refine our knowledge about reasons for lack of optimum control and correct the application problems, which may include application technique and rates or length of exposure of the target plants before inundation.

The recent study by Paveglio *et al.* (1993b) found that Rodeo® applied with a hand-held wand at the maximum recommended application rate for hand-held apparatus (a 5 percent solution) caused an 84 percent reduction in *Spartina* stem densities at study sites in Willapa Bay after one year. However, aerial application to other sites in Willapa Bay using a similar concentration did not significantly reduce *Spartina* density. As experience is gained, the protocol for each method that best achieves the combined needs of *Spartina* control and resource protection will be refined. This reaffirms the need for continued information gathering and reporting to be a part of *Spartina* control. This will best be addressed in the context of Integrated Weed Management.

Past results may not have been as effective as desired in all instances. However, if *Spartina* or other aquatic emergent noxious weeds can be controlled by safe applications of glyphosate, this would be a valuable tool.

C. F21 It is irresponsible to condone herbicide use given the clear potential for negative impacts, impacts that reach far beyond the area of application, and highly uncertain positive effects. Impacts identified present far more reason for concern than is admitted. (10.1, 37.2)

R. F21 **Certainly the use of herbicides has potential negative results but so too do all the potential alternative treatments and the no action alternative. The available data summarized in the EIS does not appear to support the statement that the impacts will reach far beyond the area of application, especially considering the buffer zones proposed in the mitigation section. No scientific evidence has been developed to indicate that "Impacts identified present far more reason for concern than is admitted," and a great deal of information indicates this statement is not accurate.**

The long-term benefit of an effective noxious weed management plan will be very significant and positive. We must remember that the goal is to protect the natural resources and diversity of Washington's lands.

C. F22 A message evident in the discussion of glyphosate is that additional testing is needed. Additional testing is recommended even where glyphosate has been labeled practically non-toxic (avian and mammalian toxicology). Monsanto encourages testing where significant risk is suspected but wholesale testing of all organisms for all endpoints is not feasible or compatible with current risk-assessment trends, of which use surrogate species and tier testing are key components. Results of studies with representative surrogate species are extrapolated and any inherent uncertainties compensated for with safety or uncertainty factors.

Tier-testing involves a continuum of testing, where minimal risk (toxicity plus exposure) at a lower tier would indicate that proceeding with higher tier testing would be unnecessary. Tier testing is designed to determine the propensity of a chemical to produce adverse effects and tiers often proceed from less to more complex procedures (Tier 1 - acute toxicity, Tier 2 - chronic toxicity, Tier 3 - field testing).

Monsanto disagrees with testing recommendations outlined in the EIS, but supports field observations to ensure that glyphosate is working effectively without adverse impacts. Several text changes are suggested to reflect Monsanto's position that additional testing is not need (please see comment letter text for specific suggestions). (24.1)

R. F22 **All of the aquatic toxicological data needs identified in the EIS are valid. In addition, it would be helpful to have data regarding ecosystem effects.**

C. F23 Revise text (page 1-3, 1st para. last sentence) to read: "...related to microbial biodegradation rates and sorption processes in both soil and water. (24.3)

R. F23 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F24 Revise text (page 1-3, 2nd para., 4th sentence) to read: "the treatment area can be expected unless nontarget vegetation is avoided..." (24.4)

R. F24 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F25 Last two paragraph on page 1-3 are redundant, please delete. (24.5)

R. F25 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F26 Unless interaction and use together of Sevin® and Rodeo® are expected, please remove last paragraph of page 1-4. (24.6)

R. F26 **Sevin® and Rodeo® may be used in the same general area, and for this reason possible synergistic effects were evaluated to the extent that information is available.**

C. F27 The last paragraph of page 1-11 does not clearly explain what water quality parameters are being affected and does not cite studies. Is this a reference to potential enrichment (phosphate), and/or increased nutrient runoff? Because this is mentioned elsewhere in the document, we suggest eliminating the first and last sentence and deleting the first part of the second sentence, so that the paragraph begins with: Overspray and drift are..." (24.7)

R. F27 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F28 For smoother flow, move the 3rd para. (page 1-12) to the end of the section. 24.8

R. F28 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F29 Revise text (page 1-12, 4th para., 1st sentence) to read: Dead and decaying vegetation following glyphosate treatment can cause secondary effects on water quality from treatment of noxious emergent plants. (24.9)

R. F29 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F30 Delete "by contrast" from page 1-12, 5th para., 1st sentence. (24.10)

R. F30 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F31 Please revise text (page 1-18, last para.) to read: Available information on the effects of glyphosate on submerged aquatic plants suggest that there is no risk to this group of plants. In some cases, however, more

information may be necessary where a particular species may be at risk. For example, eelgrass is an ecologically important species in Washington. No information is currently available..." (24.11)

R. F31 **Comment noted. Information indicates that there is minimal risk to aquatic macrophytes during submergence. However, as glyphosate is used to kill some submerged aquatic plants (Barrett, 1985), there is some potential risk. Spraying areas during receding tides while eelgrass is still completely submerged but *Spartina* is above water has been suggested as a possible mitigation tool for eelgrass protection. Current information also suggests that impacts to eelgrass can occur if glyphosate is sprayed onto it directly. Additional information can only help us to better protect this valuable resource.**

C. F32 Monsanto suggests removing the text (second paragraph, page 1-31) because they have toxicological information on N-nitroglyphosate in mammalian systems that indicates it does not differ significantly from glyphosate and samples contain such a low amount that it is unlikely that this compound would contribute to acute toxicology.

In addition, Monsanto studies revealed that applicator exposure under normal use conditions is non-detectable, public exposure is non-existent, and microbial and photodegradation are both rapid and essentially complete.

The Federal Register also states that "no detectable residue of N-nitroglyphosate, contaminant of glyphosate, are expected to be present in the commodities for which tolerances are established. (24.12, 25.1)

R. F32 **This comment is addressed in Section 4.5.1, paragraph 23.**

C. F33 Regarding the need for information on salmonid fry and larvae, please note results of a chronic fathead minnow study that found no effects at the highest level tested (25 mg/l). (24.13)

R. F33 **The EIS text (page 126) affirms that "acute or chronic fish toxicity hazards from glyphosate to control noxious aquatic vegetation are not expected to occur." However, information regarding effects of glyphosate on the sensitive early marine stages (salmonid fry and larvae) is needed. Fathead minnows are not salmonids, they are cyprinids.**

C. F34 Regarding the statement that information is lacking for all life stages of marine fishes, please note that Monsanto has toxicity data for marine fish, invertebrate, and plant species (see list in comment letter). 24.14

R. F34 **See Section 4.5.1, paragraph 11 and R.33.**

C. F35 Relative to other species, Monsanto has a fairly extensive data base on glyphosate bio-accumulation and excretion so suggest removing text (page 1-33, 3rd para., 1st sentence). 24.15

R. F35 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F36 If text is not removed (page 1-34, 2nd para.) we recommend revisions to reflect that routine testing for mutagenic, carcinogenic, and teratogenic potential for chemicals in salmonids is not available and that there is no evidence that suggests a concern. (24.16)

R. F36 **See Section 4.5.1, paragraph 11.**

C. F37 Protocol does exist for a sheepshead minnow study, but because convention provides for chronic testing of the most sensitive species, and fathead minnow were more sensitive than sheepshead minnow, chronic tests were done on fathead minnow (page 1-34). (24.17)

R. F37 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F38 Based on 2 studies of AMPA, AMPA appears to be less toxic to marine organisms than glyphosate: acute toxicity to daphnia, 690 mg/l (Study #AB-90-401); acute toxicity to trout, 520 mg/l (Study # AB-90-402) (page 134). (24.18)

R. F38 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F39 If text is not removed (page 1-38, 2nd para., 2nd sentence), please add reproduction information for daphnia magna (see Monsanto Toxicological Study) that indicates reproduction and other biological parameters were not affected at concentrations of 50 mg/l or below. (24.19)

R. F39 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F40 I have an economic interest in farming oysters from clean and safe water. Pesticides should be used only as a last resort. (8.3)

R. F40 **Certainly all agencies share the concern that oysters be farmed from clean, safe, waters and would oppose the use of any tool that would seriously compromise this use.**

According to the findings of the EIS, it appears that glyphosate would have a minimal and short-term effect on water quality, though some information needs exist. Glyphosate is being evaluated as one of the control options. If species such as *Spartina* were less aggressive and easier to control, they would not be noxious weeds and intensive management programs would not be required.

C. F41 Glyphosate will be the principle means of *Spartina* control because (18.4):

a It has the quickest and lightest touch on the environment;
b Does not required repeated physical disturbance of sediments;
c Would probably result in less release of plant material into water;
d Could be applied to large areas to reverse aerial increase;
e Use under proper dosage and conditions will kill the entire plant with the fewest repeat applications.

The EIS must address and fairly compare these possibilities. (18.4)

R. F41 **Though some may consider glyphosate a quick and immediate fix to a very long-standing problem, we must recognize that there are possible advantages and disadvantages with this as with all alternatives evaluated. Decisions about use of glyphosate must be made with full recognition of both its advantages and disadvantages. We feel that integrated management is the best forum in which to evaluate all necessary factors.**

C. F42 A full blown, multi-decade worst case analysis of use of Rodeo®/surfactant is requested, that evaluates (35.15):

a existing cumulative impacts of Roundup® on Willapa Bay from existing forestry and household uses;
b Synergistic effects of Rodeo®/surfactant and Sevin®;
c Cumulative impacts of persistence from continuous or repetitive spraying;
d Cumulative bio-accumulation impacts from multi-decade spraying in Willapa Bay. (35.15)
e The relationship between non-native *Spartina* and non-native eelgrass.

R. F42 a **The EIS evaluates the use of Rodeo®, not Roundup®. However, given the nature of Roundup®, including the short efficacy period and its rapid binding with soil, we have no evidence of any impact from existing forestry or household uses to Willapa Bay and no reason to believe that there would be any.**

b **Comment noted.**

c **The effect of repeated spraying has already been identified as a data need in Section 4.5.3. Data derived from applications to estuarine environments does indicate much longer persistence than documented in fresh water systems. There have been no documented impacts at these levels. The possibilities of continuous or repetitive spraying appear to be remote, and if proposed, would be regulated through the permit process. Continued information gathering is an essential component of Integrated Weed Management. The level and direction of any future research is, of course, very dependent on funding and priorities.**

d **The bioconcentration factor of glyphosate is so low that it is classified as "non-accumulative" so it is unlikely that multi-decade spraying will lead to bioaccumulation.**

e **The relationship between *Spartina* and eelgrass is covered in Appendix A (comment e). Additionally, the relationship between non-native *Spartina* and non-native eelgrass is fairly clear. In simple summary, both are introduced species. The eelgrass has become important habitat and food source for native fish species. *Spartina* does not serve this function and is in fact destructive of that habitat. It has become an aggressive colonizer since it has begun spreading by seed as well as vegetatively, and displaces the eelgrass, and changes the nature of the native mudflat habitat by trapping sediment. Because of its aggressiveness and destructiveness to the environment, the *Spartina* species have been classified as noxious weeds at public hearing by the Washington State Noxious Weed Control Board. All the class A and class B noxious weeds on the state weed list are species not native to the state of Washington, however, not all non-native plants are classified as noxious weeds.**

C. F43 Proper dosage and conditions were not allowed in the 1992 tests. (18.5)

R. F43 **The permit issued for the experimental application of glyphosate in Willapa Bay in 1992 allowed for use of the label rate requested in the**

application. The rate requested was at the lower range of the allowable label rate. Results indicate that at this rate, aerial application of glyphosate was not very effective and there were no impacts to benthic communities. Lack of efficacy in these studies could be attributed to factors other than, or in addition to, application at a lower label rate.

In addition to the studies of aerial application, there was an investigation at Willapa Bay of glyphosate efficacy when applied to *Spartina* using a hand-held wand. In this study, glyphosate and surfactant were applied at the maximum recommended application rate for hand-held apparatus (5 percent in solution). An evaluation one year later found that *Spartina* stem density was significantly reduced in the treated plots when compared to control plots.

C. F44 It is ludicrous to suggest that glyphosate has shown 0-100% effectiveness. It is extremely easy to misapply this material, and therefore it is incorrect to assume misapplications assume ineffectiveness. Differing results from trials may be due to differences in:

a products used (Roundup®/Rodeo®);
b drying time prior to immersion (little or none to adequate drying time);
c amount of sediment on leaves;
d cleanliness of in situ water
e amount of surfactants used. (5.10)

In discussing efficacy, conditions of each study that may have altered efficacy should be discussed (page 53), including:

a Lack of one year follow-up by Fresh and Carr, expectation of 100% loss of eelgrass for growing season from effective treatment, different people looking at *Spartina* impacts;

b Conditions of Willapa Bay application (poor weather conditions, sediment covered plants).

c Conditions of Bulthuis and Shaw studies (insufficient eelgrass absorption time, sediment laden *Spartina*).

d English work on *Spartina* anglica;

e Inclusion of Crockett studies.

R. F44 **The lack of follow up, insufficient time to study eelgrass effects, and causes of ineffective studies in Great Britain are mentioned in the EIS. The Willapa Bay, and Bulthius and Shaw studies do not indicate that excessive amounts of sediment were on plant leaves or that weather was poor. Crockett studies are evaluated in Appendix E (Pesticide Characterization).**

In the Bulthuis and Shaw study, the lack of effect on eelgrass is attributed by the authors to the short time of exposure. In the Bulthuis and Scott study on *Spartina*, the authors suggest that the reason for lack of efficacy is the time of exposure. Though plants were exposed for 8 hours, which is 2 hours more than the minimum label requirement, authors provide this as a possible explanation for lack of efficacy. The report contains no information to suggest that *Spartina* was sediment laden.

The set of operating conditions and methodology necessary to achieve application of glyphosate for an acceptable level of *Spartina* control appears to be fairly rigid. Whether these conditions can be achieved in the "real world" on a consistent and practical basis is yet to be demonstrated. The recent study of glyphosate efficacy when applied by hand-held wand indicates that a significant reduction in *Spartina* density is possible when the herbicide is applied at the maximum recommended rate for hand-held apparatus (5 percent in solution). The protocol for application of this chemical needs to be both very strictly defined and as closely followed as possible to achieve a better and more accurate assessment of glyphosate's effectiveness and utility.

It is possible that failure to apply under the best of conditions influenced efficacy in the aerial application studies, but this cannot be verified. Conditions during the experimental aerial application in Willapa Bay included misting weather conditions, grass over 6 feet tall, and a spray level that was about one-half the highest allowable label rate. However, none of these parameters were contrary to the Rodeo® label. These factors may have influenced efficacy, and may reveal factors that should be examined in subsequent aerial testing.

With regard to humidity, Monsanto (Crockett, 1993) reports that applications should be avoided when "...heavy dew is present on leaf surface" and that application should not occur if dew "...causes spray droplets to run off of leaf surfaces. Small amounts of dew should not pose a problem to herbicide applications as long as the leaves are not wetted by the spray solution to the point of run-off of spray droplets." Dripping droplets were not observed during the Willapa application.

Application at the highest label rate for broadcast aerial spray may improve efficacy, but any such application would also have to evaluate environmental impacts and persistence at this higher rate.

Spraying when plants are much shorter may also improve efficacy. Some have suggested spraying in the early spring as the plants are emerging, but it is not known if this would allow for translocation of glyphosate to the rhizomes. Using a higher spray volume is another suggestion, and may be possible with hand applications. It may be problematic to increase spray volume for aerial applications.

C. F45 Please summarize study designs of studies cited in EIS discussions of efficacy (concentration used, size of treatment areas, etc.) (35.22)

R. F45 **Refer to response F58.**

C. F46 The EIS (page 51) should discuss the following factors that may affect efficacy (5.33)

a Drying time (6 hours is normally considered adequate, less than 5 should be suspect);

b Water used for mixing (on site water not considered acceptable, any study using such water should be considered suspect);

c Amount of sediment on leaves (mowing clumps 4-5 weeks before spray may improve efficacy where prolonged dry weather coincides with treatment window);

d Weather (During and for 6 hours after applications it must not be raining, drizzling, foggy, or damp. Only the lightest overcast can be tolerated.);

e Appropriate type and amount of surfactant (too much or too little will dramatically reduce efficacy, better sticking surfactants such as LI-700® may increase efficacy in wet conditions); and

f Ammonia (may increase absorption into plant);

R. F46 **See Section 3.5.3, paragraph 2 (comments a, d, and e).**
There is no information in the Willapa Bay or Padilla Bay studies about the effects of onsite vs offsite water, amount of sediments on leaves, or ammonia (comments b,c, and f).

Monsanto (Crockett, 1993) has provided the following information about factors that might influence efficacy:

"Surfactant Rates: Rates in excess of the label recommended rates are not encouraged nor supported. Should excessively high rates be used, beyond those recommended, negative results would not be expected but, some mixing or compatibility problems could conceivably occur.

Surfactant rates lower than those recommended may lead to reduced herbicide performance. Low surfactant rates may not provide the desired level of wetting required to get the glyphosate into the plant.

Rain fastness. Glyphosate requires approximately 6 hours of rain free weather to be most effective. Reduced control may be observed if rainfall or tidal inundation occurs less than 6 hours after application. Plant growth, timing of application, environmental conditions, debris on leaf surfaces, all affect the speed that glyphosate is able to move into the plant. Retreatment would likely be required if rainfall occurs within two hours of application. Should any of the factors noted above cause reduced movement of glyphosate into the plants, additional rain-free weather may aid in maximizing the total effectiveness of the application.

Sediment or debris. Silt, salt, or other debris reduce the effectiveness of glyphosate movement in to the leaf surface. Some materials found on leaf surfaces may actually bind glyphosate so that it is unable to enter the leaf surface. These would include silt and other organic debris. Best results are obtained when plants are free of debris on the leaf surfaces. The degree to which glyphosate effectiveness is affected would correlate to the type and amount of debris present. Research to address these areas specifically have not been completed. Commercial applications and tracking product performance have shown, however, the dust layers and debris on leaf surfaces do result in reduced herbicide performance.

Water Quality. Water used as a diluent with Rodeo® should be free of silt or other debris or sediment. Use of clean water is recommended. Water high in calcium, magnesium, or iron has been shown to be detrimental to glyphosate activity due to the presence of glyphosate binding sites to the divalent and trivalent

ions. Salt water has been successfully used as a diluent with Rodeo®. Clean tap or well water would always be preferred, however, due to the chance of sediment contamination.

***Spartina* treatment timing. A complete timing study from early spring to late fall has not been done. Parallel research on other perennial grass species, however, would indicate that the preferred treatment window with glyphosate would include that period from flowering through the fall. Other timings may show acceptable efficacy, but have not been fully researched. This is one area that additional information and data would be "nice to know." Springtime applications to quackgrass, a perennial spread by rhizomes, often is effective and commercially acceptable, but not as effective as a well-timed fall application.**

C. F47 Monsanto's 1990 trials provided nearly 100% initial control from both spray and wiper applications, with no regrowth in 36 months. Data are available for review upon request. (23.1)

R. F47 **This study is cited in EIS with 2 months of follow up. The 36 month followup data were not available at the time the EIS was written.**

C. F48 Efficacy depends upon abiotic (weather, time prior to tidal inundation, salt or mud on leaves, spraying protocol), and biotic (age and size of plant, plant phenology) factors. (9.a.3)

R. F48 **See response to comment F46.**

C. F49 The Long Beach Research and Extension Unit of Washington State University has begun research evaluating factors affecting efficacy of Rodeo® for *Spartina* control (effects of LI 700, ammonium sulfate, time of application, exposure time, spray volume, and application method). Data should be available by spring. (9.a.5)

R. F49 **Since the referenced study is not complete, it will not be included in the Final EIS.**

C. F50 Text should note that glyphosate does not persist in environment as active ingredient (page 54, 4th para.). (5.35)

R. F50 **As noted in Appendix E (Pesticide Characterization), and in Table 8 of EIS, studies indicate that glyphosate can persist in sediments up to one year.**

C. F51 Please provide an explanation for variations in persistence of glyphosate in estuaries (<90 days up to a year). (35.23)

R. F51 **Factors that contribute to variability in persistence of glyphosate are covered in Appendix E (Pesticide Characterization).**

C. F52 Should note that it is known (or intended?) that glyphosate does not control seed germination. (5.36)

R. F52 **The text does not imply that glyphosate controls seed germination, only that if plants survive the initial spraying they can spread seed that would germinate the next year, and the new plants would have to be sprayed.**

C. F53 Based on preliminary results on impacts associated with a deliberate overspray of tidelands with Rodeo®, the statement on page xvi, second paragraph, second sentence is not valid. (5.11)

R. F53 **The question of short-term vs long-term effects on eelgrass is covered in Section 3.5.3.**

C. F54 References to laboratory studies should be deleted from Page 53, first para: single site exposures cannot be compared with constant exposure studies (see also page 127). (5.34)

R. F54 **See Section 3.5.3, paragraph 10.**

C. F55 Bivalve larvae are present in water most of the year [or as stated in another portion of comment letter #5, from June until September] (comment directed to pages 97, 107,and 127). Native species tend to spawn early in the summer and introduced species into late fall. The oystermen should have a say in mitigation related to oysters: they state that they will bear the consequences of impacts to oysters in the short term if *Spartina* will be controlled. (5.59)

R. F55 **The EIS indicates that *Spartina* control will be a long term process requiring long-term commitment. In Willapa Bay natural oyster spawning occurs approximately July 15 (after water temperature reaches 64-65 degrees Fahrenheit) through August. Most Willapa growers routinely culture larvae or import seed. Few rely on natural sets. However, this does not negate the importance of natural production, especially for state reserve areas (native and Pacific) and recreational harvest. Generally, spraying during September should**

not present a problem. The need for mitigation during other periods will be considered on a case by case basis.

Oyster growers would have an opportunity to provide comment on proposals requiring modifications to water quality standards. Additionally, co-lead agencies would invite participation of any interested person during development of Integrated Management plans for which agencies were responsible, including projects on public lands managed by any of the co-lead agencies for this EIS.

C. F56 Doses for comparable body weights would be more useful than allegations and extrapolations from rats, mice, and rabbits. Not all mammalian biology is the same: dioxin causes cancer in rodents but in humans it causes dermatitis (chloracne). Information regarding EPA's designation as a class E carcinogen should come first in this discussion (page 127). (5.60)

R. F56 **The human health risk assessments for glyphosate and 2,4-D used methods for extrapolating doses from animal studies for comparable human body weights. Available information indicates that dioxin is a human carcinogen.**

C. F57 It is not appropriate to reference research that is not complete. The credibility of the work must be in doubt based upon incomplete processing of sample, delayed presentation of data and analysis, and lack of public review. Improper number manipulations are suspected (page 129). (5.61)

R. F57 **The implication that incomplete research discussed in the EIS lacks credibility is without substance.**

C. F58 Please clarify where the Paveglio study was done and its relationship to the 3 studies mentioned on page 32 (3rd para.). Please also provide the size of spray plots. (35.26)

R. F58 **See Section 3.5.3, paragraph 4.**

C. F59 Please clarify the relationship of the label rate and rate applied in all three studies and the Simenstad et al. study referenced on page 53. Were these all half the rate that could be legally applied? What justified the use of Rodeo® at rates exceeding 4.7 L/ha? (35.27)

R. F59 **Rodeo® was not applied at rates exceeding 4.7 L/ha. Rather, it was aerially applied at 4.7 L/ha which is approximately half the maximum**

allowed aerial application rate on the supplemental label for control of *Spartina* (a 5 percent solution equals the lowest aerial label rate of 4 pints per acre; 7.5 pints per acre is the highest rate allowed for aerial application). The surfactant X-77 Spreader® was applied at a rate of 0.9 L/ha, an amount double that recommended on the *Spartina* supplemental label, but within the limits specified on the main label, so this exceedence was also both legal and within the label recommendations.

Pesticides can legally be applied at rates less than stated on a label. However, the company (Monsanto) warrants products only when used

according to label directions. Hence, if Rodeo® were used at less than the label rate and it were ineffective, then the warranty would be voided.

C. F60 In reference to the discussion of Simenstad's study (page 53), how can observations be made from high variability results when no conclusions can be drawn? (35.28)

R. F60 **Simenstad's completed study has now been reviewed and the results have been incorporated into the Final EIS. See section 3.5.3 for the discussion of this study.**

C. F61 What are the inert ingredients in Rodeo®? (6.2)

R. F61 **Water.**

C. F62 Please explain surfactant biodegradation in more concrete terms than "fairly rapid," by providing data on half-life and persistence. (29.7)

R. F62 **Please see changes to the EIS made in response to comment F4.**

C. F63 What is the benchmark for use of the term "low bio-concentration?" (29.8)

R. F63 **Please see changes to EIS made in response to comment F4.**

C. F64 The fate of glyphosate, breakdown products, and surfactants beyond the treatment site is not evaluated, except for an estimate of the amount washed away on the first tide. Half-life and persistence information is misleading in that it assumes degradation or disappearance for a substance that could actually be washed to another location.

R. F64 **The herbicide must be applied at low tide to assure adequate contact time before wash-off (label recommends 6 hours before wash-off), therefore the efficacy and application amount will not change because of tides as long as label directions are followed. Besides the normal degradation, dilution of the herbicide in the tide would minimize the possibility that there would be any significant off-site impacts. (10.26)**

C. F65 Impacts to eelgrass have great long- and short-term implications. It is difficult to understand why this would be considered acceptable given that one of the main concerns with *Spartina* is that it outcompetes eelgrass. (10.27)

R. F65 **There are three species of *Spartina* of concern statewide. They have different abilities to compete with specific intertidal species and different responses to control. Glyphosate spraying is one control alternative that will be dealt with within the context of Integrated Weed Management. The need to protect intertidal species (including eelgrasses) proximate to *Spartina* will, of course, continue to complicate *Spartina* control.**

Left unchecked, *Spartina* will displace eelgrass in Willapa Bay and has done so in several areas. We have two studies of the impact of glyphosate on eelgrass -- one showing impact and one showing no impact (authors of the study showing no impact suggest minimal exposure time --two to three hours-- might explain the lack of any response). Additionally, a native salt marsh plant, *Atriplex patula*, responded to application by glyphosate at rate of 1.7 quarts per acre.

The fact that impacts to non-target species have been documented gives us cause for concern. We recognize the need to take precautions to minimize the potential impact on eelgrass by preventing, to the greatest extent practicable, any direct applications of Rodeo® to eelgrass and protecting eelgrass from damage when using other control methods (please see Mitigation Section - Appendix 1).

C. F66 The EIS does not adequately assess the significant impacts of eelgrass that could result from using highly persistent and mobile pesticides (page 53). (29.11)

R. F67 **The EIS adequately addresses these potential impacts.**

C. F67 How is eelgrass to be protected from indiscriminate herbicide use? (22.2)

R. F67 **Aquatic herbicide use is regulated by a Short-Term Water Quality Modification Permit through the Department of Ecology. Resource agency staff and others may provide recommendations on these permits prior to their issuance. Indiscriminate use of pesticides is illegal.**

WDF manages for the protection of both native (*Zostera marina*) and introduced (*Z. japonica*) eelgrass. This means that all control work (including herbicide use) must be designed so as to sequentially avoid, minimize or compensate for impacts to eelgrass. The EIS provides options for doing this.

C. F68 The dispersal of glyphosate to the micro-layer, which tends to concentrate organic materials and is laden with microscopic life including fish and shellfish larvae, should be assessed. (10.28)

R. F68 **See Section 4.5.1, paragraph 13.**

C. F69 Food chain and long-term reproductive and sublethal effects of glyphosate have not been assessed. (10.29)

R. F69 **See Section 4.5.1, paragraph 11.**

C. F70 Potential effects of surfactants on the micro-layer and physiology of non-target species are not addressed. Only incomplete, short-term studies are available. (10.30)

R. F70 **See Section 4.5.1, paragraph 13.**

C. F71 Studies of sediment fauna do not address impacts other than survival, do not test varying concentrations, nor repeat applications and as such leave many unanswered questions. (10.31)

R. F71 **See Section 3.5.3, paragraph 14.**

C. F72 Does information exist regarding the potential for glyphosate to depress the immune system of humans or dolphins? (6.3)

R. F72 **Ebasco has not identified any toxicity studies specifically designed to assess the potential for glyphosate to depress the immune system of humans or dolphins.**

C. F73 The Legacy of Dead Tomatoes (Newsweek) reveals unforeseen negative impacts from a pesticide. (8.2)

R. F73 **Comment noted. Any control activity or no activity has the potential for "unforeseen negative impacts."**

C. F74 Please identify the "other" herbicides with which chemical control mechanisms are most effective, and why is not this explained in the text (page 50)? (29.8)

R. F74 **See Section 3.5.2, paragraph 3.**

C. F75 The discussion of the fate and persistence of AMPA (page 52) is inadequate [commenter used 2,4-D/AMPA but it appears that glyphosate/AMPA was intended]. 29.10

R. F75 **The study by Paveglio et al. (1993a) does not contain any additional information regarding fate and persistence of AMPA to add to the EIS.**

C. F76 Please include information on the toxicity of 2,4-D to amphibians as this was not addressed in the EIS and freshwater is important amphibian habitat. (28.5, 35.16)

R. F76 **2,4-D toxicity data is not available for amphibians.**

C. F77 Toxicity of 2,4-D to aquatic invertebrates, soil micro-organisms, ectomycorrhizal fungi of value in normal vascular plant growth, and non-target species must all be considered when contemplating use of 2,4-D. (28.7)

R. F77 **Agreed. As evident in Ecology's proposed mitigation section (Appendix 1), mitigation has been proposed to lessen potential effects. We have proposed limiting possible formulations to use of the DMA formulation of 2,4-D, which is less toxic to invertebrates. We have also included application restrictions to lessen the potential for impacts to non-target species from spray drift.**

C. F78 Please clarify an apparent discrepancy between text (page 46) that states 2,4-D is relatively mobile but groundwater contamination is only "infrequently" reported and information that there have been several cases of 2,4-D groundwater contamination in several areas in the US. (29.6)

R. F78 **2,4-D is relatively mobile, however groundwater contamination with 2,4-D has not been widely reported, and reports indicate it is most often associated with point sources, such as spills.**

C. F79 The EIS does not reflect available data, and in several instances the text states that studies are not available or are incomplete when they are, in fact, now available. For example, the EIS states that eye and dermal irritation, and dermal sensitization studies, are needed but these studies have been submitted and approved by EPA. Also the EIS states that effects on reproduction in animals include fetal malformation in rats when there are at least 12 new studies in rats and rabbits that indicate no fetal malformations occur at dose levels tested. In all cases, maternal effects were evident at or before fetal effects. We will send you additional studies per our agreement and would appreciate your consideration of this new information. (26.1)

R. F79 **Information received from the 2,4-D task force included specific proposed changes to the text of the EIS and technical appendices. Many of these proposed changes were based upon fulfillment of several re-registration requirements that occurred either concurrent with or subsequent to our finalizing of the technical documents upon which the EIS is based. Review of the numerous studies recently accepted by EPA represents a significant amount of work that cannot be accomplished within the EIS timeline.**

Changes in the status of 2,4-D registration have been noted in the EIS text. Tables generated by EPA's Office of Pesticide Programs that summarize the reregistration status of 2,4-D as of September 1993 are included as Attachment 1 to this RS. However, the analysis of 2,4-D and potential impacts has not been changed because we have not evaluated these new studies. These revisions will require significant evaluation within the full context of all new information submitted for re-registration. Additional analysis will occur though one of the many SEPA mechanisms available for updating analysis, which include addendums and supplemental EISs. This analysis will be postponed until EPA completes its review of the potential carcinogenicity of 2,4-D, allowing for a more comprehensive review that encompasses all available data.

With regard to the task force concern that the industry was not contacted for 2,4-D, it is noted that representatives of the task force were contacted last fall as the technical appendices were being developed. Additionally, Dr. Dost reviewed the technical appendices on behalf of the task force and his comments were incorporated into the technical documents where appropriate. Information contained in comments on the draft EIS would have been considered for inclusion had it been made available during development of the technical documents.

C. F80 Carlo 1992 is cited as suggesting that results of 2,4-D research barely achieved statistical significance and therefore should not be considered as evidence of carcinogenicity in animals. Because the chemical industry is responsible for this, this objection should be dismissed. (7.1)

R. F80 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F81 Though the "Fingerhut Study" found a 46% increase in all cancers, Carlo claimed this study cleared dioxin as a human carcinogen. EPA has determined that dioxin is a human carcinogen and causes birth defects. (7.3)

R. F81 **A great deal of controversy exists concerning the carcinogenicity of both dioxin and 2,4-D. Many scientists are in disagreement with EPA's stance regarding 2,4-D carcinogenicity, thus it is not surprising that the EPA's rulings are placed under scrutiny. Each study cited in the EIS was reviewed for validity, and where there were concerns about acceptability, these were stated. The fact that this author has disagreed with EPA on other issues does not mean that all of his opinions should be considered invalid.**

C. F82 "Veterans and Agent Orange: Health Effects of Herbicides Used in Vietnam"(National Academy of Sciences' Institute of Medicine, 1993) to conclude that there is a positive association between 2,4-D and 2,4,5-T and development of non-Hodgkin's lymphoma, Hodgkin's Disease, Soft-tissue Sarcoma, Porphyria Cutanea Tarda and Chloracne, and a limited association between exposure and development of "Respiratory Cancers (Lung, Larynx and Trachea), Prostate Cancer and Multiple Myeloma." (7.4)

R. F82 **Appendix G evaluated the major studies of human carcinogenic effects of 2,4-D and a summary of that information was included in the EIS. The new report on Agent Orange is a review of all of the studies involving human exposure to 2,4-D, 2,4,5-T and its contaminant TCDD, and two other pesticides. It does not provide any new data that are specific to 2,4-D and is therefore not appropriate to evaluate for the EIS.**

C. F83 Known or suspected health effects of 2,4-D include carcinogenesis, mutagenesis, and prenatal damage (March - May, 1990. (7.5)

R. F83 **All of these health effects are covered in Section 4.5.2.**

C. F84 Any EIS that fails to examine and report the pros and cons of chemical science promotes the status quo. Failure to report negative health findings does not meet requirements of an unbiased report. (7.6)

R. F84 **Potential impacts to human health were evaluated in the human health risk assessments conducted for glyphosate and 2,4-D (Appendices F and G) and are summarized in Sections 4.5.1 and 4.5.2 of the EIS.**

C. F85 Please correct text to reflect that the number of states where the Experimental Use Permit may be granted has dropped from 22 to 17 (page 4-1). (27.1)

R. F85 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F86 Please credit V. Carrithers as the source of Garlon 3A/purple loosestrife information. (27.2)

R. F86 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F87 Please exclude information regarding Triclopyr ester from the EIS, because this is a product (Garlon 4) which is not approved for aquatic use nor is it pending for aquatic registration. The reference may be confusing. (27.3)

R. F87 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F88 Please credit Gerich, et al, and Mayes, et al. for the 2 studies discussing fathead minnows (section 4.5). (27.4)

R. F88 **Comment noted. Changes to the text of the technical appendices were considered only where such changes affect EIS findings.**

C. F89 Surfactants should have a separate subsection within the "impacts" sections or superficial discussion of surfactant toxicity should be removed and surfactants discussed only relative to use to increase pesticide efficacy. (39.6)

R. F89 **Comment noted.**

C. F90 Discussion of impacts of trace impurities in herbicides and surfactants are speculative and irrelevant, and should be deleted so as not to cause unnecessary alarm to the public. Toxicity of these constituents has already been factored into assessments of impacts to human health and the environment through lab and field tests. (39.7)

R. F90 **The comment states that all of the toxicity studies used Rodeo®, so all of the toxicity from impurities is already factored into the studies. Some of the studies used Roundup® which contains a surfactant, and other studies used various surfactants or no surfactant with glyphosate. Because the toxicities of the surfactants vary, it is important to include specific information about them so that an informed choice can be made if surfactants are used. The information about trace impurities that was included in the EIS indicated that they were unlikely to cause adverse human health effects.**

C. F91 Please revise discussion of USFWS research to reflect correct information [see letter for proposed changes: specific comments 1 through 6]. (39.8)

R. F91 **Comment 1- A discussion of application rate has been added to the Final EIS based upon review of the final Simenstad report.**

Comment 2- See Section 3.5.3, paragraph 6.

Comment 3- See Section 3.5.3, paragraph 6.

Comment 4- See Section 3.5.3, paragraph 10.

Comment 5- There is no supporting evidence given with this statement. No changes were made to the EIS.

Comment 6- The final results from Simenstad et al. (1993) are included in the Final EIS.

C. F92 The USFWS finds information from published literature and studies conducted last year sufficient to justify the use of Rodeo® in marine and freshwater ecosystems for noxious emergent weed control. Additional information is useful and should focus on herbicide efficacy. (39.15)

R. F92 **Comment noted.**

C. F93 Please add to additional information needs (page 136):

a Efficacy of Rodeo® plus various surfactants plus ammonium sulfate.

b Glyphosate efficacy and tidal exposure.

c Spray drift and efficacy from use of boom and ball aerial applications. (39.20)

R. F93 **The question of ammonium sulfate (comment a) was addressed in response to comment F 46. Efficacy of glyphosate and efficacy of application methods (comments b,c) are addressed in the second bullet under Glyphosate Information Needs in the Final EIS text.**

C. F94 We do not agree that additional information is needed for the following (page 126):

a) Toxicologic studies. Glyphosate impacts on higher trophic levels such as aquatic birds [glyphosate concentrations much higher than expected in the field resulted in body burdens of aquatic food chain organisms tested (LC_{50}) hundreds to thousands times lower than those found to impact waterfowl and quail]. It is unlikely that other birds would be orders of magnitude more sensitive than the tested species.

b) Chronic studies of impacts of glyphosate on marine fishes (tides replace water twice a day). Impacts of glyphosate on salmonids have been extensively studied (published literature/field and laboratory), including acute toxicity tests (seawater challenge) on fry and smoltification. (39.21)

R. F94 **a) The possibility exists that perching birds and those that utilize wetland areas may have different tolerances than those tested.**

b) The text suggests that some very specific chronic toxicity studies be performed on marine fish for which no data exists (i.e. behavioral changes). It also recommends evaluating effects from repeated exposures. Neither of these have been evaluated and are valid concerns.

C. F95 Glyphosate will be applied once per year, so information on persistence for repeated, within year treatments, is unnecessary. Paveglio et al. (1993) found significant declines in glyphosate and surfactant concentrations within four months of treatment. It is highly unlikely that detectable or biologically important levels will remain one-year post-treatment. (39.16)

R. F95 **The study by Paveglio et al (1993a). reports that glyphosate concentration in sediment decreased by 57% (from 1.73 to 0.75 ppm) at 119 days post-treatment.**

Assuming that this disappearance rate remains constant, the concentration of glyphosate in sediments after one year will have decreased approximately 90%. While it is likely that this is not a biologically important concentration, it is not known with certainty. Additionally, the label allows application at a rate almost twice the amount applied during this experimental application. No information is available regarding persistence at this higher application rate.

Available information suggests that application to a site more than once per season is being contemplated.

C. F96 The real concern is that false public perceptions of biocides will cause the estuary to be lost (see discussion buried in Appendices EB, Section 3 that is not carried forward to the EIS). It is important that sound public policies, particularly regarding the use of chemicals in the environment, be determined by an informed public. The EIS must allow this determination to be made from an unbiased and balanced appraisal of all aspects. (18.6)

R. F96 **All efforts were made by the authors to produce an unbiased and balanced EIS document. All data contained in this document were critically reviewed. The document identifies where data are uncertain or contradictory. In such instances, the authors' best professional judgement was given. The intention of this EIS is to state what is known, and to identify what is unknown, thereby helping in the decision making process.**

C. F97 The fact that inert ingredients are proprietary information makes it nearly impossible to adequately assess health impacts. (7.2)

R. F97 **Inert ingredients are part of the glyphosate formulation; therefore, studies of the health effects of glyphosate will also evaluate the health effects of these ingredients.**

Through our assessment we discovered that information on adjuvants is limited, and thus decided that only those specific adjuvants evaluated in this EIS (three surfactants) would be considered in our permit decisions. Other adjuvants would be considered case by case on an experimental basis only.

C. F98 Tables 7 and 8 should be moved to impacts section.

R. F98 **Comment noted.**

C. F99 Tables 7 and 8 should be amended to reflect the following:

a Citations are not provided for all studies cited;
b USFWS work not included;
c To be consistent with previous tables, Table 7 should discuss the most applicable use situations and limitations for various application methods including aerial application with boom and spray ball; hand-held application with back-pack sprayer, or wick; and hand-held broadcast sprayer by boat, hovercraft, truck, or ATV. (39.33)

R. F99 **See Section 3.5.1, Tables 7 and 8.**

a Except for new studies that were not in the original Appendices, references were omitted from the EIS and readers were referred to the Appendices.
b See Section 3.5.1
c The applicable use situations and limitations for application methods are included in the text of Section 3.5.1.

C. F100 Include a complete description of Rodeo® application conditions per label requirements (page 50). (39.34)

R. F100 **A complete description of Rodeo® application conditions per label requirements is not included here because of its length (label booklet and supplemental label is about 8 pages). However, it is contained in Appendix E, Pesticide Characterization.**

C. F101 Non-target vegetation impacts from glyphosate will also depend on plant-surface moisture (page 125). (39.42)

R. F101 **No supporting documentation is given for this comment. Changes were not made to the EIS.**

C. F102 Note that Fresh's work was part of the fate and effects studies (page 125). (39.43)

R. F102 **See Section 4.5.1, paragraph 6.**

C. F103 Non-target plant impacts may be avoided by treating when mudflats are immersed but *Spartina* is not (low tide) (page 126). (39.44)

R. F103 **This possible method of mitigation is contemplated in the Appendix 1-Proposed Agency Mitigation Measures. Experimental trials of this potential mitigation measure would be required.**

C. F104 Delete highly speculative reference to synergistic effects of glyphosate and carbaryl. Carbaryl is applied in June and glyphosate in August, so synergism is highly unlikely. Carbaryl is applied to oyster beds infested with ghost shrimp, which rarely occur in the intertidal zone occupied by *Spartina* (page 129). (39.45)

R. F104 **Please see response to G.14**

C. F105 *Spartina* needs to be treated before flowering (Mitigation, page 15). (39.46)

R. F105 **Please see information provided by Monsanto in response to comment number F.46**

C. F106 Restricting treatments to periods offering at least 4 hours without tidal inundation is arbitrary because additional information regarding exposure period is needed (mitigation 14-15). (39.47)

R. F106 **The pesticide label recommends avoiding wash-off for 6 hours after application.**

G. Integrated Weed Management Alternative

C. G1 The document needs to present a solid, one sentence, clear definition of Integrated Weed Management followed by the usual caveats and explanations (there are a variety of definitions floating around).(5.12)

Same comment made for several areas of EIS, including:
Page xvi, 3rd para.
Page 54, 3.6.1

R. G1 **The definition of Integrated Weed Management found in Section 3.6.1 is adequate for the purposes of this EIS. The definition has been debated for years, and the definition included in the EIS is based upon the federal definition.**

C. G2 Replace "continuous monitoring and evaluation" with "ongoing inventory of habitat" (page 55). (5.37)

R. G2. **See Section 3.6.1, paragraph 2.**

C. G3 Discussion of IWM lacks clarity/is not useful (see comment for specifics, and Willapa specific example) (5.38, 10.32)

R. G3 **The discussion of IWM presents a conceptual framework and is not intended to apply to particular species or infestation situations. It describes the process of IWM implementation. The example of a preliminary approach to developing a control program for Willapa Bay outlined in the comment letter is valid, but is inappropriate for inclusion in the EIS.**

C. G4 The text (page xvi, 3rd para) grossly mischaracterizes IWM in stating that preventing establishment of new invaders is the top priority and eradication of established invader populations are the second and third priorities while Figure 2 (page 50) does not list eradication as an objective for established invaders. Please clarify. (35.11)

R. G4 **By definition (Section 3.6.2, paragraph 5), established invaders are "noxious weeds whose population density and distribution are such that all seed production cannot be prevented within a specific site." By this definition, eradication of established invaders is not possible.**

C. G5 The damage and action threshold concept as stated on page 57 is not applicable where eradication is the goal, such as *Spartina* estuary infestations. (5.39)

R. G5 **See Section 3.6.2, paragraph 9. The damage and action thresholds can reflect either actual or potential environmental damage, and are set at one plant if eradication is the goal.**

C. G6 Discussion of plan development (Page 58), is not useful for general reader. Actual dynamics of *Spartina* in estuaries are not represented by use of terms such as core, perimeter, and outlier populations. (5.40)

R. G6 **The basic concepts discussed in this section are valid, but designations of core, perimeter, and outlier populations do not apply to all sites, especially if sites are defined as large areas, such as Willapa Bay. These concepts could still be used in relation to specific clusters of colonies within Willapa Bay.**

The EIS is not designed to dictate or present a control plan. This is the responsibility of land management agencies, noxious weed boards, and private landowners, with input from the appropriate regulatory agencies. The colonization patterns vary widely in Willapa from one site to another, and do not resemble the colonization patterns in the

Puget Sound, San Juan Islands, or the other coastal estuaries. Each site will need its own approach and goals. DNR feels that eradication of outlier populations in the Copalis estuary, Grays Harbor and Argyle Lagoon is essential as these populations have already reached critical action thresholds.

C. G7 Efficacy table (pages 66-67) is inaccurate. Assumptions that glyphosate efficacy is low to medium and that burning is efficacious is erroneous. Classification by terms noted in comment 5.40 not useful for *Spartina*. Clarify definition of "new invader" and "potential new invader." (5.41)

R. G7 **See changes to Table 9. Burning can be effective at containing *Spartina* populations, especially by preventing seed set. See response to comment G6 regarding classification of infestation areas. New invader and potential new invader are defined in Section 3.6.2, paragraphs 3 and 4. Glyphosate efficacy for seedlings could be low, while its efficacy for controlling pre-flowering plants could be high, however results have been extremely variable. Glyphosate efficacy is also affected by weather conditions, tides, and the experience level of the applicator.**

C. G8 Section 4.0 is too complicated. (5.42)

R. G8 **Given the vast amount of information presented, the existing EIS organization was developed to keep to a minimum repetition and confusion, and remain in compliance with SEPA rules. We regret any difficulties you encountered in reviewing this EIS. Any specific suggestions for improvement would have been considered.**

C. G9 The suggestion that volunteer labor be used is disturbing especially for chemical applications. (10.33)

R. G9 **Volunteer labor is best utilized for mechanical and physical removal of noxious weeds. For example clipping and bagging the seed heads of purple loosestrife before seed production occurs or digging and bagging the entire plant are each methods suitable for volunteers. There are many examples of volunteer labor being used with great success in not only actual removal of weeds but in restoration of sites. WDW has prepared a booklet entitled "<u>Organizing Volunteers To Control Purple Loosestrife</u>".**

Any application of a restricted use chemical would need to be performed by licensed individuals or those working under the close

supervision of such an individual. All pesticides labeled for aquatic use are Washington State restricted-use pesticides.

C. G10 Additional research should be conducted while a control program is implemented, including (11.4):

a effects of glyphosate on phytoplankton,
b surfactants, and
c biological control plan.

R. G10 **These are among research needs that have been identified in the EIS. We agree that continued research and information gathering should be a component of Integrated Weed Management.**

C. G11 Monitoring effects of glyphosate applications should be conducted to fulfill additional information needs, including (28.2):

a Effects on phytoplankton; and
b Biological effects in the marine environment of glyphosate and the surfactant.

R. G11 **The level of monitoring required would vary depending on areal extent of any proposed activity, and possibly method of application. Comments received during the permit review process would be used in developing monitoring requirements.**

Based on previous research as reported in the EIS, impacts from a single application at the highest label rates for hand spraying are not anticipated where appropriate mitigation is employed. Labels for aerial and broadcast spray applications allow rates double those for which efficacy and impact data are available.

C. G12 Variable efficacy should be contemplated when making decisions regarding use of glyphosate. (28.3)

R. G12 **Comment noted. We agree that the causes of variable efficacy should be determined. The Department of Agriculture believes that the apparent variable efficacy is more likely to be a result of the variable conditions of application and skill of applicators than any inherent problem with glyphosate. Site specific situations may impact efficacy of glyphosate. For example, the higher rate listed on a label (up to 7 1/2 pints) may be required for extensive infestations for acceptable efficacy.**

C. G13 EPA agrees that impacts to eelgrass and other native species should be mitigated. (28.4)

R. G13 **Comment noted.**

C. G14 It is imperative that IWM strategy include funding for continued research into chemical toxicity, persistence, and potential effects of synergism. At the least, we need more information regarding human health impacts related to synergistic effects of carbaryl and glyphosate/surfactant since these are both proposed for use in Willapa and the EIS indicates persistence of glyphosate for a period that may last for 4 months. (29.2)

R. G14 **In addressing concerns of the Shoalwater Bay Tribe about interaction between glyphosate for *Spartina* control and carbaryl for burrowing shrimp control, particularly in Willapa Bay, a fundamental issue is whether or not the two chemicals actually have an opportunity to interact in any significant concentration. Current practice of carbaryl application is one application during the season, timed to coincide with the extreme summer low tides and warm weather; generally around the first of July and only on the specifically approved (400-800 acre) areas for that season. This is scheduled to maximize the time between the tidal inundations and maximize the environmental conditions that allow the rapid breakdown following the bed contact time.**

The 1992 SEIS on the use of carbaryl for burrowing shrimp control concludes that the persistence of carbaryl in environments such as Willapa Bay and Grays Harbor in summertime is relatively short. Numerous studies are cited. Generally the breakdown of carbaryl is accelerated in an alkaline, aqueous condition. A 1987 test done by WDF generally found that on Willapa Bay sediments, only 1% of the original concentration was present after 1 day; results showed near background concentrations after 16 days. These tests were conducted in mid-July, comparable to real treatment times.

The conclusion is that given current practices for the application of carbaryl and for glyphosate, it is unlikely that the chemicals would have any realistic possibility of contact that would allow some adverse synergism.

C. G15 We also understand that additional research needs can be bottomless and be utilized to delay or justify delay of an effective control program. Do not let the information needs delay control. (11.3, 14.2, 18.12)

R. G15 **We do not intend to delay a control program, but we will need to ensure through the permit process that critical information is developed through monitoring and evaluation of impacts associated with various treatment methods.**

C. G16 The goal of *Spartina* control should be eradication because a goal limited to control would require active control measures "forever" that would result in greater costs in the long run. (14.3)

R. G16 **The EIS discusses situations in which eradication is an appropriate goal in Section 3.6. The choice of control strategy depends on specific characteristics of targeted infestations.**

While the ultimate goal of eradication is admirable, it may not be achievable in all instances. Specific goals will be set in IWM plans for each geographic area, along with priorities for control. The law and administrative code require "control" and "containment" of a Class B Designate; only Class A Noxious Weeds must be eradicated.

C. G17 Our understanding of the philosophy underlying IPM is using chemicals only as a last resort. Is this the philosophy presented in this document? (22.9)

R. G17 **The philosophy of using IWM is to use control methods that are effective and minimize environmental impacts. Potential impacts of implementing all potential control methods are weighed on their own merits.**

C. G18 The EIS discussion (pages 57, 58) of public involvement in IPM needs to address the following questions (29.12):

a Will treatment schedules be provided to the public?
b Will the public have input on scheduling?
c Who will review and evaluate specific strategies?
d At what stage will the public become involved?
e How much deference will be given to the public? (29.12)

The public should be informed of all research, which could be accomplished through regularly scheduled progress reports. (29.14)

R. G18 **Progress reports are a good idea. The public has been involved as part of the EIS process.**

Numerous jurisdictions and private landowners will be treating emergent noxious weeds by various methods. Co-lead agencies do not have the jurisdiction or regulatory authority to require public involvement for all of these control efforts. Each agency does have public involvement policies that would be in affect for activities over which we do have jurisdiction. Public participation and ownership in plan development of larger infestations on public lands would be desirable.

Development of management plans will include the public. The opportunities for public are available through existing county noxious weed boards, local environmental groups such as The Willapa Alliance, Beach Watchers, The Native Plant Society and The Nature Conservancy.

C. G19 The public should be informed of the mode, location, timing, and scope of herbicide applications. 29.13

R. G19 **Permit applications requesting the use of pesticides in water are circulated to agencies with interest or jurisdiction for review. Among agencies to which these applications are normally routed are Fisheries, Wildlife, local governmental agencies in the proposed treatment area and potentially affected tribes. Any agency with interest or jurisdiction who does not currently receive this information may ask that Ecology add them to the circulation list for proposals that occur within their area of interest or jurisdiction.**

Additionally, any person can request and comment on these proposals. When Ecology is SEPA lead agency for projects proposing use of aquatic pesticides, it publishes notice of SEPA activity in the SEPA register, which is issued each week. This published information is, in essence, notice that Ecology is beginning consideration of a proposed pesticide application to water or other activity that requires a permit. Interested persons will need to review this SEPA Register for notification of projects proposed in their area of interest.

To receive your personal copy of the weekly publication, the SEPA Register, you will need to call the Department of Ecology [(206) 407-6923] and ask to be put on this mailing list.

There may be cases where agencies other than Ecology are the SEPA lead. This may happen, for example, when the Departments of Natural Resources, Wildlife, or General Administration propose control activities on lands that they manage. It is likely that these

projects would also require some type of SEPA activity and as such, these proposals would also be reported in the SEPA register.

We also encourage agencies that are developing Integrated Vegetation Management Plans to incorporate into this planning process a mechanism for public input. Where any of the agencies that are cooperating in this EIS are responsible for developing a Integrated Management Plan, we will ensure that the public has a substantial role in Plan development.

C. G20 *Spartina* currently occupies approximately 2,500 of 47,000 acres (5%) of intertidal area in Willapa Bay and smaller percentages in other coastal areas of Washington. Though *Spartina* may never be eradicated from Willapa bay, it should be considered a Priority Level II (as described in Section 3.6.3) rather than level III infestation based upon its occupation of available habitat.

It is inappropriate to wait for *Spartina* infestations to reach a particular threshold before initiating treatment, as advised under Priority III.

Priorities should be assigned based upon areas-wide infestations such as Willapa and Padilla Bays, and Grays Harbor because *Spartina* is in early stages of infestation in the Pacific Northwest (small management sites per Appendix 2 are not appropriate).

Implementation of immediate, aggressive control of *Spartina* infestations by federal, state, and private land managers could prevent spread of *Spartina* and control existing infestations. Management recommended in section 3.6.3 would require years of control to contain *Spartina*, resulting in long-term disturbance from control methods.

Level III Action (use of all appropriate control methods for containment of the plant at an acceptable level) is appropriate where established, ubiquitous weeds, such as purple loosestrife, exist. (39.4)

R. G20 **A site can be defined as narrowly or broadly as needed, and can include a large area, such as Willapa Bay. Likewise, assignment of priority level depends on many factors, including potential for invasion. The infestation at Willapa Bay could be designated as Priority II, based on its relatively recent arrival. Action and damage thresholds are based on a number of factors, as described in the EIS, and can be set at one plant. These decisions must be made by weed managers for each infestation. The fictitious scenarios presented in Appendix 2 are not intended to represent any particular infestations**

and should not be interpreted to represent the situation in Willapa Bay.

C. G21 Please amend Table 9 to reflect the following:

a Discuss herbicide by application method;
b Cutting or mowing will only contain or reduce *Spartina* if mowed to the mud for 8 months;
c Table should note that efficacy of mechanical crushing, burning and flaming, and grazing are based on speculation.
d Flaming is used to stop seed production and will not contain or reduce plant spread by rhizomes;
e For maximum efficacy, glyphosate should be applied to *Spartina* as it begins to flower (August, plant just beginning to sprout in April). (39.35)

R. G21
a Application methods are described in Section 3.5.
b Footnote 1 of Table 9 specifies that efficacy depends on several things, including techniques used in implementing control measures, application timing, and number of treatments.
c The paragraph in which Table 9 is introduced (Section 3.6.4, paragraph 2) indicates that selection of management methods is based on "best professional judgement of the authors, state agency reviewers, and other scientists with technical expertise and is based on balancing efficacy against consideration of environmental impacts." See appendices for additional information used during the selection process.
d See Table 9.
e Table reflects Rodeo® label recommendations for application during the actively growing stage.

H. Implementation of Management Alternatives

C. H1 The EIS should include a *Spartina* control plan that outlines conditions under which various alternatives should be used. (11.5)

R. H1 **A *Spartina* control plan does not need to be part of the EIS. Plans do need to be written. A programmatic EIS for all noxious emergent plants cannot provide the level of detail suggested in this comment. Conditions vary dramatically for the three *Spartina* species alone, let alone purple loosestrife's statewide populations. The populations also change yearly.**

C. H2 As described in the EIS, IWM appears to be a recommendation to do what is thought best and that in practice people will do whatever is easiest without consideration of long term environmental consequences. (10.11)

R. H2 **Comment noted. This is a valid point. Humans tend to do what is easiest. The ability of a landowner to develop plans may also be limited by resources.**

Activities requiring a short term water quality modification permit would be guided by the permit process and the EIS process. Ecology has considered requiring that applications for these permits be accompanied by Integrated Management Plans. However, Ecology does not currently have the resources to establish standards for, let alone review, any such plans. We will have to rely on landowners and local expert agencies such as local weed boards to develop plans for areas where co-leads are not responsible for control activities.

C. H3 Few can fault IWM as a concept with a firm basis in common sense, but IWM could stagnate the whole process. *Spartina* will continue its expansion as people with divergent views debate implementation and evaluate progress. The EIS should evaluate the human aspect of IWM. (18.10)

R. H3 **This is an interesting idea, but beyond the scope of the EIS. According to state law, *Spartina* is designated for mandatory control in designated regions.**

C. H4 Where can I get help with specific noxious plant management problems such as identifying noxious plants and developing a management strategy? Are field guides or color brochures available that can help citizens identify noxious species? (1.2.)

R. H4 **Your best source of help will be your county noxious weed control board. They will be able to identify weeds, alert you to noxious weeds that you will likely encounter, and suggest control options. You can also purchase the text, <u>Weeds of the West</u> for general weed identification, and many noxious weed bulletins from your county Cooperative Extension office. Help is also available from a number of other sources, including: County Cooperative Extension Offices, the Washington State Noxious Weed Control Board, and the Washington State Department of Agriculture.**

Please see Attachment 2appendices to this responsiveness summary for a complete list of local weed boards and extension offices.

C. H5 Does the EIS include all available information on all available alternatives (does it review all available literature on results of control programs throughout the U.S.)? (1.3.)

R. H5 **Co-lead agencies, Ebasco Environmental, and the ACOE conducted a thorough search for information regarding control alternatives. EIS development consisted of an very intense period of locating, reviewing, and incorporating into technical documents all available literature. This effort was completed in the early months of 1993. With few exceptions, the draft EIS is based exclusively on information contained in these technical reports.**

Since the time the technical reports were completed, we have learned of purple loosestrife control projects in other areas of the U.S. from which we might gain additional information regarding effectiveness of various methods. Our understanding is that these are research projects that are not yet complete. As our budgets allow, we will compile this information into subsequent SEPA documents (addendums, supplementals, etc.) and will use it as we develop integrated management plans.

C. H6 We support Integrated Weed Management (IWM) to maximize efficacy and minimize negative impacts. (4.1., 11.2, 14.1, 20.1, 28.1)

R. H6 **Comment noted. We appreciate your support for our preferred alternative.**

C. H7 We support adoption of the DEIS. *Spartina* is spreading at an alarming rate and needs to be dealt with immediately. (21.1)

R. H7 **Comment noted.**

C. H8 The Willapa Alliance offers the help of staff and board members in developing and implementing the IWM action plan. (4.3)

R. H8 **Comment noted. Your support for IWM and your involvement in the developing and implementing a IWM action plan in your area is appreciated.**

C. H9 A Willapa Bay Management Plan will be developed that will entail:

a Organizing into subareas,
b Selecting by subarea the most effective management alternatives;

c Scheduling to coincide with appropriate plant growth and reproductive stages;
d Monitoring effectiveness and environmental impacts;
e Adjusting plan based upon results of monitoring;
f Developing appropriate mitigation measures.

A Willapa Bay *Spartina* Management Task Force will be organized to:

a Inventory subareas;
b Assess environmental consequences of various combinations of management alternatives;
c Develop a management plan and schedule;
d Organize public review of management plan and results of monitoring;
e Assist and inform private landholders;
f Coordinate management activities of public agencies and private landholders;
g Monitor and evaluate efficacy and impacts of the management plan.

As a Willapa Bay *Spartina* Management Task Force sub-committee, local experts will compile information and develop management options for the Willapa Bay Integrated Weed Management Task Force. (4.2.)

R. H9 **Comment noted. Your efforts and interest are appreciated and supported.**

C. H10 The Soil Conservation Service should be consulted for site specific information regarding soils. The environmental characterization discussion of soils is too brief to be useful (Page 10). (5.17)

R. H10 **See Section 2.1.3, paragraph 1.**

C. H11 Areas too difficult to mow are best controlled by chemicals. (9.a.2)

R. H11 **The comment is understandable but may not always be true. For areas too difficult to mow, there may be other feasible alternatives as well as chemical control. The IWM strategy means that the whole range of strategies available would be considered depending on the nature of the control site.**

C. H12 Will control activities be limited to alternatives assessed in the EIS so that we could not explore potentially better methodology such as use of a totally innocuous spray additive that is not assessed in the EIS (such as

ammonium sulfate), or a fall application of Rodeo® applied with 200 gallons of Rodeo® (this allows high penetration of dense canopy and has been successful in New Zealand)? (9.b.2)

R. H12 **All the co-lead agencies are committed to continuing the search for improved methods and tools that, depending on the assessment of impact, could be added by supplement or addendum to the EIS.**

Use of experimental methodology outside that considered in the EIS would be evaluated for permitting on a case by case basis. It is not precluded.

C. H13 Recognizing the difficulty and expense of managing *Spartina* and that there are no easy answers, action should be taken at the earliest opportunity to at least stabilize the *Spartina* infestation. (11.1)

R. H13 **Comment noted.**

C. H14 No action could be the ultimate result if funding is not available, though political or regulatory delay and/or indecision, or if use of an effective and safe chemical is blocked by regulations. 18.2

R. H14 **Comment noted.**

C. H15 Little Purple Loosestrife control will be accomplished without the support of involved agencies, the Governor's office, and financial support from the Legislature and Congress. This should be the first step after the EIS.

Native plants communities have been disturbed in many ways in Washington, so to maintaining wetlands will require intervention on the side of native and/or benign neglect. (13.7)

R. H15 **Comment noted. The appropriate agencies will continue to seek legislative appropriations necessary to support noxious weed control activities within the normal budgetary process.**

C. H16 The most important aspect in this management process is time. At what point will action be taken? (8.27)

R. H16 **Some physical control methods (e.g. hand pulling and mowing) are available and are being conducted now. Co-lead agency decisions regarding management options can be made 7 days after issuance of the final EIS. We intend to begin additional management activities by 1994.**

C. H17 What has Washington State done to control *Spartina* at Damon Point, and how does this jive with Priority II efforts to deal with New Invaders? (35.13)

R. H17 **WDF has issued HPA approval to DNR for mowing of the sites near Damon Point during both 1992 and 1993.**

I. Regulatory Authority

C. I1 Please correct section 5.1.1 to reflect that Weed Districts are formed under 17.04 RCW and Intercounty Weed Boards are formed under 17.06. (13.6)

R. I1 **See Section 5.1.1, paragraph 2.**

C. I2 We support the idea of inspecting/cleaning boats, but how would this be enforced (page 61)? (35.12)

R. I2 **We would consider this in the context of existing regulatory authority, such as noxious weed quarantines.**

C. I3 Because Rodeo® may persist up to one year, spray schedules may overlap, and short-term modifications can last up to one year, Water Quality Standards may be violated continuously. (35.16)

R. I3 **Research indicates glyphosate has persisted up to one year in estuarine environments. The levels at which it may persist were not reported but are expected to be low (based on Willapa residue analysis). Given existing toxicity data, it is not anticipated that water quality standards would be violated. This issue as identified as an additional information need, and will be factored into Ecology's permit decisions.**

C. I4 Since mitigation measures (page 122) do not limit usage of Rodeo®, what would prevent its daily use and what would this do to Water Quality Standards. (35.17)

R. I4 **The daily use of Rodeo® in Willapa Bay is not even a theoretical possibility. The application of Rodeo® requires a combination of low tides and favorable weather that occur only a few times during the potential application season. There are other application constraints such as restrictions when salmon smolts are present (DOF). There are a number of other practical constraints not the least of which is cost. Rodeo® is expensive and application must be by a person**

licensed for aquatic applications. In addition there are the constraints of the short term water quality variance.

C. I5 Please make more clear that the state law requires noxious weed control, but that this means prevention of seed production, and not eradication (see section 1.1, page 1, and page 55). Little information is provided how seed production is related to *Spartina*.(35.12)

R. I5 **See Section 1.1, paragraphs 3 and 5. State law 17.10.150 requires that the owner eradicates all Class A noxious weeds and controls and prevents the spread of Class B designate weeds. In 16-750 WAC, "prevent the spread of noxious weeds" is defined as "contain," which is defined as "to confine a noxious weed and its propagules to an identified area of infestation." For Class B designate weeds, control means eradication for annual and biennial plants because without seed production, the species will be eradicated. For perennials, control will not necessarily lead to eradication. However, existing infestations will not be allowed to spread from the area currently occupied by roots, rhizomes, stolons, tubers, etc.**

C. I6 Is control of *Spartina* achieved by stabilization of existing *Spartina* colonies as long as seed production (as opposed to vegetative propagule) does not occur? Section 3.5.3 should clarify this. (35.25)

R. I6 **Please note the answer above. Control requires that seed production is stopped and that no vegetative propagules spread from the site.**

C. I7 Given that entities involved are the same, why are ghost shrimp and *Spartina* issues categorically divided? (22.7)

R. I7 **The EIS and a supplemental EIS for the treatment of ghost shrimp has already been completed. See "Supplemental Environmental Impact Statement, Use of the Insecticide Carbaryl to Control Ghost and Mud Shrimp in Oyster Beds of Willapa Bay and Grays Harbor", prepared by the Washington Department of Fisheries and the Washington Department of Ecology, March 31, 1992. In terms of environmental documentation, the considerations for emergent noxious weeds are in fact very different than those for control of ghost and mud shrimp.**

Many of the persons involved with ghost shrimp control in Willapa Bay are also concerned with *Spartina* control. However, noxious emergent weed issues are much broader than Willapa Bay. In

addition, the problems of ghost shrimp and *Spartina* are separate problems with a separate set of needs and control options available.

C. I8 The conflict between the regulatory and management functions within and between agencies will probably be the most serious hurdle to achieving an acceptable solution to the *Spartina* invasion. (18.15)

R. I8 **This EIS has been developed as a cooperative effort between the resource agencies. All have agreed that *Spartina* control is desirable and are committed to following the guidelines of the EIS.**

C. I9 The lack of management expertise in at least three agencies is disconcerting. (18.16)

R. I9 **DNR is a land management agency, and will be drafting the integrated management plan for *Spartina* on state owned aquatic lands. DNR will also be working with neighboring land owners, including private, county, state, and federal entities, to insure that we are moving in a common direction, with similar goals. Regulatory agencies will be involved to provide input, and to insure that the permitting process goes smoothly.**

C. I10 State agencies can conjure up regulations but cannot design and implement a management strategy. (18.17)

R. I10 **Comment noted. The intent of this programmatic EIS is to put together basic elements or components that can be used to develop a plan. The implementation will be most effective if locally directed. Additionally, actual control is beyond the duties of some of the co-lead agencies who do not have land management mandates. Despite this lack of mandate (and correspondent funding), these agencies have a strong interest in ensuring that impacts associated with noxious weeds are minimized, and as such can and will help facilitate the design of management plans.**

C. I11 When agency decisions are not based on scientific evidence the result can be irreversible environmental and economic damage, the very situation these public employees are required to prevent. (18.19)

R. I11 **We agree and for this reason initiated the EIS process.**

C. I12 Please make clear whether the public or their employees decide the final, timely, course of action? (18.21)

Agency staff have been hired to make the decisions, with proper levels of public input and with concern for the public interest. Some members of the public will insist that a certain course of action be followed, and others will insist the opposite. Both are public opinions are valid, but a course of action still needs to be undertaken.

The overall intent of this EIS is to provide resource agencies and others with guidance for making decisions related to noxious emergent weed control. Mitigation to avoid and minimize environmental impacts and requirements of existing mandated authorities will still need to be met. Examples include: Federal pesticide rules, State Hydraulics rules and Cleanwater Act requirements.

C. I13 If certain regulatory agencies dominate over the EIS contents the situation can be made worse by narrow perspectives and biases that will misinform the public regarding evidence and options. (18.20)

R. I13 **Comment noted.**

C. I14 The law does not intend that Ecology reduce water quality standards by allowing chemical application to water without first assessing human health risks in comparative/relative terms. (2.a.)

R. I14 **Ecology concurs and for this reason participated in the development of this EIS to ensure these risks were adequately characterized.**

C. I15 Burrowing shrimp have taught us much about the stalling games that agencies can play in delaying action and ignoring serious problems. (5.5)

R. I15 **Comment noted.**

C. I16 The draft EIS should be adopted as is rather than delaying *Spartina* control activities in the Willapa estuary. (5.4; 30.1)

R. I16 **We are all working towards a prompt, environmentally sound, and effective approach to *Spartina* management. The State Environmental Policy Act (SEPA), under which this EIS was prepared, provides a mechanism that helps everyone involved make informed choices. SEPA also enables participation by people impacted by decisions that will be based, in part, on this EIS. Adopting the draft EIS as is would not allow for corrections and clarifications prompted by comments on the EIS. While we understand the need to expedite where possible, we could not forego an essential part of the EIS process.**

Control programs have been ongoing as appropriate for several years. DNR recently completed a three week effort to mow 90 acres of mudflats in the hook of Leadbetter Point. The Willapa National Wildlife Refuge contributed resources and staff to the project. Other DNR control work has proceeded in the Hood Canal, Sequim Bay, and Kala Point. Private and tribal efforts have begun to eradicate reported clones of *Spartina* on the Kitsap Peninsula (Appletree Cove and Church Wetland), Vashon Island (Fern Cove), and San Juan Island (Argyll Lagoon).

C. I17 Aggressive alien species need a more timely response from agencies with jurisdiction. (5.13b)

R. I17 **Comment noted and concurred with. Early detection and treatment are extremely important in reducing potential adverse impacts to the environment and in limiting overall costs of mitigation measures. This requires adequate funding to enable response in a timely manner.**

The need for a timely response is the reason that a programmatic EIS was prepared. It is intended to provide framework for rapid action.

C. I18 Would flooding and then excavating ever be permitted (page 99)? (5.52)

R. I18 **This is one alternative methodology. It would be dealt with within the constraints of IWM. However, because of extreme environmental effects, its relative utility as a control option is limited.**

C. I19 Would sediment excavation be permitted (see 107, 4.3.2)? (5.56)

R. I19 **Excavation is one alternative that would be dealt with within the constraints if IWM. Because of environmental concerns, however, its relative utility as a control option is limited.**

C. I20 I find this document to be lacking in elements 4 and 5 of the NEPA guidelines. (5.64)

R. I20 **This EIS was prepared under the State Environmental Policy Act (SEPA), not the National Environmental Policy Act (NEPA).**

C. I21 Does the EIS comply with EPA's recommended good management practices for Willapa Bay, Puget Sound, Padilla Bay, etc. that rejects use of pesticides in these areas. (22.12)

R. I21 **Because this question was specific to EPA policy, EPA was asked to provide information that would assist in responding to this comment:**

Rodeo® is specifically labelled for application to aquatic habitats, however its use in estuarine and marine habitats may not have received adequate attention. The Departments of Natural Resources and Ecology are working to gain sufficient information to reduce the uncertainty in this area. Trials of control methods have been undertaken and the results are being analyzed.

The use of any chemical to control undesirable plant growth can be criticized because of unknown side effects, but in this case there is a clear and extensive degradation of a natural community under way by an alien plant species. The community is replicated many times in the Pacific Northwest, and infestations of *Spartina* are gaining a foothold in a number of them.

Alternative controls have been sought and tried including biological, physical, chemical, and mechanical methods. No single control method has proven entirely satisfactory, hence the EIS recommendation for an Integrated Weed management (IWM) program.

In the situation of *Spartina* in Northwest estuaries, we have only two choices: to accept radical alteration of our coastal estuaries with destruction of natural resources and accompanying economic and aesthetic impacts, or to carefully implement an IWM program designed to apply the best control method in each case. Regardless of the control method used, a well-designed and continuous monitoring program must be undertaken, with feedback of information for use in implementation of the controls. (Jack Gakstatter, EPA, personal communication, 1983)

C. I22 Application of pesticides into bays and estuaries seems to contradict the following provision of EPA's "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters" (1993, page 3-39):

> For aerial spray applications maintain and mark a buffer area of at least 50 feet around all watercourses and waterbodies to avoid drift or accidental application of chemicals directly to surface water. (35.3)

R. I22 **Because this question was specific to EPA policy, EPA was asked to provide information that would assist in responding to this comment.**

Per Jack Gakstatter (personal communication, 1983) the policy quoted relates to forest applications. He explains that applications for emergent aquatic vegetation are different than forestry applications in that they intentionally target wetland or surface water. Though the concept of buffers for forest practices (e.g. to reduce the pollution load to surface waters) may be a relevant concept, the use of buffers when application to waterbodies is intentional is problematic. EPA suggests that management practices in the referenced guidance manual may be worth consideration but they "do not believe that there are any directly relevant to the use of in-water herbicides for controlling invasive emergent plants." Please see response to I.23 for additional insight into EPA's understanding of this situation.

J. Miscellaneous or Addressing More Than One Alternatives

C. J1 An additional alternative should be considered that considers all alternatives evaluated except chemical (a combination of physical, biological, and mechanical controls) to control noxious weeds. (3.b, 15.1, 16.3, 35.18)

R. J1 **This alternative was not specifically identified during the scoping process, and for this reason was not evaluated. Though not specifically evaluated, this alternative is inclusive in the IWM option in that a landowner/manager may select an alternative that does not include use of pesticides.**

C. J2 Please review the document to insure consistent use of the word "control," (See general Rodeo® use instructions on page 50 and definition of control on page 55). 35.24

R. J2 **See Section 1.1, paragraph 1.**

C. J3 We concur with the EIS finding (summary, page xiii) that managing noxious emergent vegetation could have probable adverse environmental effects, but the EIS does not adequately describe these impacts. (35.6)

R. J3 **It is difficult to respond to this comment as it is not specific. All agencies find the discussion of impacts adequate.**

C. J4 Tables 13-18 do not adequately reflect the uncertainties noted in the Executive Summary (little known about efficacy, impacts, mitigation..) (35.7)

R. J4 **Comment noted.**

C. J5 To be consistent with the summary of PL beneficial uses, please incorporate beneficial uses of *Spartina* from page 72 into the executive summary (page xiv). (35.8)

R. J5 **See Executive Summary, paragraph 4.**

C. J6 Please identify the glyphosate/surfactant combination by the trade name Rodeo® to make the association more clear. (35.4)

R. J6 **Pesticides were referenced by their appropriate tradenames or chemical names to enable distinctions among various products discussed in the EIS, including Roundup®, glyphosate, Rodeo® (glyphosate plus water), various surfactants, and glyphosate plus a surfactant. Because the surfactant used in Roundup® is a trade secret, we do not know what it is and thus cannot assume that the surfactant is the same as any of the many non-ionic surfactants marketed in this state. Available information indicates that the surfactant used in Roundup® is not chemically similar to LI-700®. The mitigation section of the EIS recommends use of LI-700® where possible due to low toxicities for species tested.**

C. J7 The EIS data does not support eradication and states that it is an inappropriate objective for established noxious weed infestation, so we fail to understand why the EIS had adopted eradication as an objective. This sends false signals that eradication is an easily achievable objective. (35.2)

R. J7 **The EIS does not "adopt" any management alternative, but presents Integrated Management as the preferred alternative. A specific Integrated Management Plan may propose eradication as an appropriate goal for some species in some locations, as discussed in the Integrated Management Section of the EIS.**

C. J8 In many instances, the EIS relies on personal communication of interested parties (agency officials) instead of genuine scientific research. (29.1)

R. J8 **Personal communication is often the only information available. Research rarely addresses integration of techniques. Many agency officials have expertise in vegetation management and/or other subjects addressed in this EIS.**

C. J9 Throughout the document replace "broadleaf" with "broadspectrum" when referencing glyphosate. (24.2)

R. J9 **Use of the term "broadleaf" in the EIS is appropriate.**

C. J10 Impacts discussion needs to better differentiate between long- and short-term impacts (5.1)

Specific sections to which this comment applies are:

a page xvi, second paragraph, second sentence (5.1)
b page 45, Table 7 (5.1)
c page 73, Table 12 (5.1)
d page 92-95 (5.1)
e page 98 (5.1)
f page 100 (5.1)
g page 104, 4.3 (5.1)
h pages 107-110 (5.1)

R. J10 **The magnitude and duration of impacts associated with implementation of control measures must be assessed on a case-by-case basis, and would depend on the nature of infestation, infestation site, presence of non-target species, and numerous additional aspects of the local environment. Some impacts are obviously of short duration, such as noise during control activities, water turbidity, decreases in dissolved oxygen levels, loss of recreation opportunities, and many impacts to animals. Impacts that are obviously of long duration include loss of archaeological sites, some types of worker injury, and establishment in other areas following dispersal to new sites. The duration of other impacts are less easily assessed. For example, impacts due to sediment mobilization may be of short- or long-duration, depending on the type of sediment, sensitive resources that would be smothered and their ability to recover, and topography. Impacts to biota would depend on the ability of each species to survive disturbance and to respond to changes in the environment. Much of the information needed to determine duration of impacts to many components of the environment is not available and we have chosen to avoid unsupported speculation.**

C. J11 There is little or no attempt to assess long-term effects of alternatives. (10.3)

R. J11 **See response to comment J10.**

C. J12 The EIS is weakened by failing to weigh the short-term impacts of a control program against a disastrous long-term impacts of not dealing with *Spartina* in a timely manner. (18.18)

R. J12 **Integrated Weed Management is the preferred alternative, despite the fact that all control methods have some adverse environmental impacts. IWM was selected rather than the No Action Alternative because the long-term impacts of noxious weed infestations greatly outweigh the short-term (or long-term, if these exist) impacts of the control measures.**

C. J13 Sediment release and movement is an impact common to all alternatives and should be stated as such throughout the document. (5.2)

Specific sections to which this comment applies are:

a page xvi, first sentence (5.2)
b page 19, 3.2.1 and following tables (5.2)
c page 45, table 7 (5.2)
d page 122, 4.5.1, last section

R. J13 **The Executive Summary includes sediment mobilization as a potential negative impact of implementation of physical, mechanical, and chemical methods when applied to *Spartina* control. Disruption of sediments is mentioned for biological controls using livestock, and this method is not recommended. Among parts of the EIS where sediment mobilization is presented as a possible negative impact are tables for physical (Table 15), mechanical (Table 15, but note change in caption), biological (Table 17), and chemical (Tables 7, 18) control measures.**

C. J14 The following criteria are applied unevenly throughout the document (10.8):

a Uncertainty or ineffectiveness of alternatives. For methods other than chemical, these factors are considered extremely negative and possible cause for rejection. Whereas it appears to be only an inconvenience for chemical alternatives.

b Risk to laborers. Though considered for some mechanical methods, the extent of risk to chemical laborers is not considered (a risk amplified by proposed use of unskilled volunteers).

c Erosion and sedimentation. These factors are evaluated in different ways for different methodologies.

R. J14 **a Known information was presented in an unbiased manner. Imbalances among discussions sometimes result from varying**

amounts of information available for the various control methods. These imbalances should not be perceived as favoring one method over another, but as a consequence of limitations in the body of information.

b The intention of the human health risk assessments for glyphosate and 2,4-D was risk to the public, not the risk to laborers. The use of "unskilled volunteers" appears to be misunderstood by the respondent. Application of Rodeo® to an aquatic environment requires an aquatic pesticide applicator's license that can only be obtained through training and testing by the Department of Agriculture. Even if volunteers were to be used, they could not be "unskilled volunteers" without violating state law. We are not aware of any agency contemplating use of "unskilled volunteers" for pesticide applications.

This does not mean that volunteers can not perform valuable services. Certainly volunteers may be used for survey, hand removal or other appropriate tasks.

c Different methodologies produce different amounts of disturbance to sediments.

C. J15 The EIS comparison of alternatives is unbalanced, as evident by:

a Varied level of EIS analysis (chemical alternative differentiated from others through extensive detail and analysis); and

b Research focus (many dollars have been spent to quantify impacts from glyphosate but impacts from other methods have not been measured); 18.3

R. J15 **Comments recieved through public scoping emphasized the importance of providing in the EIS a thorough assessment of chemical alternatives. Strong demands for the use of glyphosate were equally strongly countered by concerns over the potential environmental impacts of its use. This controversy far outweighed that for other possible methods. Glyphosate research was essential to completion of the EIS and was given priority for the limited funds available.**

The evaluation of each control method required that all available information be collected and reviewed. By virtue of regulatory requirements and wide ranging environmental implications, the chemical methods database is larger than that regarding other control

methods. The EIS was written by summarizing 4 technical reports (Appendices E (2), F, and G). Also available were 6 toxicity studies provided by Monsanto and 3 fate/persistence/effects studies from Willapa Bay.

Given the sheer volume of available data, the chemical methods section is more detailed than the other control method sections. This may be due in part to the regulatory requirements imposed upon chemical manufacturers (i.e., studies required for registration) and the historical data that implicate chemicals in ecological and human health impacts.

C. J16 Constant reference to sediment removal is distracting and irrelevant to the core control problem (see page 107, 4.3.2; page 117, 2nd para; page 122, 4.5.1, last section). Depending on the energy of the site, sediments would shift in one to three years. On sites where clones were killed in 1990-91, little eelgrass and triglochin had seeded in by 1991 and were abundant by 1993. Some of the material trapped by clones had shifted and is expected to move in the next few years. The entire surface has been available for feeding and roosting by migratory shorebirds since 1990. After control, habitat was enhanced naturally at much less cost than scraping and replanting. Sediment removal could be an option for landowners with re-vegetation considered after 3-years if site has not begun to recolonize. Natural re-vegetation is a function of elevation. (5.57)

R. J16 **Little information is available on sediment release following *Spartina* control or eradication, although some studies have shown that sediments are mobilized following natural dieback. See Appendix C, Section 3.2.1.1 for additional information. Natural shifting of sediment may have less impact because heavy equipment would not be needed.**

It is questionable that observations based on small clones are directly transferable to conditions in larger infestations. However, the need for mechanical restoration of bed contours will have to be assessed case by case through project follow-up as we gain experience with control results. This underscores the need for planned, long-term, information gathering as an integral part of *Spartina* management.

C. J17 Instead of continually referring to the need for additional information regarding impacts and mitigation, the EIS should state that information is always incomplete and that changes may be made in the future. (5.6)

Specific sections to which this comment applies are:

a Page xiii, third paragraph, first sentence
b page 88
c page 103, 4.2.5
d page 135

R. J17 **Needed information is identified to indicate the incomplete state of knowledge on many components of noxious weed control and as a guide for future research. It is important to note that poorly designed experiments lacking controls and anecdotal information can sometimes be misleading and not be applicable to general situations. By discussing information needs, it is not the intention to suggest that existing information is flawed or that management decisions cannot be made with only the information that exists. The statement "changes will be made in the future" implies that the EIS will continue to be updated. Information will be available in the future and may impact conclusions made in the current EIS.**

For 2,4-D, additional information regarding human health effects is critical. For example, firm answers regarding carcinogenicity are still needed. For both 2,4-D and glyphosate, information concerning ecosystem impacts (not just single species impacts) is also critical.

C. J18 Attempting control of *Spartina* with herbicide application is typical, addressing one problem without due consideration of incidental impacts. I haven't reviewed the DEIS, which I am certain provides justification of a decision tacitly made. It would be better to begin more tedious and expensive controls such as manual and mechanical removal, while biological control methods are sought that would be environmentally benign. (6.1)

R. J18 **As noted in the EIS, each alternative has potential adverse impacts. Without making site specific assessments, it is not reasonable to assume that a particular method of dealing with *Spartina* would have less impact than another.**

Some physical control methods (e.g. hand pulling and mowing) are available and have been used on a limited basis for several years. Hand mowing was conducted in 1992 and expanded in 1993. Integrated Weed Management will be available coincident with issuance of the EIS. We agree that the search for long-term biological controls is highly desirable.

C. J19 Some control of *Spartina* is necessary but the excellent EIS reveals complex issues, data gaps, and potentially serious impacts from some control options. (8.1)

R. J19 **Comment noted. There are several alternatives identified for which no significant long-term impacts have been identified that could not be mitigated. These include some forms of physical control and use of glyphosate.**

C. J20 It is premature to finalize the EIS given uncertainties about efficacy and impacts of alternatives and incomplete studies. (10.2)

R. J20 **Studies will always be incomplete. These species are spreading at an alarming rate. The no action alternative clearly spells out the consequences of inaction. Monitoring and research can continue as management alternatives are put into place.**

Information in the EIS is sufficient to allow Noxious Emergent Weed control programs to move forward in an environmentally responsible manner. In the future, as continued experience, insight and new information is gained, additional SEPA evaluation may become appropriate.

C. J21 "Labor intensive" is identified as a negative attribute even though labor intensive alternatives are usually more selective and may provide additional jobs that need not be highly paid or highly skilled. Why is this considered "bad." (10.9)

R. J21 **The criteria for selecting an alternative is not the length of time required. Potential impact is a part of the decision making with an Integrated Weed management system. The keys are the similarity of results (efficacy), costs, and impacts.**

C. J22 Equally applicable to all alternatives, not just crushing, is the uncertainty regarding number of treatments required (page 32). (10.21)

R. J22 **The number of treatments required to effect control under the alternative methods depends on how the treatments are conducted. Most control methods, such as covering and digging only need to be applied once if implemented properly. Control methods to prevent seed set would have to be done annually as long as the infestation existed. The number of times treatments are required to accomplish a particular goal is known for most treatments and, if not implicit, has been discussed in the EIS. Text has been added to Section 3.3.2,**

paragraph 12. A discussion of the number of herbicide treatments required has been added to Section 3.5

C. J23 Criteria for selecting an alternative should not be the length of time required. Alternatives that take a little longer with similar results but with less potential impact should be preferred. (10.22)

R. J23 **Comment noted. This will be addressed within the context of IWM.**

C. J24 The concept of "as long as no wildlife, fish, or invertebrate species have come to depend on *Spartina*," (Section 4.4.1, p. 115) is very disturbing in that it suggests a stewardship policy of allowing noxious weeds just because a few opportunistic species are using the altered environment. (14.4)

R. J24 **Phrase deleted. See Section 4.4.1, paragraph 4 of the EIS.**

C. J25 It may be true that potential types of impacts of combined alternatives may be the sum of all impacts, it is not true for the level of impact (Executive Summary, last sentence). (14.5)

R. J25 **See Executive Summary, last paragraph, for response.**

C. J26 Given inadequacies of the EIS, agencies should proceed cautiously by giving preference to several physical and mechanical methods that do not pose long-term risks. (10.4)

R. J26 **Based on the available information, there is no indication that chemical control with the chemicals in the EIS, in fact, offers any more long term risk than mechanical or physical. All methods will be considered within he context of IWM.**

C. J27 In its current form, the EIS does not allow an informed judgement on a course of action. This is not due to the complexity of the problem but rather to confusing repetition, overwhelming verbiage, and numerous non-scientific editorial biases concerning key aspects of the overall program. The data and conclusions in the technical reports are not brought forward in a balanced and understandable form for the EIS. (8.25)

R. J27 **Comment noted. The co-lead agencies find the EIS adequate, non-biased, understandable, and useful for making informed decisions.**

The EIS was written in a balanced manner, and presents facts available from published literature, unpublished reports, and

conversations with knowledgeable individuals. The intention of the document is not to provide management plans for specific situations.

C. J28 Were various sections reviewed by anyone outside the state agencies except the consultants? (8.26)

R. J28 **The EIS process provides the draft EIS as a mechanism for review and comment by interested parties. Due to their very specific knowledge of and participation in ongoing *Spartina* control activities, input on all documents from Fred Paveglio and Kevin Kilbride of the U. S. Fish and Wildlife Service was requested by the Department of Natural Resources. The U.S. Fish and Wildlife Service submitted substantial comments that were incorporated as appropriate. Additionally, a group of technical experts nominated by co-lead agencies were asked to review the technical documents, and comments recieved were also incorporated as appropriate.**

C. J29 The working group's intent to use only "peer-reviewed" material for the technical reports and DEIS does not argue well for the documents ability to distinguish between accurate field observations and statistical abuse. (5.7)

R. J29 **Much of the existing information on the noxious weeds included in the EIS and their control is not published or peer-reviewed. Consequently, the EIS has drawn upon many sources of information, including knowledgeable individuals and unpublished reports, which have been cited throughout the technical reports. Unsupported speculation has not been included in the EIS.**

C. J30 The working group's non-competitive hiring of at least one research group that did not complete their research on glyphosate impacts does not argue well for this document's ability to distinguish between accurate field observations and statistical abuse. (5.8)

R. J30 **We appreciate your concern but do not concur with the implied relationship between contractor selection and performance with information prioritization. Statistically based, peer reviewed, published information is generally preferred in the EIS. However, all types of information have, as appropriate, been used and cited in the document. See also R J29.**

State agencies are directed to use resources within other state agencies where possible. A bid process is not required for work to be conducted through any such "interagency agreement."

C. J31 Identify people who developed the list of information needs so that motives can be examined. Justifiable scientific reasons must be provided for suggesting additional studies. Most informational needs were probably included to delay or prevent the process from moving forward or to financially benefit researchers, some of whom may be involved in the EIS process. (18.13)

R. J31 **Information needs were identified primarily by the authors of the EIS and were reviewed by Agency representatives (see pages ii and iii for list of authors). The purpose of the Information Needs sections was to identify data gaps in the current information about control methods and characteristics of the biology of noxious species that could affect the decision making process. As noted in the Executive Summary, little is known about efficacy, potential impacts, and mitigation opportunities associated with several of the control methods. Much of the available information is anecdotal or relates to limited studies, sometimes without adequate experimental design.**

C. J32 We find the DEIS to be thoroughly inadequate and recommend that Ebasco be barred from preparing future environmental documentation for the State of Washington. (35.1)

R. J32 **Comment noted and rejected.**

C. J33 We fail to understand why this document was issued when important research data was not available unless co-leads were already committed to a course of action. [see letter for complete list of 9 cited]. (35.5)

R. J33 **One intent of the EIS was to identify data gaps. There will never be a point, when *Spartina* is still a problem that can be successfully addressed, when all the data will be available. All the co-leads recognize that we do not know everything that would be desirable to know about *Spartina* control and that an important part of IVM is continually assessing both impacts and results, and tuning the control program accordingly.**

We believe that information in the EIS is sufficient to allow Noxious Emergent Weed control programs to move forward in an environmentally responsible manner.

C. J34 We object to the fact that agencies chose a preferred alternative before the EIS was issued and that the EIS states that agencies will likely adopt this EIS for requests for permits allowing use of Rodeo® or 2,4-D. EISs are

designed to provide adequate information to decision makers, not justify decisions already made. (35.14)

R. J34 **Agencies involved agreed that integrated management is the preferred alternative and decided to identify it as such. SEPA does not discourage or disallow identification of a preferred alternative.**

Stating that we will likely adopt this EIS for requests for permits means that we will evaluate permit requests based upon information available in this EIS. Other information, such as that provided in the permit application, will be used to make decisions appropriate for specific sites. Agencies will not use the EIS to justify decisions already made, but as guidance for decisions.

C. J35

a The EIS is flawed in that it does not provide economic information (page 72, 4.1). (5.14)

b Economics of various levels of IWM need to be evaluated. (18.11)

c The lack of a serious economic evaluation of No Action is a serious deficiency leaving an impression that it will not invoke future costs. (5.25)

d Short-term impacts of sediment shifting need to be weighed against long-term impacts of loss of industry. (5.48)

R. J35 **It is recognized that economic realities will be among the most relevant factors when deciding how to manage noxious emergent vegetation. Economics of any given alternative will be site specific and may possibly involve social factors. Such issues are much to variable to be dealt with in a programatic EIS. It was determined early on that a legitimate economic evaluation could not be conducted within the budget and time frame of this EIS. SEPA rules allow for, but do not require, an economic assessment (WAC 197-11-440(8). Further,**

> **"The decision whether to include such information and the adequacy of any such additional analysis shall not be used in determining whether an EIS meets the requirements of SEPA."**

C. J39 A general quantitative evaluation of "labor intensive" and its costs would be useful both in the EIS and in development of site-specific management plans. (10.10)

R. J39 **We are not aware of any pool of information on labor costs. WSDA and the state board have some information on the cost of weed control by hand. The hand-control projects for purple loosestrife have used volunteers and inmate labor.**

As noted previously, costs would be quite variable and need to be assessed on a site-specific basis.

C. J40 To what extent does the EIS consider employment opportunities associated with *Spartina*? (22.11)

R. J40 **This is only briefly touched upon in the EIS, as it is beyond the scope of this document.**

C. J41 Water quality variance applicants should be required to add to a fund that explores the marketing potential for *Spartina* products. (29.5)

R. J41 **Currently there is no mechanism available for charging applicants for short-term modifications to water quality standards.**

C. J42 *Spartina* spreads toward deeper tideland by trapping silt. There is an unusually high rate of sedimentation in Willapa Bay due to years of poor forestry practices, oyster dredging and dragging, careless road-building and construction, and animals grazing too close to streams. Relying on pesticides only reinforces the status quo and delays the shift to more sustainable methods. Treating symptoms with pesticides allows underlying causes to continue. We cannot wait to stop the serious erosion in our watershed. Hopefully the EIS will lead to positive action in controlling erosion. (8.6)

R. J42 **Studies of agricultural, forest management, or other human activities that could enhance the likelihood of establishment of *Spartina* populations, especially in Willapa Bay are identified as an information need in Section 4.6.2, paragraph 5.**

Efforts are currently underway to address compliance with the Federal Clean Water Act through the Forest Practices Act. Additionally, recent passage of Section 62.17 of the Coastal Zone Management Act may lead to policies that govern activities that may impact coastal waters.

C. J43 Wherever possible, *Spartina* should be avoided or eradicated in infancy. (10.6)

R. J43 **We agree with this statement and have developed the EIS, in part, to help us respond more quickly to newly established plant populations.**

C. J44 Is scientific research being conducted to determine if there are biological, botanical, hydrologic, and economic impacts connecting ghost and burrowing shrimp and *Spartina* emergence? (22.4)

R. J44 **To our knowledge, no such research is being conducted and there is nothing to indicate that this would be a fruitful area for research.**

C. J45 Have oyster industry activities (dredging, monoculture, shucking) contributed to *Spartina* growth by eroding tidal-flat beds and releasing mud and silt trapped by *Spartina*? (???)

R. J45 **Other than the introduction of the *Spartina* in the late 1800's, there is no information that we are aware of indicating that any activity of the oyster industry has contributed to the spread of *Spartina*.**

C. J46 Does the EIS recommend any changes to oyster-farming/extraction practices to mitigate effects of spraying Sevin or expansive growth of *Spartina*. (22.8)

R. J46 **Rack and long-line oyster culture are discussed in the EIS as one way of dealing with *Spartina*.**

C. J47 *Spartina* has potential as a highly productive crop that requires no tillage, fertilizer, seed, or cultivation. Potential uses include soil additives, fuel production, wastewater treatment, animal feed, paper production, and construction resources. Why not actively exploit the plant given that there is no simple way to reduce or eliminate infestations? (2.13)

R. J47 **We agree that uses of *Spartina* should be explored. However any such activity would not be desired or allowed if it were to increase *Spartina* populations or inhibit control measures. Though *Spartina* control measures may not be simple, preservation of the existing ecosystem requires that we take action.**

C. J48 The document organization is confusing. (39.1)

R. J49 **Comment noted.**

C. J49 Impacts analysis should not be included in the "alternatives" section. (39.5)

R. J49 **SEPA regulations specifically require this discussion in this location).**

C. J50 Provide an "information needs" subsection addressing needs for both impacts assessment and efficacy. (39.14)

R. J50 **Comment noted.**

C. J51 Loosestrife is more established and expansive than *Spartina*, so the two are not comparable (page 2). (39.22)

R. J51 **We do not agree. The establishment situation for both common species in the respective genera are site specific. Contrast the situation with both L. virgatum and S. patens which are very rare.**

K. Appendices

C. K1 The hypothetical scenarios are not useful when dealing with estuary-wide problems. (5.15)

R. K1 **Specific plans will need to be developed for an infested estuary with the EIS used as a reference.**

C. K2 Regarding expectations of long-term site plans at the permit stage, comments in the 2nd paragraph are excellent (page 7). (23.9)

R. K2 **Comment noted. We appreciate your support for this concept.**

C. K3 The idea of management areas is great, and minimizes bureaucracy. Suggested revision (page 8, para. 2): "For instance, maintenance crews or designated agents of the DOT.." (23.10)

R. K3 **See Appendix 1, Part Two, paragraph 11.**

C. K4 Light frosts often enhance control when glyphosate is applied in the fall, please revise "first frost" to "first killing frost" (page 8, para. 3; page 15, para. 1). (23.11)

R. K4 **See Appendix 1, Part Two, paragraph 12 and Part Three, paragraph 7.**

C. K5 Revise text (page 8, last line) to read: Purple loosestrife seedlings are susceptible after emergence. Best results on seedlings is obtained before plants are 12 inches tall. Taller plants would require higher rates of glyphosate." (23.12)

R. K5 **See Appendix 1, Part Two, paragraph 12.**

C. K6 Revise text (Page 4, para. 5; Page 8, cont.; pg. 14. ref. p. 6) to include heavy dew along with rainfall and water on leaves. (23.12)

R. K6 **See Appendix 1, Part Two, paragraph 13.**

C. K7 The section incorrectly interprets the label and incorrectly states that Monsanto does not allow applications in winds in excess of 5 miles per hour. The label states:

"Avoid drift. Extreme care must be used when applying this product to prevent injury to desirable plants and crops." "The likelihood of plant or corp injury occurring from the use of this product is greatest when winds are gusty or in excess of 5 miles per hour or when other conditions, including lesser wind velocities, will allow spray drift to occur."

Rather than place upper wind speed limits on the permits (because there are situations other than wind speed that cause drift), I recommend cautioning applicators to consider all factors involved and not to apply under conditions that would cause drift. (23.14)

R. K7 **Your comments are noted. We feel that guidelines are necessary. Guidelines for other factors that contribute to drift or compensate for drift (e.g. buffers) may be desirable also. However, we also believe that the intent of each guideline should be clearly stated. Exceptions to guidelines should be allowed where applicators can demonstrate (as a component of the spray program) that the intent of the guideline is still being met. For instance, drift cards or other methodology might be used to document compliance with the intent to avoid drift. As experience is gained with control methodology, guidelines will likely change.**

C. K8 Please insert into text (para. 9) "...compensation or re-vegetation may..." (23.15)

R. K8 **Unable to locate referenced text.**

C. K9 Each square meter of intertidal area reclaimed from *Spartina* would be one of the most positive mitigative programs in the state. (18.22)

R. K9 **Comment noted.**

C. K10 This section contains numerous unscientific, conflicting, and sophomoric limitations that will make IWM implementation difficult, if not impossible. One example is Fisheries prohibition on any control work between March and June even though this is the best time for some control methods such as hand pulling and mowing. (18.23)

R. K10 **There are no permit requirements for hand pulling, hand scything or small scale hand digging. These are options that may be conducted at any time of the year. Generally, mowing in the spring is not practical until plants are well up - usually not before mid May. However, conditions were written into Hydraulics Permits for Willapa Bay mowing during 1993 which allowed work to occur prior to June 15. We expect this to be a continuing viable option. As experience continues to be gained new opportunities to cooperatively resolve additional concerns will be found. Environmental concerns are a necessary integral component of IWM. Their consideration early in the IWM planning process will help facilitate issuance of permits for control work.**

C. K11 The public is left with the impression that people cannot work in the intertidal area. (5.62)

R. K11 **As stated in this section, the closures are guidelines for working in areas where conflicts with or impacts to sensitive species may occur. By using the chart as a reference and comparing the time proposed for work, WDF staff can assist the proponent in achieving their objective with the least amount of harm to sensitive species.**

C. K12 Fisheries misunderstands the difference between native and introduced eelgrass species, continues to assume indifference to field observation that young salmon use all stages of *Spartina*, and fails to consider salmonid impacts related to alteration of all intertidal areas to higher salt marsh. (5.63)

R. K12 **WDF policy requires that changes to habitats from projects that may affect fish life be sequentially avoided and/or minimized or compensated for. Often this is accomplished through management of limiting habitats (such as eelgrass) or key species types (such as salmonids). WDF manages for the protection of both native (*Zostera marina*) and introduced (*Z. japonica*) eelgrass. Both species provide unique and overlapping functions - all of which are very valuable for fish production.**

An overall intent of this EIS is to provide resource agencies and others with guidance for making timely decisions related to noxious emergent weed control. All cooperating agencies have agreed that *Spartina* control is necessary.

C. K13 Ecology's requirement for public notice for even the smallest sites tends to discourage control. Ecology should consider a more workable process for smaller sites. (13.8)

R. K13 **Public notice is required by the Water Quality Standards.**

C. K14 William Brookreson's plan is refreshingly positive. It provides a sound evaluation of the problem and provides objectives and suggestions for a management framework. The plan should be emphasized in the EIS and all agencies should state acceptance or explain rationale for rejection of this plan. (8.24)

R. K14 **Comment noted.**

ATTACHMENT 1:

REREGISTRATION DATA

October 1, 1993

REREGISTRATION STUDY DEADLINES FOR 2,4-D ACID, DMA SALT AND 2-EH ESTER

(Supported by the 2,4-D Industry Task Force II)

* *indicates studies that are subject to waiver of Hearing and Appeal Rights*

GDLN.# & DERIVATIVE	NAME	DUE DATE	STATUS
81-3 (2-EHE)	Acute Inhalation	1/15/93	study submitted 12/30/92; reviewed 3/1/93; acceptable - **GDLN. SATISFIED**
81-X (acid)	Acute Oral Neurotoxicity	2/28/94	**outstanding**
81-X (acid)	Chronic Oral Neurotoxicity	6/30/94	**outstanding**
* 82-1b (DMA)	90-day Feeding, Non-rodent	6/30/93	study submitted 5/19/93; **IN REVIEW**
* 82-1b (2-EHE)	90-day Feeding, Non-rodent	6/30/93	study submitted 5/19/93; **IN REVIEW**
123-2 (acid)	Aquatic Plant Growth (4 species)	2/28/94	EEB review of 1/5/93 required 4 additional aquatic plant growth studies; Agency letter of 3/9/93; **outstanding**
* 161-1 (2-EHE)	Hydrolysis	4/30/93	study submitted 5/31/93; **IN REVIEW**
162-3 (acid)	Anaerobic Aquatic Metabolism (repeat study)	8/31/94	**outstanding**
162-4 (acid)	Aerobic Aquatic Metabolism (repeat study)	8/31/94	**outstanding**
165-1 (acid)	Confined Rotational Crops (repeat study)	1/31/95	**outstanding**
201-1 (acid, DMA, 2-EHE)	Droplet Size Spectrum	12/31/94	Data generated by SDTF will be submitted for members. Individual data must be submitted for all others.

GDLN.# & DERIVATIVE	NAME	DUE DATE	STATUS
202-1 (acid, DMA, 2-EHE)	Drift Field Evaluation	12/31/94	Data generated by SDTF will be submitted for members. Individual data must be submitted for all others.
164-1 (DMA)	Terrestrial Field Dissipation (8 studies)	12/31/95	outstanding
164-2 (DMA)	Aquatic Field Dissipation (2 studies)	12/31/95	outstanding
164-3 (DMA)	Forest Field Dissipation (1 study)	12/31/95	outstanding
-DMA-X (Moiety)	Aerobic Soil Metabolism	12/31/95	outstanding
-DMA-X (Moiety)	Aerobic Aquatic Metabolism	12/31/95	outstanding
-DMA-X (Moiety)	Anaerobic Aquatic Metabolism	12/31/95	outstanding
161-2 (2-EHE)	Photodegradation in Water	4/30/93	study submitted 4/27/93; sent for review on 5/12/93; IN REVIEW
164-1 (2-EHE)	Terrestrial Field Dissipation (8 studies)	12/31/95	outstanding
164-3 (2-EHE)	Forest Field Dissipation (1 study)	12/31/95	outstanding
2-EHE-X (Moiety)	Aerobic Soil Metabolism	1/31/94	outstanding
2-EHE-X (Moiety)	Aerobic Aquatic Metabolism	1/31/94	outstanding
2-EHE-X (Moiety)	Anaerobic Aquatic Metabolism	1/31/94	outstanding
165-3 (acid)	Accumulation in Irrigated Crops	NA	RESERVED
165-4 (acid)	Accumulation in Fish	NA	RESERVED (pending results of octanol/water partition coefficient)
165-5 (acid)	Accumulation in Non-Target Organisms	NA	RESERVED (pending results of octanol/water partition coefficient)
171-4a (acid)	Plant Metabolism (one additional crop)	not determined	PENDING

GDLN.# & DERIVATIVE	NAME	DUE DATE	STATUS
171-4b (acid)	Animal Metabolism - Hen	1/31/93	Hen metabolism study was reviewed and accepted on 4/6/93; poultry metabolism requirement **SATISFIED**
171-4b (acid)	Animal Metabolism - Goat (repeat study)	4/30/93	Goat metabolism study was submitted 4/27/93; sent for review on 5/5/93; reviewed and accepted on 6/16/93; requirement **SATISFIED**
171-4c,d	Residue Analytical Methods (includes validation)	6/30/94	**outstanding**
171-4e	Storage Stability	9/30/95	**outstanding**
171-4g	Magnitude of the Residue in Fish	12/31/94	**outstanding**
171-4k	Cropfield Trials	9/30/95	**outstanding**
171-4l	Crop Processing Studies	9/30/95	**outstanding**

Report Number : 2.1
Run Date : 10/01/93

Office of Pesticide Programs
Chemical Review Management System
Reregistration Status Report

Branch: RB
Section: RS-III
CRM: JCOOMBS

Case : 0073 2,4-D

Chemical : 030001 Dichlorophenoxyacetic acid

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	61-2(a)	Begin. mat. & mnfg. pr	03/01/89	No Decision/Not Satisf	Study	41973501	08/07/91		No Decision
						Study	41789901	02/20/91		No Decision
						Study	41637501	09/24/90	04/30/91	Acceptable
						Study	41140201	06/22/89		No Decision
						Study	41067001	04/14/89		No Decision
						Study	41055801	04/06/89	10/25/89	Unacceptable
						Study	41055802	04/06/89		No Decision
						Study	41055803	04/06/89		No Decision
						Study	41055804	04/06/89		No Decision
						Study	41049701	03/31/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		61-2(b)	Discussion of Impuriti	03/01/89	No Decision/Not Satisf	Study	42045501	08/08/91		In Review
						Study	42045502	08/08/91		In Review
						Study	41973501	08/07/91		No Decision
						Study	41637501	09/24/90	04/30/91	Acceptable
						Study	41599404	08/24/90		No Decision
						Study	41735701	01/03/90		No Decision
						Study	41203301	08/15/89		No Decision
						Study	41140201	06/22/89		No Decision
						Study	41067001	04/14/89		No Decision
						Study	41055801	04/06/89	10/25/89	Unacceptable
						Study	41055804	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		62-1	Preliminary Analysis	09/01/89	No Decision/Not Satisf	Study	41926201	06/28/91	09/25/91	Unacceptable
						Study	41637501	09/24/90		No Decision

Case : 0073 2,4-D

Chemical : 030001 Dichlorophenoxyacetic acid

Branch: RB
Section: RS-III
CRM: JCOOMBS

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
						Study	41140201	06/22/89		No Decision
						Study	41067001	04/14/89		No Decision
						Study	41055802	04/06/89	10/25/89	Unacceptable
						Study	41055805	04/06/89	10/25/89	Unacceptable
		63-2	Color	/ /	No Decision/Not Satisf	Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-3	Physical State	/ /	No Decision/Not Satisf	Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-4	Odor	/ /	No Decision/Not Satisf	Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-5	Melting Point	/ /	No Decision/Not Satisf	Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-6	Boiling Point	/ /	No Decision/Not Satisf	Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-7	Density	03/01/89	No Decision/Not Satisf	Study	41855701	04/23/91		No Decision
						Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-8	Solubility	03/01/89	No Decision/Not Satisf	Study	42026301	09/19/91	07/16/92	Unacceptable
						Study	41880601	05/20/91		No Decision
						Study	41332001	12/20/89		No Decision
						Study	41332002	12/20/89		No Decision

Branch: RB
Section: RS-III
CRM: JCOOMBS

Case : 0073 2,4-D

Chemical : 030001 Dichlorophenoxyacetic acid

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
						Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-9	Vapor Pressure	/ /	No Decision/Not Satisf	Study	41332003	12/20/89		No Decision
						Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-10	Dissociation Constant	/ /	No Decision/Not Satisf	Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-11	Oct/Water partition Co	03/01/89	Acceptable/Satisfied	Study	41332004	12/20/89	07/27/90	Acceptable
						Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-12	pH	/ /	No Decision/Not Satisf	Study	41055803	04/06/89		No Decision
						Study	41926202	09/01/88	09/25/91	Acceptable
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		63-13	Stability	03/01/89	No Decision/Not Satisf	Study	42795401	06/03/93		No Decision
						Study	42023601	09/19/91	07/16/92	Acceptable
						Study	41973502	08/07/91		No Decision
						Study	41855701	04/23/91		No Decision
						Study	41055803	04/06/89		No Decision
						Study	40808301	08/30/88		No Decision
						Study	40424001	11/23/87		No Decision
		71-2(a)	Acute avian diet. quai	08/28/90	Acceptable/Satisfied	Study	41586101	08/08/90	10/24/91	Acceptable
		71-2(b)	Acute avian diet. duck	06/01/89	Acceptable/Satisfied	Study	41546202	07/03/90	03/18/92	Acceptable

Branch: RB
Section: RS-III
CRM: JCOOMBS

Case : 0073 2,4-D

Chemical : 030001 Dichlorophenoxyacetic acid

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	71-4(a)	Avian repro. quail	/ /	Reserved					
		71-4(b)	Avian repro. duck	/ /	Reserved					
		71-5(a)	Simulated field study	/ /	Reserved					
		71-5(b)	Actual field study	/ /	Reserved					
		72-1(b)	Fish toxicity bluegill	06/01/89	Acceptable/Satisfied	Study	41158301	09/01/88	03/18/92	Acceptable
		72-1(d)	Fish toxicity rainbow	06/01/89	No Decision/Not Satisf	Study	41737303	01/01/91		In Review
		72-2(a)	Invertebrate toxicity	06/01/89	Acceptable/Satisfied	Study	41158301	07/07/89	03/18/92	Acceptable
						Study	41158302	07/07/89	03/18/92	Unacceptable
		72-2(b)	Invertebrate toxicity	06/01/89	Acceptable/Satisfied	Study	41835211	04/04/91	07/17/91	Acceptable
		72-3(a)	Estu/mari tox. fish	09/01/89	No Decision/Not Satisf	Study	41737307	01/01/91		In Review
		72-3(b)	Estu/mari tox. mollusk	10/12/93	No Decision/Not Satisf	Study	99999999	05/21/92	08/06/92	Unacceptable
						Study	41848001	04/04/91	07/16/91	Supplemental
		72-3(c)	Estu/mari tox. shrimp	09/01/89	No Decision/Not Satisf	Study	41737306	01/01/91		In Review
		72-4(a)	Early life stage fish	01/01/93	Acceptable/Satisfied	Study	99999999	06/08/92	08/17/92	Acceptable
						Study	41737304	01/01/91	03/18/92	Unacceptable
		72-4(b)	Life cycle invertebrat	03/01/91	Acceptable/Satisfied	Study	41835211	04/01/91	09/18/91	Acceptable
		72-5	Life cycle fish	/ /	Reserved					
		72-6	Aquatic org. accumulat	/ /	Reserved					
		72-7(a)	Simul. field-aquatic o	/ /	Reserved					
		81-4	Primary eye irration-r	06/01/89	Acceptable/Satisfied	Study	41125302	06/12/89	09/08/89	Acceptable
						Study	41125304	06/12/89	09/08/89	Supplemental
		81-5	Primary dermal irritat	01/15/92	Acceptable/Satisfied	Study	42232701	03/06/92	04/28/92	Acceptable
						Study	41125301	06/09/89	09/08/89	Supplemental
						Study	41125303	06/09/89	09/08/89	Supplemental
		82-1(b)	90-day feeding-nonrode	03/01/90	Acceptable/Satisfied	Study	42780001	05/19/93		No Decision
						Study	42780004	05/19/93		No Decision
						Study	41737301	01/07/91	06/06/91	Acceptable

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Case : 0073 2,4-D

Chemical : 030001 Dichlorophenoxyacetic acid

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	82-2	21-day dermal-rabbit/r	05/01/90	Acceptable/Satisfied	Study	41735301	01/01/91	07/22/91	Acceptable
						Study	41735304	01/01/91	07/22/91	Acceptable
		83-1(b)	Chronic tox - non-rode	05/01/94	No Decision/Not Satisf	Other Submission	protocol	08/23/91	11/26/91	Acceptable
		83-2(a)	Oncogenicity - rat	03/31/95	No Decision/Not Satisf					
		83-2(b)	Oncogenicity-mouse	03/31/95	No Decision/Not Satisf					
		83-3(b)	Teratogenicity - rabbi	01/01/91	Acceptable/Satisfied	Study	41747601	01/04/91	07/22/91	Acceptable
		83-4	2-generation repro.-ra	/ /	Reserved					
		84-2(a)	Gene mutation-ames	06/01/89	Acceptable/Satisfied	Study	41409801	03/07/90	12/01/90	Acceptable
		84-2(b)	Struct. chrom. aberrat	09/01/89	No Decision/Not Satisf	Study	41870101	05/08/91		In Review
						Study	41142003	03/19/90	06/26/90	Acceptable
						Study	41409804	03/07/90	12/01/90	Supplemental
		84-4	Other genotoxic effect	09/01/89	Acceptable/Satisfied	Study	41870101	05/08/91	09/15/91	Acceptable
						Study	41409807	03/07/90	12/01/90	Supplemental
		85-1	General metabolism	09/01/90	Acceptable/Satisfied	Study	41981601	08/14/91		No Decision
						Study	41737302	01/01/91	09/09/91	Acceptable
		123-1(a)	Seed germ/seedling eme	01/15/92	Acceptable/Satisfied	Study	42772901	07/15/93		In Review
						Study	42416802	07/28/92	11/19/92	Acceptable
		123-1(b)	Vegetative vigor	01/15/92	Acceptable/Satisfied	Study	42842701	07/15/93		In Review
						Study	42416801	07/28/92	11/19/92	Acceptable
		123-2	Aquatic plant growth	02/28/94	No Decision/Not Satisf	EPA Letter OR Due Date		09/13/93		No Decision
						Study	41420001	03/19/90	01/05/93	Supplemental
		124-1	Terrestrial field	/ /	Reserved					
		124-2	Aquatic field	/ /	Reserved					
		161-1	Hydrolysis	06/01/89	Acceptable/Satisfied	Study	41007301	02/22/89		Acceptable
		161-2	Photodegradation-water	06/01/89	Acceptable/Satisfied	Study	41125306	06/12/89		Acceptable
		161-3	Photodegradation-soil	06/01/89	Acceptable/Satisfied	Study	41125305	06/12/89		Acceptable
		161-4	Photodegradation-air	06/01/89	Reserved					

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Case : 0073 2,4-D

Chemical : 030001 Dichlorophenoxyacetic acid

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	162-2	Anaerobic soil metabol	01/01/91	Waived					
		162-3	Anaerobic aquatic meta	08/01/94	No Decision/Not Satisf	Study	41557901	07/17/90	05/24/91	Supplemental
		162-4	Aerobic aquatic metab.	08/01/94	No Decision/Not Satisf	Study	42045301	10/04/91		In Review
		163-1	Leach/adsorp/desorptio	09/01/91	No Decision/Not Satisf	Study	42045302	10/04/91		In Review
		163-2	Volatility - lab	09/01/89	Reserved					
		163-3	Volatility - field	04/01/90	Reserved					
		164-1	Terrestrial field diss	01/01/91	Waiver Pending					
		164-2	Aquatic field dissipat	01/01/91	Waiver Pending					
		164-3	Forest field dissipati	01/01/91	Waiver Pending					
		164-5	Long term soil dissipa	/ /	Reserved					
		165-1	Confined rotational cr	01/01/92	Waiver Pending					
		165-2	Field rotational crop	/ /	Reserved					
		165-3	Accumulation - irrig c	01/01/92	Reserved					
		165-4	Bioaccumulation in fis	/ /	Reserved					
		165-5	Bioaccum-aquatic non-t	/ /	Reserved					
		171-4(a)	Nature of residue - pl	08/01/91	Waived					
		171-4(b)	Nature of residue - li	04/30/93	Acceptable/Satisfied	Study	42749701	04/27/93	06/16/93	Acceptable
						Study	42749702	04/27/93	06/16/93	Acceptable
						Study	42605201	12/30/92	04/06/93	Acceptable
		171-4(c)	Res. analyt. method -	03/01/90	Time Extension Pending					
		171-4(d)	Res. analyt. method -	03/01/90	Time Extension Pending					
		171-4(e)	Storage stability	03/01/90	Time Extension Pending					
		171-4(f)	Mag. of res. potable H	06/01/90	Time Extension Pending					
		171-4(g)	Mag. of res. in fish	06/01/90	Time Extension Pending					
		171-4(h)	Mag. of res. irrigated	06/01/90	Time Extension Pending					
		171-4(j)	Mag. meat/milk/poultry	06/01/90	Time Extension Pending					
		171-4(k)	Apple	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision

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Case : 0073 2,4-D

Chemical : 030001 Dichlorophenoxyacetic acid

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	171-4(k)	Asparagus	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Corn, Field	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Range, Grasses	06/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(k)	Raspberry (black, Red)	06/01/90	Use Pattern Changed	Study	40881401	04/20/92		Acceptable
						Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Sorghum	06/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(k)	Soybeans	06/01/90	No Decision/Not Satisf	Study	40404502	09/01/88		In Review
						Study	40404501	09/01/88		In Review
						Study	40404503	09/01/88		In Review
		171-4(l)	Almond	08/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(l)	Apple	08/01/90	Use Pattern Changed	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(l)	Citrus Group	08/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(l)	Corn, Field	08/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(l)	Grapes	08/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision

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Chemical : 030001 Dichlorophenoxyacetic acid

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(l)	Millet	08/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(l)	Plum	08/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(l)	Potato	08/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(l)	Rice	08/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(l)	Sorghum, Grain	08/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(l)	Wheat	08/01/90	Time Extension Pending	Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission		09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		201-1	Droplet size spectrum	12/31/94	No Decision/Not Satisf					
		202-1	Drift field evaluation	12/31/94	No Decision/Not Satisf					
		81-X-SS	Dermal Neurotox.	06/01/94	No Decision/Not Satisf	Other Submission	PROTOCOL	09/28/92		In Review

Report Number : 2.1
Run Date : 10/01/93

Office of Pesticide Programs
Chemical Review Management System
Reregistration Status Report

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Case : 0073 2,4-D

Chemical : 030019 Dimethylamine 2,4-dichlorophen

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	61-2(a)	Begin. mat. & mnfg. pr	03/01/89	No Decision/Not Satisf	Study	41055809	03/28/89		No Decision
		61-2(b)	Discussion of Impuriti	03/01/89	No Decision/Not Satisf	Study	41964401	08/01/91		In Review
						Study	41055809	03/28/89		No Decision
		62-1	Preliminary Analysis	09/01/89	No Decision/Not Satisf	Study	41964401	08/01/91		In Review
						Study	41055801	03/28/89		No Decision
		63-2	Color	03/01/89	No Decision/Not Satisf	Study	41055811	03/28/89		No Decision
		63-3	Physical State	03/01/89	No Decision/Not Satisf	Study	41055811	03/28/89		No Decision
		63-4	Odor	03/01/89	No Decision/Not Satisf	Study	41055811	03/28/89		No Decision
		63-5	Melting Point	03/01/89	No Decision/Not Satisf	Study	41055811	03/28/89		No Decision
		63-6	Boiling Point	03/01/89	No Decision/Not Satisf	Study	41055811	03/28/89		No Decision
		63-7	Density	03/01/89	No Decision/Not Satisf	Study	41055811	03/28/89		No Decision
		63-8	Solubility	03/01/89	No Decision/Not Satisf	Study	42021002	08/01/91		In Review
						Study	41332001	12/20/89		No Decision
		63-9	Vapor Pressure	03/01/89	No Decision/Not Satisf	Study	42021001	08/01/91		In Review
						Study	41055811	03/28/89		In Review
		63-10	Dissociation Constant	03/01/89	No Decision/Not Satisf	Study	41308901	12/20/89		No Decision
		63-11	Oct/Water partition Co	03/01/89	No Decision/Not Satisf	Study	41055811	03/28/89		No Decision
		63-12	pH	03/01/89	No Decision/Not Satisf	Study	41055811	03/28/89		No Decision
		63-13	Stability	03/01/89	Acceptable/Satisfied	Study	41755701	01/01/91	04/25/91	Acceptable
		71-1(a)	Acute avian oral quail	06/01/89	Acceptable/Satisfied	Study	41546201	07/03/90	11/12/91	Acceptable
		71-2(a)	Acute avian diet. quai	06/01/89	Acceptable/Satisfied	Study	41749501	01/01/91	11/16/92	Acceptable
						Study	41158308	07/07/89	11/16/92	Unacceptable
		71-2(b)	Acute avian diet. duck	06/01/89	Acceptable/Satisfied	Study	41749502	01/01/91	10/02/92	Acceptable
						Study	41158307	07/07/89	11/16/92	Unacceptable
		71-4(a)	Avian repro. quail	/ /	Reserved					
		71-4(b)	Avian repro. duck	/ /	Reserved					
		71-5(a)	Simulated field study	/ /	Reserved					

Case : 0073 2,4-D

Branch: RB
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Chemical : 030019 Dimethylamine 2,4-dichlorophen

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	71-5(b)	Actual field study	/ /	Reserved					
		72-1(a)	Fish toxicity bluegill	06/01/89	No Decision/Not Satisf	Study	41158309	07/01/89		In Review
		72-1(b)	Fish toxicity bluegill	06/01/89	No Decision/Not Satisf	Study	41158309	07/07/89		In Review
		72-1(c)	Fish toxicity rainbow	06/01/89	No Decision/Not Satisf	Study	41158309	07/01/89		In Review
		72-1(d)	Fish toxicity rainbow	06/01/89	No Decision/Not Satisf	Study	41158309	07/07/89		In Review
		72-2(a)	Invertebrate toxicity	09/01/89	No Decision/Not Satisf	Study	41835210	04/04/91		In Review
						Study	41158311	07/07/89		In Review
		72-3(a)	Estu/mari tox. fish	06/01/89	No Decision/Not Satisf	Study	41835209	04/04/91		In Review
						Study	41158310	07/07/89		In Review
		72-3(b)	Estu/mari tox. mollusk	06/01/89	Acceptable/Satisfied	Study	41973401	07/07/89	11/12/91	Acceptable
		72-3(c)	Estu/mari tox. shrimp	06/01/89	No Decision/Not Satisf	Study	41835208	04/04/91		In Review
						Study	41158310	07/07/89		In Review
		72-4(a)	Early life stage fish	09/01/89	No Decision/Not Satisf	Study	41767701	01/01/91		In Review
		72-4(b)	Life cycle invertebrat	03/01/91	No Decision/Not Satisf	Study	41835201	04/01/91		In Review
		72-5	Life cycle fish	/ /	Reserved					
		72-6	Aquatic org. accumulat	/ /	Reserved					
		72-7(a)	Simul. field-aquatic o	/ /	Reserved					
		81-1	Acute oral tox. rat	06/01/89	Acceptable/Satisfied	Study	00157512	03/01/86	01/15/92	Acceptable
		81-2	Acute dermal tox. rabb	06/01/89	Acceptable/Satisfied	Study	00157513	03/01/86	01/15/92	Acceptable
		81-3	Acute inhal. tox rat	06/01/89	Acceptable/Satisfied	Study	00157514	03/01/86	01/15/92	Acceptable
		81-4	Primary eye irration-r	06/01/89	Acceptable/Satisfied	Study	00157515	03/01/86	01/15/92	Acceptable
		81-5	Primary dermal irritat	06/01/89	Acceptable/Satisfied	Study	00157516	03/01/86	01/15/92	Acceptable
		81-6	Dermal sensitization	06/01/89	Acceptable/Satisfied	Study	00157517	03/01/86	01/15/92	Acceptable
		82-1(a)	90-day feeding-rodent	06/01/90	Acceptable/Satisfied	Study	41896702	06/01/91	09/12/91	Acceptable
		82-1(b)	90-day feeding-nonrode	06/01/93	Time Extension Pending	Study	42780002	05/19/93		In Review
						Study	42780006	05/19/93		In Review
		82-2	21-day dermal-rabbit/r	06/01/90	Acceptable/Satisfied	Study	41735303	01/01/91	07/22/91	Acceptable

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Chemical : 030019 Dimethylamine 2,4-dichlorophen

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
						Study	41735306	01/01/91	07/22/91	Acceptable
		83-1(a)	Chronic tox-rodent	/ /	Reserved					
		83-1(b)	Chronic tox - non-rode	/ /	Reserved					
		83-2(a)	Oncogenicity - rat	/ /	Reserved					
		83-2(b)	Oncogenicity-mouse	/ /	Reserved					
		83-3(a)	Teratogenicity - rat	08/01/90	Acceptable/Satisfied	Study	99999999	02/18/93	05/21/93	Acceptable
						Study	41735201	01/01/91	06/06/91	Supplemental
		83-3(b)	Teratogenicity - rabbi	04/01/91	Acceptable/Satisfied	Study	42224001	03/04/92	07/29/92	Acceptable
						Study	41747601	01/01/91	07/22/91	Acceptable
		83-4	2-generation repro.-ra	/ /	Reserved					
		84-2(a)	Gene mutation-ames	06/01/89	Acceptable/Satisfied	Study	41409802	03/07/90	12/01/90	Acceptable
		84-2(b)	Struct. chrom. aberrat	09/01/89	Acceptable/Satisfied	Study	99999999	10/31/90	04/05/91	Acceptable
						Study	41420004	03/19/90	06/26/90	Unacceptable
						Study	41409805	03/07/90	12/01/90	Supplemental
		84-4	Other genotoxic effect	09/01/89	Acceptable/Satisfied	Study	41870102	05/08/91	08/15/91	Acceptable
						Study	41409808	03/07/90	12/01/90	Supplemental
		85-1	General metabolism	12/01/90	Waived					
		123-1(a)	Seed germ/seedling eme	11/15/91	No Decision/Not Satisf	Study	42772903	07/15/93		In Review
						Study	42389501	08/13/92		In Review
		123-1(b)	Vegetative vigor	11/15/91	No Decision/Not Satisf	Study	42772905	07/15/93		In Review
						Study	42343901	06/05/92		In Review
		123-2	Aquatic plant growth	08/31/93	No Decision/Not Satisf	Study	99999999	09/28/92		In Review
						Study	41505901	05/31/90	11/12/91	Unacceptable
						Study	41505902	05/31/90	11/12/91	Acceptable
						Study	41505903	05/31/90	11/12/91	Acceptable
						Study	41505904	05/31/90	11/12/91	Acceptable
						Study	41420002	03/19/90	01/05/93	Acceptable

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Chemical : 030019 Dimethylamine 2,4-dichlorophen

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	124-1	Terrestrial field	/ /	Reserved					
		124-2	Aquatic field	/ /	Reserved					
		161-1	Hydrolysis	06/01/89	Reserved					
		161-2	Photodegradation-water	06/01/89	Reserved					
		161-3	Photodegradation-soil	06/01/89	Reserved					
		161-4	Photodegradation-air	06/01/89	Reserved					
		162-1	Aerobic soil metabolis	12/31/95	No Decision/Not Satisf					
		162-2	Anaerobic soil metabol	/ /	Reserved					
		162-3	Anaerobic aquatic meta	12/31/95	No Decision/Not Satisf					
		162-4	Aerobic aquatic metab.	12/31/95	No Decision/Not Satisf					
		163-1	Leach/adsorp/desorptio	01/01/90	Reserved					
		163-2	Volatility - lab	09/01/89	Reserved					
		163-3	Volatility - field	04/01/90	Reserved					
		164-1	Terrestrial field diss	12/01/95	No Decision/Not Satisf	Protocol	protocol	06/22/93		In Review
						Other Submission	protocol	12/18/92	03/22/93	Unacceptable
		164-2	Aquatic field dissipat	09/01/93	No Decision/Not Satisf					
		164-3	Forest field dissipati	09/01/93	No Decision/Not Satisf					
		164-5	Long term soil dissipa	/ /	Reserved					
		165-1	Confined rotational cr	01/01/92	Reserved					
		165-2	Field rotational crop	/ /	Reserved					
		165-3	Accumulation - irrig c	/ /	Reserved					
		165-4	Bioaccumulation in fis	/ /	Reserved					
		165-5	Bioaccum-aquatic non-t	/ /	Reserved					
		171-4(a)	Nature of residue - pl	09/15/91	No Decision/Not Satisf	Study	41991503	08/23/91	06/30/92	Unacceptable
		171-4(b)	Nature of residue - li	10/15/91	No Decision/Not Satisf	Other Submission	WAIVED	09/01/88		No Decision
		171-4(c)	Res. analyt. method -	03/01/90	Time Extension Pending					
		171-4(d)	Res. analyt. method -	03/01/90	Time Extension Pending					

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Case : 0073 2,4-D

Chemical : 030019 Dimethylamine 2,4-dichlorophen

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	171-4(e)	Storage stability	03/01/90	Time Extension Pending					
		171-4(f)	Mag. of res. potable H	06/01/90	Time Extension Pending					
		171-4(g)	Mag. of res. in fish	06/01/90	Time Extension Pending					
		171-4(h)	Mag. of res. irrigated	06/01/90	Time Extension Pending					
		171-4(j)	Mag. meat/milk/poultry	06/01/90	Time Extension Pending					
		171-4(k)	Cherry	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Corn, Field	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
						Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Cranberry	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Grapefruit	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Orange	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Peach	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Pistachio	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Plum	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Range, Grasses	06/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(k)	Strawberry	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Wheat	06/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		201-1	Droplet size spectrum	12/31/94	Waiver Pending					
		202-1	Drift field evaluation	12/31/94	Waiver Pending					
		81-X-SS	Dermal Neurotox.	10/01/89	Waiver Pending					

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Office of Pesticide Programs
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Case : 0073 2,4-D

Chemical : 030063 Isooctyl(2-ethylhexyl) 2,4-dic

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	61-2(a)	Begin. mat. & mnfg. pr	08/27/90	No Decision/Not Satisf	Study	41968301	08/02/91		No Decision
						Study	40998701	02/15/89	10/25/89	Acceptable
		61-2(b)	Discussion of Impuriti	03/01/89	No Decision/Not Satisf	Study	41968301	08/02/91		No Decision
						Study	41055806	09/01/88	10/25/89	Unacceptable
		62-1	Preliminary Analysis	09/01/89	No Decision/Not Satisf	Study	41055807	09/01/88	10/25/89	Acceptable
		63-2	Color	03/01/89	No Decision/Not Satisf	Study	41055808	09/01/88	10/25/89	Acceptable
		63-3	Physical State	03/01/89	No Decision/Not Satisf	Study	41055808	09/01/88	10/25/89	Acceptable
		63-4	Odor	03/01/89	No Decision/Not Satisf	Study	41055808	09/01/88	10/25/89	Acceptable
		63-5	Melting Point	03/01/89	No Decision/Not Satisf	Study	41055808	09/01/88	10/25/89	Acceptable
		63-6	Boiling Point	03/01/89	No Decision/Not Satisf	Study	41431301	03/21/90		No Decision
		63-7	Density	03/01/89	No Decision/Not Satisf	Study	41055808	09/01/88	10/25/89	Acceptable
		63-8	Solubility	03/01/89	No Decision/Not Satisf	Study	41968302	08/02/91		In Review
		63-9	Vapor Pressure	03/01/89	Acceptable/Satisfied	Study	41332007	12/20/89	10/25/89	Acceptable
						Study	41055808	09/01/88	10/25/89	Acceptable
		63-10	Dissociation Constant	03/01/89	No Decision/Not Satisf	Study	41055808	09/01/88	10/25/89	Acceptable
		63-11	Oct/Water partition Co	03/01/89	Acceptable/Satisfied	Study	41332009	12/20/89	07/27/90	Acceptable
		63-12	pH	03/01/89	No Decision/Not Satisf	Study	41055808	09/01/88	10/25/89	Acceptable
		63-13	Stability	03/01/89	No Decision/Not Satisf	Study	41968303	08/02/91		No Decision
		71-1(a)	Acute avian oral quail	06/01/89	Acceptable/Satisfied	Study	41158303	07/07/89	03/18/92	Acceptable
		71-2(a)	Acute avian diet. quai	06/01/89	Acceptable/Satisfied	Study	41158305	07/07/89	03/18/92	Acceptable
		71-2(b)	Acute avian diet. duck	06/01/89	Acceptable/Satisfied	Study	41158304	07/07/89	03/18/92	Acceptable
		71-4(a)	Avian repro. quail	/ /	Reserved					
		71-4(b)	Avian repro. duck	/ /	Reserved					
		71-5(a)	Simulated field study	/ /	Reserved					
		71-5(b)	Actual field study	/ /	Reserved					
		72-1(a)	Fish toxicity bluegill	01/01/93	Acceptable/Satisfied	Study	99999999	05/27/92	08/06/92	Unacceptable
						Study	41158306	07/07/89	03/18/92	Unacceptable

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Chemical : 030063 Isooctyl(2-ethylhexyl) 2,4-dic

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Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
						Other Submission	LEWD0005	09/01/88		Acceptable
		72-1(b)	Fish toxicity bluegill	06/01/89	Acceptable/Satisfied					
		72-1(c)	Fish toxicity rainbow	06/01/89	Acceptable/Satisfied	Study	99999999	06/08/92	08/19/92	Acceptable
						Study	41737303	01/07/91	11/20/91	Supplemental
		72-1(d)	Fish toxicity rainbow	06/01/89	Acceptable/Satisfied	Study	41158306	01/01/91	03/18/92	Unacceptable
		72-2(a)	Invertebrate toxicity	01/01/93	Acceptable/Satisfied	Study	99999999	05/27/92	08/06/92	Acceptable
						Study	41158312	07/01/89	03/18/92	Unacceptable
		72-2(b)	Invertebrate toxicity	06/01/89	No Decision/Not Satisf	Study	41835207	04/04/91		In Review
		72-3(a)	Estu/mari tox. fish	09/01/89	No Decision/Not Satisf	Study	41835201	04/04/91		Acceptable
		72-3(b)	Estu/mari tox. mollusk	09/01/89	No Decision/Not Satisf	Study	41835202	04/04/91	09/12/91	Acceptable
		72-3(c)	Estu/mari tox. shrimp	09/01/89	No Decision/Not Satisf	Study	41835203	04/04/91	09/12/91	Acceptable
		72-4(a)	Early life stage fish	09/01/90	No Decision/Not Satisf	Study	41737305	01/15/91		In Review
		72-4(b)	Life cycle invertebrat	03/01/91	No Decision/Not Satisf	Study	41835207	04/01/91		In Review
		72-5	Life cycle fish	/ /	Reserved					
		72-6	Aquatic org. accumulat	/ /	Reserved					
		72-7(a)	Simul. field-aquatic o	/ /	Reserved					
		81-3	Acute inhal. tox rat	01/15/93	Acceptable/Satisfied	Study	42605202	12/30/92	03/01/93	Acceptable
						Study	00163712	10/01/86	01/29/92	Upgradable
		81-4	Primary eye irration-r	06/01/89	Acceptable/Satisfied	Study	00163711	10/01/86	01/29/92	Acceptable
		81-5	Primary dermal irritat	06/01/89	Acceptable/Satisfied	Study	00163711	10/01/86	01/29/92	Acceptable
		81-6	Dermal sensitization	06/01/89	Acceptable/Satisfied	Study	00163713	10/01/86	01/29/92	Acceptable
		82-1(a)	90-day feeding-rodent	02/01/91	Acceptable/Satisfied	Study	99999999	04/29/92	07/23/92	Acceptable
						Study	41896701	06/01/91	09/12/91	Supplemental
		82-1(b)	90-day feeding-nonrode	06/01/93	No Decision/Not Satisf	Study	42780003	05/19/93		No Decision
						Study	42780005	05/19/93		No Decision
						Study	99999999	11/05/92	01/13/93	Acceptable
		82-2	21-day dermal-rabbit/r	04/01/90	Acceptable/Satisfied	Study	41735302	01/01/91	07/03/91	Acceptable

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Chemical : 030063 Isooctyl(2-ethylhexyl) 2,4-dic

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
						Study	41735305	01/01/91	07/03/91	Acceptable
		83-1(a)	Chronic tox-rodent	/ /	Reserved					
		83-1(b)	Chronic tox - non-rode	/ /	Reserved	Study	protocol	06/03/93		No Decision
		83-2(a)	Oncogenicity - rat	/ /	Reserved					
		83-2(b)	Oncogenicity-mouse	/ /	Reserved					
		83-3(a)	Teratogenicity - rat	01/15/92	Acceptable/Satisfied	Study	42304601	05/15/92	08/27/92	Acceptable
						Study	42304602	05/15/92	08/27/92	Acceptable
		83-3(b)	Teratogenicity - rabbi	01/15/92	Acceptable/Satisfied	Study	42304603	05/15/92	08/27/92	Acceptable
						Study	42304604	05/15/92	08/27/92	Acceptable
		83-4	2-generation repro.-ra	/ /	Reserved					
		84-2(a)	Gene mutation-ames	06/01/89	Acceptable/Satisfied	Study	41409803	03/07/90	12/01/90	Acceptable
		84-2(b)	Struct. chrom. aberrat	09/01/89	No Decision/Not Satisf	Study	41420005	03/19/90	06/26/90	Acceptable
						Study	41409806	03/07/90	12/01/90	Supplemental
		84-4	Other genotoxic effect	09/01/89	Acceptable/Satisfied	Study	41870103	05/08/91	08/15/91	Acceptable
						Study	41409809	03/07/90	12/01/90	Acceptable
		85-1	General metabolism	01/04/93	No Decision/Not Satisf	Study	99999999	01/08/93	04/29/93	Acceptable
						Study	42261801	03/31/92	08/19/92	Upgradable
		123-1(a)	Seed germ/seedling eme	11/15/91	No Decision/Not Satisf	Study	42772902	07/15/93		In Review
						Study	42449201	08/27/92		In Review
		123-1(b)	Vegetative vigor	11/15/91	No Decision/Not Satisf	Study	42772905	07/15/93		In Review
						Study	42343902	06/05/92		In Review
		123-2	Aquatic plant growth	06/01/89	No Decision/Not Satisf	Study	41735202	01/01/91		In Review
						Study	41735203	01/01/91		In Review
						Study	41735204	01/01/91		In Review
						Study	41735205	01/01/91		In Review
						Study	41735206	01/01/91		In Review
		124-1	Terrestrial field	/ /	Reserved					

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Chemical : 030063 Isooctyl(2-ethylhexyl) 2,4-dic

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	124-2	Aquatic field	/ /	Reserved					
		161-1	Hydrolysis	04/30/93	No Decision/Not Satisf	Study	42770501	05/13/93		In Review
						Study	42770502	05/13/93		In Review
						Study	42735401	04/14/93		In Review
		161-2	Photodegradation-water	04/30/93	No Decision/Not Satisf	Study	42749702	04/27/93		No Decision
		161-3	Photodegradation-soil	06/01/89	Reserved					
		161-4	Photodegradation-air	12/01/91	Waiver Pending					
		162-1	Aerobic soil metabolis	01/01/94	No Decision/Not Satisf					
		162-2	Anaerobic soil metabol	01/01/91	No Decision/Not Satisf	Other Submission	WAIVED	09/01/88		No Decision
		162-3	Anaerobic aquatic meta	01/01/94	No Decision/Not Satisf					
		162-4	Aerobic aquatic metab.	01/01/94	No Decision/Not Satisf					
		163-1	Leach/adsorp/desorptio	01/01/90	Reserved					
		163-2	Volatility - lab	09/01/91	No Decision/Not Satisf	Study	42059601	10/30/91		In Review
		163-3	Volatility - field	04/01/90	Reserved					
		164-1	Terrestrial field diss	12/01/95	No Decision/Not Satisf	Other Submission	protocol	12/18/92	03/22/93	Unacceptable
		164-2	Aquatic field dissipat	01/01/91	Waived					
		164-3	Forest field dissipati	12/31/95	No Decision/Not Satisf					
		164-5	Long term soil dissipa	/ /	Reserved					
		165-1	Confined rotational cr	01/01/95	Reserved					
		165-2	Field rotational crop	/ /	Reserved					
		165-3	Accumulation - irrig c	01/01/92	Reserved					
		165-4	Bioaccumulation in fis	/ /	Reserved					
		165-5	Bioaccum-aquatic non-t	/ /	Reserved					
		171-4(a)	Nature of residue - pl	08/01/92	No Decision/Not Satisf	Other Submission		07/22/93		No Decision
						Study	42615601	01/07/93	04/06/93	Acceptable
						Study	42439701	08/13/92	04/06/93	Acceptable
						Study	42423101	07/31/92	08/26/92	Unacceptable

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Case : 0073 2,4-D

Chemical : 030063 Isooctyl(2-ethylhexyl) 2,4-dic

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
000264	RHONE-POULENC AG COMPA	171-4(b)	Nature of residue - li	10/15/91	Reserved					
		171-4(c)	Res. analyt. method -	03/01/90	Time Extension Pending					
		171-4(d)	Res. analyt. method -	03/01/90	Time Extension Pending					
		171-4(e)	Storage stability	03/01/90	Time Extension Pending					
		171-4(f)	Mag. of res. potable H	06/01/90	Time Extension Pending					
		171-4(g)	Mag. of res. in fish	06/01/90	Time Extension Pending					
		171-4(h)	Mag. of res. irrigated	06/01/90	Time Extension Pending					
		171-4(j)	Mag. meat/milk/poultry	06/01/90	Time Extension Pending					
		171-4(k)	Blueberry	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Corn, Field	06/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
						Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(k)	Potato	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Range, Grasses	06/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
		171-4(k)	Strawberry	06/01/90	Use Pattern Changed	Other Submission	AMENDUSE	09/01/88		No Decision
		171-4(k)	Sugarcane	06/01/90	Time Extension Pending	Other Submission	TIMEPEND	09/01/88		No Decision
		201-1	Droplet size spectrum	12/31/94	No Decision/Not Satisf	Other Submission	PROTOCOL	12/04/91	03/08/93	Unacceptable
		202-1	Drift field evaluation	12/31/94	No Decision/Not Satisf					
		81-X-SS	Dermal Neurotox.	04/01/91	Reserved					

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Case : 0073 2,4-D

Chemical : 030053 Butoxyethyl 2,4-dichlorophenox

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
062719	DOWELANCO	61-2(a)	Begin. mat. & mnfg. pr	03/01/89	No Decision/Not Satisf	Study	41055812	04/06/89	10/25/89	Acceptable
		61-2(b)	Discussion of Impuriti	03/01/89	No Decision/Not Satisf	Study	41961301	07/31/91		In Review
						Study	41055812	04/06/89	10/25/89	Unacceptable
		62-1	Preliminary Analysis	09/01/89	Acceptable/Satisfied	Study	41055813	04/06/89	10/25/89	Acceptable
		63-2	Color	03/01/89	No Decision/Not Satisf	Study	41055814	04/06/89		No Decision
		63-3	Physical State	03/01/89	No Decision/Not Satisf	Study	41055814	04/06/89		No Decision
		63-4	Odor	03/01/89	No Decision/Not Satisf	Study	41055814	04/06/89		No Decision
		63-5	Melting Point	03/01/89	No Decision/Not Satisf	Study	41055814	04/06/89		No Decision
		63-6	Boiling Point	03/01/89	No Decision/Not Satisf	Study	42830901	07/01/93		No Decision
						Study	41431301	03/21/91		No Decision
		63-7	Density	03/01/89	No Decision/Not Satisf	Study	41055814	04/06/89		No Decision
		63-8	Solubility	03/01/89	No Decision/Not Satisf	Study	42830901	07/01/93		No Decision
						Study	41669501	11/01/91	02/19/91	Unacceptable
						Study	41055814	04/06/89		No Decision
						Other Submission	PROTOCOL	09/01/88	05/30/91	Acceptable
		63-9	Vapor Pressure	03/01/89	Acceptable/Satisfied	Study	41431301	03/27/90	07/23/92	Acceptable
						Study	41055814	04/06/89		No Decision
		63-10	Dissociation Constant	03/01/89	No Decision/Not Satisf	Study	41353702	01/17/90		No Decision
						Study	41055814	04/06/89		No Decision
		63-11	Oct/Water partition Co	04/01/89	No Decision/Not Satisf	Study	41647001	10/02/90	11/01/90	Acceptable
						Study	41055814	04/06/89		No Decision
		63-12	pH	03/01/89	No Decision/Not Satisf	Study	41055814	04/06/89		No Decision
		63-13	Stability	03/01/89	No Decision/Not Satisf	Study	42487901	09/24/92		In Review
		71-1(a)	Acute avian oral quail	06/01/89	No Decision/Not Satisf	Study	41454101	04/17/90		In Review
		71-2(a)	Acute avian diet. quai	06/01/89	No Decision/Not Satisf	Study	41448401	04/11/90		In Review
		71-2(b)	Acute avian diet. duck	09/01/89	No Decision/Not Satisf	Study	41429007	03/29/90		In Review
		71-4(a)	Avian repro. quail	/ /	Reserved					

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Chemical : 030053 Butoxyethyl 2,4-dichlorophenox

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
062719	DOWELANCO	71-4(b)	Avian repro. duck	/ /	Reserved					
		71-5(a)	Simulated field study	/ /	Reserved					
		71-5(b)	Actual field study	/ /	Reserved					
		72-1(a)	Fish toxicity bluegill	07/01/89	Acceptable/Satisfied	Study	41353801	01/17/90	11/14/91	Acceptable
		72-1(c)	Fish toxicity rainbow	07/01/89	Acceptable/Satisfied	Study	41353801	01/17/90	11/14/91	Acceptable
		72-1(d)	Fish toxicity rainbow	06/01/89	Waived					
		72-2(a)	Invertebrate toxicity	06/01/89	Acceptable/Satisfied	Study	41353802	01/17/90	11/14/91	Acceptable
		72-3(a)	Estu/mari tox. fish	09/01/89	Waived					
		72-3(b)	Estu/mari tox. mollusk	09/01/89	Waived					
		72-3(c)	Estu/mari tox. shrimp	09/01/89	Waived					
		72-4(a)	Early life stage fish	09/01/90	No Decision/Not Satisf	Study	41345701	01/08/90	06/24/93	Unacceptable
		72-4(b)	Life cycle invertebrat	09/01/90	Acceptable/Satisfied	Study	41353802	01/17/90	11/14/91	Acceptable
		72-5	Life cycle fish	/ /	Reserved					
		72-6	Aquatic org. accumulat	/ /	Reserved					
		72-7(a)	Simul. field-aquatic o	/ /	Reserved					
		82-1(a)	90-day feeding-rodent	03/01/91	Acceptable/Satisfied	Study	41928101	07/01/91	09/30/91	Acceptable
		82-1(b)	90-day feeding-nonrode	03/01/90	Time Extension Pending	Waiver Request	reserve?	02/22/93		No Decision
		82-2	21-day dermal-rabbit/r	05/01/90	Acceptable/Satisfied	Study	41407901	03/05/90	12/15/90	Acceptable
		83-1(a)	Chronic tox-rodent	/ /	Reserved					
		83-1(b)	Chronic tox - non-rode	/ /	Reserved					
		83-2(a)	Oncogenicity - rat	/ /	Reserved					
		83-2(b)	Oncogenicity-mouse	/ /	Reserved					
		83-3(a)	Teratogenicity - rat	08/01/90	Acceptable/Satisfied	Study	41527101	06/11/90	12/15/90	Acceptable
						Study	41527104	06/11/90	12/15/90	Supplemental
		83-3(b)	Teratogenicity - rabbi	01/01/90	Acceptable/Satisfied	Study	42158703	01/08/92	05/26/92	Acceptable
						Study	42158706	01/08/92	05/26/92	Acceptable
		83-4	2-generation repro.-ra	/ /	Reserved					

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Case : 0073 2,4-D

Chemical : 030053 Butoxyethyl 2,4-dichlorophenox

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
062719	DOWELANCO	84-2(a)	Gene mutation-ames	03/15/92	Acceptable/Satisfied	Study	42015701	09/12/91	08/13/93	Acceptable
						Study	41797903	02/13/91	05/20/91	Unacceptable
						Study	41388204	02/14/90	06/13/90	Unacceptable
		84-2(b)	Struct. chrom. aberrat	06/15/92	No Decision/Not Satisf	Study	42015704	09/12/91	05/04/92	Unacceptable
						Study	41478301	05/09/90	05/20/91	Unacceptable
		84-4	Other genotoxic effect	06/15/92	Acceptable/Satisfied	Addendum to a Study	99999999	04/07/93	08/13/93	Acceptable
						Study	42015707	09/12/91	05/04/92	Unacceptable
						Study	41498101	05/18/90	05/20/91	Unacceptable
		85-1	General metabolism	04/15/92	No Decision/Not Satisf	Study	42579701	12/08/92	04/29/93	Acceptable
		123-1(a)	Seed germ/seedling eme	08/31/93	No Decision/Not Satisf	Study	41616801	09/04/90	11/21/91	Unacceptable
		123-1(b)	Vegetative vigor	08/31/93	No Decision/Not Satisf	Study	41616802	09/04/90	11/12/91	Unacceptable
		123-2	Aquatic plant growth	06/01/89	No Decision/Not Satisf	Study	42068401	10/22/91		In Review
						Study	41382101	02/01/90		No Decision
		124-1	Terrestrial field	/ /	Reserved					
		124-2	Aquatic field	/ /	Reserved					
		161-1	Hydrolysis	06/01/89	No Decision/Not Satisf	Other Submission	99999999	07/30/93		In Review
						Study	41483101	06/01/90	05/24/91	Unacceptable
						Study	41353701	01/17/90	05/24/91	Unacceptable
		161-2	Photodegradation-water	05/01/90	Acceptable/Satisfied	Study	41483102	06/01/90	05/24/91	Acceptable
		161-3	Photodegradation-soil	06/01/89	Waiver Pending					
		161-4	Photodegradation-air	05/01/90	No Decision/Not Satisf	Other Submission	99999999	07/30/93		In Review
						Study	41483103	06/01/90		In Review
		162-1	Aerobic soil metabolis	12/01/91	Reserved					
		162-2	Anaerobic soil metabol	01/01/91	Waiver Pending					
		162-3	Anaerobic aquatic meta	01/01/91	No Decision/Not Satisf	Study	42574701	12/03/92		In Review
		162-4	Aerobic aquatic metab.	12/01/91	Reserved					
		163-1	Leach/adsorp/desorptio	01/01/90	Waiver Pending					

Branch: RB
Section: RS-III
CRM: JCOOMBS

Case : 0073 2,4-D

Chemical : 030053 Butoxyethyl 2,4-dichlorophenox

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
062719	DOWELANCO	163-2	Volatility - lab	10/01/90	No Decision/Not Satisf	Study	99999999	07/30/93		In Review
						Study	41718001	12/01/90		In Review
		163-3	Volatility - field	04/01/90	Waiver Pending					
		164-1	Terrestrial field diss	01/01/91	Waiver Pending					
		164-2	Aquatic field dissipat	01/01/91	Waiver Pending					
		164-3	Forest field dissipati	01/01/91	Waiver Pending					
		164-5	Long term soil dissipa	/ /	Reserved					
		165-1	Confined rotational cr	01/01/92	Waiver Pending					
		165-2	Field rotational crop	/ /	Reserved					
		165-3	Accumulation - irrig c	01/01/92	Waiver Pending					
		165-4	Bioaccumulation in fis	/ /	Reserved					
		165-5	Bioaccum-aquatic non-t	/ /	Reserved					
		171-4(a)	Nature of residue - pl	04/01/90	Waived					
		171-4(e)	Storage stability	06/01/90	Reserved					
		171-4(f)	Mag. of res. potable W	06/01/90	Reserved					
		171-4(g)	Mag. of res. in fish	06/01/90	Reserved					
		171-4(h)	Mag. of res. irrigated	06/01/90	Reserved					
		171-4(j)	Mag. meat/milk/poultry	06/01/90	Reserved					
		171-4(k)	Blueberry	06/01/90	Reserved	Other Submission	RESERVED	09/01/88		No Decision
		171-4(k)	Corn, Field	06/01/90	Reserved	Other Submission	RESERVED	09/01/88		No Decision
						Other Submission	RESERVED	09/01/88		No Decision
						Other Submission	RESERVED	09/01/88		No Decision
		171-4(k)	Range, Grasses	06/01/90	Reserved	Other Submission	RESERVED	09/01/88		No Decision
		171-4(k)	Sugarcane	06/01/90	Reserved	Other Submission	RESERVED	09/01/88		No Decision
		171-4(k)	Wheat	06/01/90	Reserved	Other Submission	RESERVED	09/01/88		No Decision
						Other Submission	RESERVED	09/01/88		No Decision
		171-4(l)	Wheat	06/01/90	Reserved	Other Submission	RESERVED	09/01/88		No Decision

Branch: RB
Section: RS-III
CRM: JCOOMBS

Case : 0073 2,4-D

Chemical : 030053 Butoxyethyl 2,4-dichlorophenox

Company Number	Company Name	Guideline Number	Guideline Name	Due Date	Guideline Status	Submission Type	MRID	Received Date	Review Date	Acceptability Code
062719	DOWELANCO	201-1	Droplet size spectrum	01/11/91	Time Extension Pending					
		202-1	Drift field evaluation	/ /	Waived					
		81-X-SS	Neurotoxicity	/ /	No Decision/Not Satisf					

ATTACHMENT 2:

NOXIOUS WEED INFORMATION CENTERS

COOPERATIVE EXTENSION

Washington State University

ıllman, Washington 99164-6420

Helping You Put Knowledge To Work

Washington State University Cooperative Extension helps people develop leadership skills and use research based knowledge to improve their economic status and quality of life.

Chris Boerboom

Chris Boerboom
Extension Weed Scientist

Cooperating agencies: Washington State University, U.S. Department of Agriculture, and Washington Counties. Cooperative Extension programs and employment are available to all without discrimination.

Cooperative Extension Offices in Washington Counties

ADAMS: Courthouse, 210 W. Broadway, Ritzville 99169
ASOTIN: Courthouse Annex, Box 9, Asotin 99402
BENTON: 1121 Dudley Ave., Prosser 99350
5600E W. Canal Place, Kennewick 99336
CHELAN: 400 Washington St., Wenatchee 98801
CLALLAM: Courthouse, 223 East 4th St., Port Angeles 98362
CLARK: 2400 T Street, Vancouver 98661
COLUMBIA: Federal Bldg., 202 South 2nd St., Dayton 99328
COWLITZ: 207-4th Ave. North, Kelso 98626
DOUGLAS: Courthouse, Box 550, Waterville 98858
FERRY: Courthouse, Box 345, Republic 99166
FRANKLIN: Courthouse, Pasco 99301
GARFIELD: Courthouse, Pomeroy 99347
GRANT: Courthouse, P.O. Box 37, Ephrata 98823
GRAYS HARBOR: Courthouse, Box 552, Montesano 98563
ISLAND: Courthouse, Coupeville 98239
JEFFERSON: Federal Bldg., Box 572, Port Townsend 98368
KING: 612 Smith Tower, 506 Second Ave., Seattle 98104
KITSAP: Courthouse Annex, Box 146, Port Orchard 98366
KITTITAS: Courthouse, 5th and Main, Ellensburg 98926
KLICKITAT: Courthouse Annex, Rm 210, 228 W. Main, Goldendale 98620
LEWIS: Courthouse Annex, Box 708, Chehalis 98532-0708
LINCOLN: 303 6th, Box 399, Davenport 99122
MASON: 9 Federal Bldg., Shelton 98584
OKANOGAN: Courthouse, Okanogan 98840
PACIFIC: Courthouse, Box 88, South Bend 98586
Coastal Wash. Research Unit, Rt. 1, Box 570, Long Beach 98631
PEND OREILLE: Federal Bldg., Box 5000, Newport 99156-5045
PIERCE: 2401 South 35th, Tacoma 98504
SAN JUAN: Box 609, Friday Harbor 98250
SKAGIT: 112 County Admin. Bldg., Mt. Vernon 98273
SKAMANIA: Courthouse, Box 790, Stevenson 98648
SNOHOMISH: 600 128 Street SE, Everett 98208
SPOKANE: N. 222 Havana, Spokane 99202
STEVENS: P.O. Bldg., Box 32, Colville 99114
THURSTON: Thurston County Plaza Bldg., Suite 216, 921 Lakeridge Dr. S.W., Olympia 98502
WAHKIAKUM: Courthouse, Box 278, Cathlamet 98612
WALLA WALLA: 314 W. Main St., Walla Walla 99362
WHATCOM: Courthouse Annex, 1000 N. Forest St., Bellingham 98225
WHITMAN: Public Service Bldg., 310 North Main, Colfax 99111
YAKIMA: 233 Courthouse, Yakima 98901

County	Noxious Weed Board Office	Cooperative Extension Office
Adams	509-659-1806	509-659-0090
Weed District #1	509-488-9023	
Asotin	509-243-2098	509-243-2018
Benton	509-786-5609	509-786-5609
Weed District #1	509-786-5609	
Chelan	509-664-5540	509-664-5540
Clark	206-254-2034	206-254-8436
Columbia	509-382-4741	509-382-4741
Cowlitz	206-577-3117	206-577-3014
Douglas		509-745-8531
Ferry	509-775-5210	509-775-5235
Franklin	509-545-3847	509-545-3511
Garfield	509-843-1913	509-843-3701
Grant	509-754-2011	509-754-2011
Weed District #1	509-787-2515	
Weed District #3	509-785-3621	
Grays Harbor	206-482-4500	206-249-4332
Intercounty Weed Dist. #51	509-349-2551	
Intercounty Weed Dist. #52	509-346-9660	
Island	206-321-5111	206-679-7327
Jefferson		206-385-9158
King	206-333-4928	206-296-3900
Kitsap		206-876-7157

County	Noxious Weed Board Office	Cooperative Extension Office
Whatcom	206-354-3990	206-676-6736
Whitman	509-397-6261	509-397-6290
Yakima	509-575-2946	509-575-4218

Part III

Other Ground Water Information

Part III covers ground water data that is not covered in Parts I and II. Many types of data may be entered into various computer programs for Ground Water Management Programs. These data may include but not be limited to well inventories (a minimal amount of information for a very large number of wells), lithology, ground water models, water rights, water use, precipitation, runoff, and various types of maps and plots. As these data are not suitable for WATSTORE or STORET, Ecology needs the following where applicable:

- Hard and digital copy of the data;
- Manufacture, model, amount of memory, CPU, and modification (if any) to the computer;
- What peripherals, if any, are required to run the program;
- The name and source of the program used to process the data (including the version if applicable);

If digital data is on a floppy disk, include:

- Disk operating system (DOS),
- Number of tracks,
- Number of sectors per track,
- Density tracks per inch,
- Hard or soft sectored,
- Number of bytes per sector,
- For sequential files the data separators,
- For random access files the number of fields per record and field length,
- Data file format, ASCII, binary, etc.

If digital data is on reel of tape include:

- Number of tracks,
- Density,
- Is it labeled or unlabeled,
- Record length
- Track length,
- For sequential files the data separators,
- For random access files the number of fields per record and field length,
- Data file format, ASCII, binary, etc.

In addition, Ecology requires a written description of what the software does and what is contained in the data set. Each site must have a unique site number which is consistent with the Site ID described in Part I, field number 2 (see Page C-2) or consistent with the Local Number (Part I, field number 3, Page C-3). In addition, the type of site (i.e. well, spring, etc.) must be identified and the source of the data stated.

For the case of computer generated maps Ecology requires the latitude and longitude of the reference or register points and the projection and scale of the source map used. The data files must be compatible with ARC/INFO. The software Auto LISP can be used to convert Auto CAD files (version 2.5 or more recent) into export files that Ecology will then convert to ARC/INFO.