INTEGRATED AQUATIC PLANT MANAGEMENT PLAN FOR THE CHEHALIS RIVER BASIN

December 16, 2006

By
Bridget Simon, WSDA
Marty Peoples, WDFW

Edited by
David Heimer, WDFW
Rick Johnson, Thurston County Noxious Weed Board
Kathy Hamel, Department of Ecology

Ecology Grant #G0400331
WDFW Grant #04-1329

TABLE OF CONTENTS

Introduction – Statement of Purpose **2**

The Working Group **2**

Chehalis River Watershed **5**
Characteristics
Rare Plants
Salmon, native char, Olympic mudminnow

Problem Statement **8**

Management Goals **9**

Integrated Pest Management (IPM) **10**

Aquatic Noxious Weeds **11**

Action Plan **12**

Summary **13**

Literature Cited **14**

Appendices
Appendix A Weed Management Profiles
1. Brazilian elodea *(Egeria densa)*
2. The Knotweeds
(Polygonum cuspidatum, *P.sachalinensis*, *P. polystachum*, and *P. bohemicum)*
3. Parrotfeather *(Myriophyllum aquaticum)*
4. Purple loosestrife (*Lythrum salicaria*)

Appendix B Memorandum of Understanding
Appendix C Working Group Contact Information *(under revision)*
Appendix D Rare Plant Table (DNR Natural Heritage Program)
Appendix E Maps
Appendix F Quarantine List http://www.nwcb.wa.gov/weed_list/weed_list.htm

INTEGRATED AQUATIC VEGETATION WEED MANAGEMENT PLAN FOR THE CHEHALIS RIVER

Purpose

The purpose of the Chehalis River Integrated Aquatic Vegetation Weed Management Plan (IAVMP) is to develop a coordinated control effort for invasive aquatic weed species in the Chehalis River Watershed. The plan will coordinate the control activities for invasive species undertaken by landowners and land managers, including private, federal, tribal, state and county. This plan will also act as a working guide for future control activities. Coordinating aquatic weed management in the Chehalis River Watershed will allow a sharing of expertise and resources across management jurisdictions, resulting in more thorough control of invasive, aquatic weeds.

The Working Group

This Working Group formed and began meeting in 1997 and they continue to meet on a regular basis. The purpose of the Working Group and of The Chehalis River IAVMP is to minimize the spread of invasive weed species, to identify high priority areas for control and act to prevent economic and ecological impacts from these species.

The Working Group members have a common interest in weed management within the Chehalis River basin, and they address weed control on a multi-jurisdictional level. Members of this Working Group have signed a Memorandum of Understanding (MOU) and they include:

WA Department of Fish and Wildlife (WDFW)
WA Department of Natural Resources (DNR) Aquatics and Pacific Cascade Region
The Quinault Indian Nation
Grays Harbor Noxious Weed Control Board
Lewis County Noxious Weed Control Board
Thurston County Noxious Weed Control Board
The Nature Conservancy
The Chehalis River Council
U.S. Fish and Wildlife Service, Nisqually National Wildlife Complex

Contact information for this group is found in the Appendix of this document.

It should be noted that other agencies and organizations participate in Working Group meetings and projects as it suits their needs. The omission of their name from the Working Group membership does not diminish their importance as weed management partners.

The Washington Department of Fish and Wildlife is the lead for the Working Group, as well as lead for the Chehalis River IAVMP.

The Department of Natural Resources developed the MOU and continues to work on control of purple loosestrife, parrotfeather and knotweed at the Chehalis River Surge Plain NAP.

The Nature Conservancy currently (2004-2006) manages the SW Washington knotweed grant funds within the Chehalis River Basin.

The County Noxious Weed Control Programs organize meetings to share information on aquatic weeds in the Chehalis Basin. Thurston County manages the 2004 – 2005 Brazilian elodea project. Lewis County managed the 1997 parrotfeather project and the ongoing Plummer Lake Brazilian elodea eradication project.

The Working Group members have weed management interests or responsibilities on adjacent and co-mingled lands associated with the tributaries and main-stem of the Chehalis River of Lewis, Thurston and Grays Harbor and Mason Counties. Weed populations in one jurisdiction affect the ability of other land mangers to manage weeds on lands they administer, especially in an aquatic environment.

By working together, the members of this group work to promote an integrated and coordinated approach to weed management through information exchange, education and training, coordination of inventory and management techniques, and sharing of resources when appropriate.

Since the working group was formed, several weed removal projects have benefited the Chehalis River watershed, including:

- 2005 Brazilian Elodea removal project on the Chehalis River, by the Thurston County Noxious Weed Control Board; funding from U.S. Fish and Wildlife Service Chehalis Fisheries Restoration Fund;

- 2004 Brazilian Elodea pilot project diver dredging-removal project on the Chehalis River, by the Thurston County Noxious Weed Control Board, funded by Washington State Department of Natural Resources;

- 2004 – 2005 Knotweed Control Project in the Chehalis River Basin (with a focus on three watersheds – the Black, the Elk and the Wishkah and two tributaries Scatter Creek and the Newaukum River) by The Nature Conservancy through Washington Department of Agriculture Knotweed Control funds;

- Mapping project – ongoing;

- 2002 – 2003, Second phase of an ongoing inventory and control program for purple loosestrife (*Lythrum salicaria*) and parrotfeather (*Myriophyllum aquaticum*) in the lower Chehalis River including the area known as the Chehalis River Surge Plain, by DNR;

- 2001 – 2005, Native Species Restoration Following Knotweed Control, Chehalis River Surge Plain (CRSP) Natural Area Preserve (NAP) Preacher's Slough, by DNR;

- 1997-2003 survey and removal of parrotfeather from the Chehalis River in Thurston County, by the Thurston County Noxious Weed Control Board, funded by Washington State Department of Natural Resources;

- 1999-2003 survey and removal of Brazilian elodea from the Chehalis River in Thurston County, by the Thurston County Noxious Weed Control Board, funded by Washington State Department of Natural Resources;

- 1997 – 1998, Chehalis River Surge Plain Inventory, Early Detection and Control of Purple Loosestrife and Parrotfeather, by DNR

- 1997 Integrated Aquatic Plant Management Plan for Parrotfeather Management on the Chehalis River, by the Lewis County Noxious Weed Control Board;

- 1997-2002 control of purple loosestrife on Black River by adjacent landowners and Thurston County Weed Control,

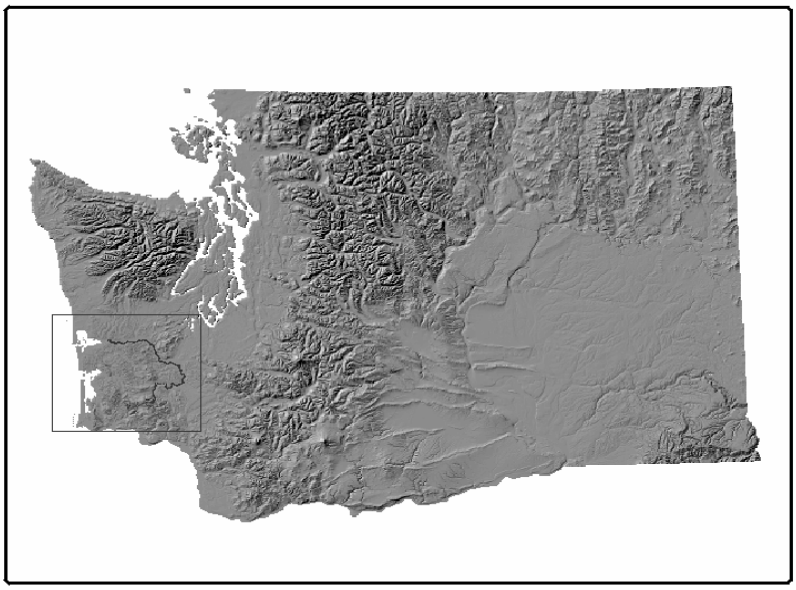
    - Purple loosestrife survey by the Thurston County Noxious Weed Control Board, and Washington State Department of Natural Resources;

- 2003-2005 control of purple loosestrife on Black River Wildlife refuge funded by U.S. Fish and Wildlife Service.

Giant knotweed encroaching on native plant species on the Wynoochee River.

The Chehalis River Watershed

The Chehalis River Basin is one of the largest river basins in Washington, second only to the Columbia River Basin. The Chehalis River drains approximately 2,200 square miles and contributes more than 80 percent of the freshwater flow into Grays Harbor (Seiler 1989). Grays Harbor is the fourth largest estuarine environment in the western United States (USACE 2003). The Chehalis River IAVMP area includes parts of Grays Harbor, Thurston, Lewis and Mason Counties.



The Chehalis River is generally a low gradient river for most of its reaches. Historically the section of river between Adna and Rochester was an extensive system of braided channels, wetlands, and riparian areas across a broad floodplain (USACE 2003). Development led to removal of woody debris and bank protection measures, which has led to channel entrenchment in this area. Draining wetlands and channelizing the river system decreased the ability of the entire system to store water (flood retention, groundwater discharge), to augment low flows and reduce summer temperatures (discharge cooler groundwater during the summer months) and reduce the peak flooding events. Now this section of the Chehalis River is slow moving and channelized.

The lower 18 miles of this river is unique in that it is tidally influenced. Below the Highway 107 Bridge (river mile 13) all riffles completely disappear, even at the lowest tides, and the river remains deep and slow moving up to its confluence with Grays Harbor. This lower part of the Chehalis River flows through the Chehalis River Surge Plain, which is characterized by the many tidal sloughs that wind through the adjacent Sitka spruce forest. At the upper reaches of the Chehalis River above Pe Ell (river mile 106) the character of the stream changes as gradient increases, more riffles appear and substrate changes to bedrock and gravel substrates.
Major tributaries include the Hoquiam, Wishkah, Wynoochee, Satsop, Cloquallum, Black, Skookumchuck, Newaukum and South Fork Chehalis Rivers. Numerous smaller tributaries flow into the Chehalis along its entire length.

One of the most striking features of the Chehalis River basin is the diversity of habitats found within, as it drains portions of the Olympic Rain Forest, Cascade Foothills and the Willapa Hills. Waters within this basin range from cold, clear, high gradient streams such as the Wynoochee, West and Middle Fork Satsop to slow moving low gradient streams such as the Black River and East Fork Satsop. Also included in this diverse mix are tidally influenced streams such as the Hoquiam and Wishkah. The broad Chehalis River valley contains many wetlands with the Chehalis River Surge Plain as the highest quality wetland in this watershed. This area acts as a filtering sponge for high volumes of water flowing to the mouth of the Chehalis River. The movement of ocean tides moving in and out of the surge plain mixes nutrients from upstream sources and marine waters. A unique habitat is created for plants, insects, fish and animals whose survival depends on this ecosystem.

For specific information on the Black, the Elk and the Wishkah River watersheds, please contact The Nature Conservancy regarding their knotweed control project.

Land use varies greatly in this watershed. In the Chehalis River valley, agricultural practices dominate land use with heavy industrial and residential use areas found around population centers. In the lower tidally influenced portion of the Chehalis River banks are often lined with docks used in shipping and fishing industries. In the foothills and mountainous areas of this drainage, timber production is the primary land use.

A. Rare Plants

Many rare wetland and aquatic plants exist in the Chehalis River Basin, and both the plant species and their habitat are threatened by the presence of invasive weeds. Listed in the Appendix is a Rare Plant Table, with a list of rare wetland and aquatic plants found in the Chehalis River Basin. These rare plants have been classified as Watch, Sensitive, Threatened or Endangered by the Washington Natural Heritage Program of the Washington Department of Natural Resources.

Because there are rare and endangered plants in the Chehalis River watershed always check with the Washington Department of Natural Resources Heritage Program for native flora and fauna locations that could be impacted by control methods prior to pursuing control. Please contact:

Sandy Swope Moody
Washington Natural Heritage Program, Dept. of Natural Resources
PO Box 47014, Olympia, WA 98504-7014
Phone: 360-902-1667 Fax: 360-902-1789
E-mail: sandra.moody@wadnr.gov
http://www.dnr.wa.gov/nhp/about.html

B. Salmon, Native Char and Olympic Mud Minnow Usage

The Chehalis River is heavily utilized by many species of resident and anadromous fish. Chinook, Coho, and Chum salmon as well as Steelhead trout inhabit the Chehalis River and its tributaries year round and support an intensive in-river sport fishery as well as ocean sport fishery. These species also support commercial and tribal fisheries in salt and freshwater.

Prior to pursuing control, the local Washington State Fish and Wildlife Area Habitat Biologist should be contacted regarding permitting and timing windows. Please contact:

Grays Harbor, Pacific, Mason, and Thurston Counties

WDFW Habitat Program – Region 6 Office
48 Devonshire Road, Montesano, WA 98563-9618
Phone: 360-586-6129 Fax: 360-664-0689

Lewis County

WDFW Habitat Program – Region 5 Office
2108 Grand Boulevard, Vancouver, WA 98661-4624
Phone: 360-696-6211 Fax: 360-906-6776

Chinook Salmon *(Oncorhynchus tshawytscha)*

Native and non-native spring and fall Chinook occur in the Chehalis River (USACE 2003). Adult Chinook salmon return to the Chehalis River from the ocean in spring, summer and fall months. Spawning occurs mainly in late summer and fall and is restricted to the mainstream Chehalis River and its larger tributaries. Most juvenile Chinook migrate to saltwater as subyearlings (fry) and are the progeny of fall and spring Chinook stocks (Gilbertson personal communication). Peak migration occurs in April through late May. Smaller percentages migrate as yearlings and are the progeny of spring Chinook stocks. Peak migration for yearlings is late April through early June (Simenstad et al. 1982).

Coho Salmon *(Oncorhynchus kisutch)*

Coho salmon are abundant in this river system and support a large recreational fishery throughout this river system and in tributaries. Adult Coho salmon return to freshwater in fall and early winter and spawn in the many tributaries of the Chehalis River (USACE 2003). Coho salmon typically spawn in the upper reaches of most streams and are very successful at passing natural stream barriers to access these smaller waters. Juvenile Coho salmon rear in freshwater for one year before migrating to the salt in April through June.

Chum Salmon *(Oncorhynchus keta)*

Chum salmon usage in the Chehalis River is restricted to its lower tributaries with the Satsop River being the major Chum producer. Chum salmon return from the ocean in fall months and typically spawn in the lower reaches of each accessible tributary. Juvenile Chum migrate to saltwater as fry with peak migration occurring from March to early May (Simenstad et al. 1982).

Steelhead Trout *(Oncorhynchus mykiss)*

Steelhead, the anadromous form of rainbow trout, return to freshwater in summer and winter months and spawn in all accessible areas of this system. Spawning occurs in spring months and juvenile steelhead spend 1-3 years rearing in freshwater before migrating to the ocean in spring (Busby et al. 1996). Steelhead, unlike the other Pacific salmon species, do not die after spawning but may return to freshwater again in following years as repeat spawners.

Coastal Cutthroat Trout *(Oncorhynchus clarki clarki/lewisi)*

Cutthroat trout are found in this system and support a limited sport fishery. Cutthroat typically enter freshwater in summer and fall months but frequently move between estuaries and freshwater during this period. Spawning occurs in spring months. Populations of resident rainbow and cutthroat trout inhabit the upper reaches of some tributaries.

Native Char *(Salvelinus spp.)*

Bull trout (*S. confluentus*) and Dolly Varden (*S. malma*) are two native char species present in western Washington. Bull trout and Dolly Varden are difficult to distinguish based upon physical characteristics. Because these two species are closely related and have similar biological

characteristics, the Washington Department of Fish and Wildlife manages bull trout and Dolly Varden together as native char (WDFW 2004). Bull trout are listed as Threatened under the Endangered Species Act while Dolly Varden are being considered for listing as Threatened. The presence of native char has been confirmed in the Chehalis River. One native char was collected on March 19, 1973 with a beach seine at RM 47 (Brix 1974). In a study by U.S. Army Corps of Engineers (2003), eight native char were captured in the lower Chehalis River near Aberdeen.

Olympic Mudminnow (*Novumbra hubbsi)*

The Olympic mudminnow (State Sensitive list) is one of five species worldwide in the family Umbridae and is the only member of the genus *Novumbra*. Three other species are found in North America and one in Eastern Europe. Olympic mudminnows are found only in Washington State. No other members of the family Umbridae are found in Washington.

The current distribution of the Olympic mudminnow includes the southern and western lowlands of the Olympic Peninsula, the Chehalis and lower Deschutes River drainages, and south Puget Sound, west of the Nisqually River (WDFW 1999). They are usually found in slow-moving streams, wetlands and ponds. Within these habitats, mudminnows require a muddy bottom, little or no water flow and abundant aquatic vegetation.

Spawning occurs over an extended period from late November to the following June. Mature mudminnows are about 50 mm (2 in) to 75 mm (3 in) long (WDFW 1999). Males become brightly colored and aggressive during spawning. Females deposit eggs in vegetation and they hatch in approximately ten days.

Mudminnows are completely dependent on healthy wetland habitat for their survival. Because of this, and the Olympic mudminnow's very restricted range and the continuing loss of wetlands, WDFW biologists believe they are vulnerable and likely to become threatened or endangered in a significant portion of its range without cooperative management.

Problem Statement – Chehalis River IAVMP

As stated previously, the purpose of the Chehalis River IAVMP is to develop a coordinated control effort of invasive aquatic weed species in the Chehalis River Watershed. This plan will also act as a working guide for future control activities.

The Chehalis River basin is currently under the threat of aggressively spreading aquatic noxious weeds. The Working Group made a decision that this IAVMP will include a finite set of invasive noxious weed species that are already being controlled in this watershed. The Working Group recognizes the importance of identifying and preventing the introduction and spread of these and other invasive species into the watershed.

Survey data collected in recent years shows established populations of the following non-native noxious weeds existing within the Chehalis River and on riparian areas adjacent to the Chehalis and its tributaries:

Brazilian elodea (*Egeria densa*)
Knotweeds - Japanese, giant, Himalayan and Bohemian
(*Polygonum cuspidatum, P.sachalinensis, P. polystachum,* and *P. bohemicum*)
Parrotfeather (*Myriophyllum aquaticum*) and
Purple loosestrife (*Lythrum salicaria*)

These invasive weed species have replaced some of our native plant species, degraded native habitats critical to fish and wildlife and reduced biodiversity in our plant communities. Riparian and wetland areas have also been choked out by weeds resulting in displaced waterfowl and increased predation. Aquatic environments are especially vulnerable to the spread of noxious weeds due to water movement and Chehalis River weed infestations have rapidly expanded in recent years.

Critical rearing habitat for juvenile salmon species has been lost in backwater sloughs that are now filled with parrotfeather and Brazilian elodea. Water quality has also been degraded for salmon species by aquatic weeds through increasing temperature, lowering dissolved oxygen and changing the pH. Invasive aquatic weeds reduce nutrient transfer to streams, which affects available prey for fish species. Aquatic weeds also change the types and size of fish found in a waterbody. Dense stands of aquatic weeds tend to reduce body size and favor fish types that are adapted to low dissolved oxygen environments.

Aquatic weeds have altered other natural processes as well. Erosion can increase as knotweed infestations replace the native vegetation that stabilized the stream banks. Increased sediment loads resulting from erosion negatively impact fish populations. Aquatic weeds can also trap sediments, changing the flow and river characteristics in a way that contributes to flooding.

Weed growth has limited recreational fishing in some areas by tangling fishing gear and restricting open water access. Tribal harvesting of salmon has also been negatively affected by interference of weeds with fishing methods and gear. Aquatic weeds have created barriers to boat passage restricting hunting opportunities for waterfowl, bird watching activities, canoeing and pleasure boating. Bank access to many parts of the river has been blocked due to tall stands of Japanese knotweed restricting recreational opportunities such swimming and picnicking. Apart from impacting their function, weeds undermine the natural beauty of waterbodies and have obstructed views of the water in many places eliminating opportunities for residents and visitors to fully enjoy our natural resources.

Management Goals

The Working Group agrees that the best way to develop a coordinated control effort of invasive aquatic weed species in the Chehalis River Watershed is to:

- Continue to meet regularly to make decisions that benefit the watershed.
- Share expertise and resources among jurisdictions as available and as necessary

The Chehalis River IAVMP will focus on achieving several goals through aquatic weed management.

1. Preserve and restore remnant riparian communities, wetlands, estuarine and freshwater aquatic systems throughout the full length of the Chehalis River, its tributaries and associated floodplain. This includes: preserving the entire riparian community with a focus on plant species composition; protecting riparian forest areas including the Chehalis River Surge Plain; preserving and restoring natural river and tidal slough hydrology; and alleviating bank instability problems.

   Special attention will also be given to protecting and enhancing habitat essential to rare or endangered species that occur in this community. These species include the Olympic mudminnow, native char and salmon stocks indigenous to this watershed.

2. Preserve and restore the permanent and seasonal wetlands that support resident and migratory waterfowl, fish, amphibians, and other invertebrates. Restore native plant communities which provide food and shelter for animals within these wetlands.

3. Preserve recreational opportunities associated with these waters including fishing, hunting, boating, swimming and wildlife viewing activities.

4. Bring together various private and public landowners, private conservation groups and public agencies as a cooperating body in seeking aquatic weed control in the Chehalis River Basin.

5. Help develop compatible economic uses of land and serve as a public education resource that provides people opportunities to experience and further understand the region's diverse landscapes and biology.

Integrated Pest Management (IPM)

Aquatic weed control in the Chehalis River watershed will follow the guidelines of Integrated Pest Management as defined in Washington State law. IPM and Integrated Aquatic Vegetation Management (IAVM) for this grant can be considered synonymous.

When developing a weed control plan that incorporates the strategies of IPM, it is necessary to evaluate control options based on the biology of the plant, to consider the extent of the infestation, to know the control options available for that species, to be aware of the plant's legal status (in regards to the noxious weed list) and to know your managements goals for the site.

There are at least two definitions of IPM in Washington State Law. Chapter 16-752 WAC defines IPM at a decision-making process which combines all feasible control techniques into a program for managing targeted noxious weeds, including but not limited to prevention, monitoring, consideration of alternative methods and evaluation.

In 1997, The Washington State Legislature enacted Chapter 17.15 RCW that requires that all state agencies follow the principles of IPM. Those principles are defined as:

"… a coordinated decision-making and action process that uses the most appropriate pest control methods and strategy in an environmentally and economically sound manner to meet agency programmatic pest management objectives."

The chapter further defines the elements of IPM to include:

(a) Preventing pest problems;
(b) Monitoring for the presence of pests and pest damage;
(c) Establishing the density of the pest population, that may be set at zero, that can be tolerated or correlated with a damage level sufficient to warrant treatment of the problem based on health, public safety, economic or aesthetic thresholds;
(d) Treating pest problems to reduce populations below those levels established by damage thresholds using strategies that may include biological, cultural, mechanical and chemical control methods and that must consider human health, ecological impact, feasibility and cost-effectiveness, and
(e) Evaluating the effects and efficacy of pest treatments.

The IPM process considers factors from the entire system in which the noxious weed problem is occurring in order to find practical, effective solutions. The goal is to keep noxious weed populations low enough to prevent unacceptable spread, damage, or annoyance, and to encourage desirable vegetation to permanently replace the weeds.

Treatment occurs when monitoring indicates thresholds have been exceeded. The method may include educational, biological, cultural, manual, mechanical, and chemical control tactics, which are then integrated into a treatment program. IPM emphasizes revegetation with desirable plant species as well as other actions that will prevent future weed infestations.

When applied appropriately, the IPM process results in improved management, lower cost, greater ease of maintenance, and lower environmental impacts from control activities.

Information sources:
Washington State Department of Agriculture/IPM
IPM Access
Washington State Department of Ecology "What is IPM"

Aquatic Noxious Weeds in the Chehalis River Basin

The Chehalis River IAVMP will currently focus on four aquatic weed species found in the watershed. Recent survey data collected show that established populations of these species exist within the Chehalis River and on riparian areas adjacent to the Chehalis and its tributaries.

Brazilian elodea (*Egeria densa*)
Knotweeds - Japanese, giant, Himalayan and Bohemian
(*Polygonum cuspidatum*, *P.sachalinensis*, *P. polystachum*, and *P. bohemicum*)
Parrotfeather (*Myriophyllum aquaticum*)
Purple loosestrife (*Lythrum salicaria*)

Appendix A contains a **Weed Management Profile** for each species, with the knotweeds grouped together in a single profile. Each Management Profile contains information on plant identification, distribution and impacts in the Chehalis River Watershed and a list of control options that can be considered for each species, depending on the control site. The Management Profiles also reference

any projects undertaken in the Chehalis River Watershed for that species. Costs associated with each project are found in those project summaries.

These Weed Management Profiles will be updated as new information becomes available, and new Weed Management Profiles will be added as necessary.

Action Plan

In addition to the individual control projects underway in the Chehalis River Basin (listed in the Weed Management Profiles of each species) the Working Group recognizes the importance of long-term control strategies for the targeted weed species. Total eradication may not be feasible for some aquatic weed species, such as Japanese knotweed, but prevention, through containment, control and protection of native habitat from further degradation, is certainly within reach for all aquatic weed species.

These widespread species are being managed to dramatically reduce existing infestations and to restore or enhance native vegetation and habitat. This Action Plan will use and develop the strategies below.

Control – Fortunately several control methods are authorized and are currently in use for all weed species listed. These methods include chemical, mechanical, biological and cultural. Some control methods require lengthy periods for permit application and approval. Part of a long-term control plan includes the containment of widespread weeds to protect native habitat from further degradation.

Survey and evaluation – Periodic and complete surveys of the Chehalis River system are needed to document the current level of infestation and evaluate control efficacy. This includes the mainstream Chehalis and lower reaches of the major tributaries, including the Hoquiam, Wishkah, Wynoochee, Satsop, Cloquallum, Black, Skookumchuck, Newuakum and South Fork Chehalis Rivers. Some portions of minor tributaries would also be surveyed, including Lincoln, Scatter and Elk Creeks. Surveys will be conducted as funding is available. Maps will be updated as surveys are completed.

Prioritization – The Chehalis River Working Group recognizes the importance of a process to prioritize weed control projects throughout the watershed. Data compiled from surveys will be used to help prioritize current and new projects, and it will be used to guide long-term control work.

Land ownership – There are a wide and diverse range of property owners (and jurisdictions) throughout the Chehalis River System. It is a continuing process to identify and update the landowners. The 2005 Knotweed Control Project by TNC showed the challenges and the successes of a control project in an area with different ownership distributions and infestation levels. County noxious weed programs work to notify landowners about weed infestations on their lands, and project teams contact landowners require control and provide advice in how to or if funding is provided to gain consent to control infestations, or to make other arrangements. All data will be downloaded into the GIS database and shared by the cooperators.

Education and outreach – Many of the control projects in place (e.g. TNC knotweed project and the Brazilian elodea project) already notify landowners and the public about what they are doing in

the Chehalis, and why. Survey crews and work crews are often the first point of contact with the public. The Nature Conservancy field crews use educational material and fliers that attach to doorknobs for property owners or interested citizens.

Local newspapers, newsletters, and resource groups are used to spread information about current projects. In addition, County Noxious Weed Control Programs have extensive educational outreach programs for the species in this plan. Strategic news releases about weed removal projects are often picked up by the media and articles are then featured in the newspapers and television. An example is the excellent news story about Thurston County's Brazilian elodea removal project which featured a large color photograph and prominent coverage.

Future plans for education and outreach include the initiation of a project to develop a newsletter for landowners and other interested parties. Public awareness and education will continue with an official development of a weed prevention program, targeting landowners and those that use these waters. Signs will be made and posted at access points to inform users of potential impacts and hazards to the Chehalis River from aquatic weed species. Education and outreach will work to educate people to recognize weed species and discourage those practices that spread aquatic weeds.

An effective education program can generate a volunteer base for specific weed projects. These projects will be identified for volunteers when and where practical. They will be given adequate instruction and tools to complete projects. Depending on the how weed is listed in a specific county, landowners may be required to control it on their property. It is hoped that the working group will be able to offer technical assistance to these landowners for weeds listed in the plan.

Funding – The ability to implement on-the-ground projects in the Chehalis Basin is directly tied to the availability of funding. The Chehalis River IAVMP identifies specific weed threats to the Basin, outlines approved methods for control and includes a record of past and on-going projects in the Chehalis River Basin, as well as provides information on the flora, fauna and habitat. The plan can be used by landowners and land managers as a tool to help apply for funding and by the granting organizations to verify their funding is being used productively and as part of a integrated effort.

In an area as large as the Chehalis River Basin, the funding for surveys and weed control projects often limit the scale of the project to just a portion of the area. However, the data, maps, and information generated from these control projects will be used to update the overall plan. This continual input of new information will benefit landowners and land managers by making them more competitive and successful in their application for grants for invasive species control projects. It is also hoped that by formalizing this plan it will be utilized and integrated by other local and regional organizations into their grant projects and management activities. As more small and medium-sized projects are funded and implemented we hope to see a cumulative improvement in weed control in the Chehalis Basin.

Summary

The effective management of invasive aquatic weeds within any watershed is problematic. There are a wide and diverse range of property owners and jurisdictions; diverse habitat; limited funding; permitting issues; a need for effective control tools; and a need for a control strategy that works.

The Chehalis River Working Group continues to overcome these obstacles through cooperative action and planning. Decisions are made to protect the whole watershed. Their accomplishments, to date, include:

- The major projects listed on Page 2.
- A cooperative association of public agencies, conservation groups and Native American tribes.
- Developing grants for big control projects.
- Developing effective control methods for this river system

Future Goals:

- Format a "Summary" for the major grant projects completed (or underway) and attach in the Appendix.
- Create an "Annual Activity Update" section in each Weed Management Profile
    - This would help those applying for grants,
    - This would show how an application for new money would fit into what others are doing in this area.
- Develop an objective methodology **to prioritize** future projects
    - Identify priority sites by habitat
    - Identify priority sites by the invasive species
    - Work within priority watersheds
    - Develop control strategies that work
        - from tributaries down to the mainstream
        - contain large infestations from spreading
        - prevent establishment of new species/new sites
- Develop a website for the Chehalis River Basin
- Develop future funding opportunities
- Strategize to maximize long-term benefits
    - Secure large funding awards for control, then go after supplemental grants to keep up with the long-term follow up

Literature Cited

Brix, R. 1974. 1974 data report of juvenile salmonid seining in Grays harbor and tributary rivers and electro-fishing and river seining in the Chehalis River in the vicinity of Washington Public Power Supply System's project nos. 3 and 5. State of Washington Department of Fisheries, Olympia, Washington.

Gilbertson, Larry. June 16, 2006. E-mail regarding Chinook salmon. Senior Scientist Quinault Department of Fisheries. Taholah, WA 98587

Integrated Pest Management Practitioners Association (IPMPA), IPM Access, Integrated Pest Management Information Service, http://www.efn.org/~ipmpa

Mongillo, P.E. and M. Hallock. October 1999. Washington State status report for the Olmpic mudminnow. Washington Department of Fish and Wildlfie. Olympia, WA.

Peggy J. Busby, Thomas C. Wainwright, Gregory J. Bryant, Lisa J. Lierheimer, Robin S. Waples, F. William Waknitz, and Irma V. Lagomarsino. August 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California (NOAA Technical Memorandum NMFS-NWFSC-27). National Marine Fisheries Service, Coastal Zone and Estuarine Studies Division, Seattle, WA

Seiler, D. 1989. Differential survival of Grays Harbor Basin anadromous salmonids: water quality implications. Pages 123–135 in C. D. Levings, L. B. Holtby and M. A. Henderson, editors. Proceedings of the national workshop on effects of habitat alteration on salmonid stocks. Department of Fisheries and Oceans, Ottawa, Ontario.

Simenstad, C. A., K. L. Fresh, and E. O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: An unappreciated function. In V.S. Kennedy (ed.), Estuarine comparisons, p. 343–364. Academic Press, New York.

U.S. Army Corps of Engineers. 2003. Native char utilization lower Chehalis River and Grays Harbor Esturay, Aberdeen, Washington. Prepared by ED Jeanes, CM Morello, and MH Appy, R2 Resource Consultants, Inc. Redmond, WA.

Washington State Department of Fish and Wildlife. October 2004. Washington State Salmonid Stock Inventory (SaSI). Olympia, WA.

Washington State Department of Agriculture, Integrated Pest Management (IPM), http://agr.wa.gov/PlantsInsects/IPM/default.htm

Washington State Department of Ecology, What is IPM, http://www.ecy.wa.gov/programs/swfa/upest/what.html

APPENDIX A

WEED MANAGEMENT PROFILE

Brazilian elodea (*Egeria densa*)

DISTRIBUTION AND IMPACTS

Brazilian elodea (*Egeria densa*) is a Class B noxious weed and was first discovered in the Chehalis River in July of 1997, near Centralia, Washington with the infestation size estimated to be less than one acre. The total acreage as measured by a 2005 survey project is 25 acres. The total river miles where elodea infestations are found today is approximately fifteen miles.

The original source of infestation is Plummer Lake, in Lewis County where an aggressive control program is underway.

Brazilian elodea was found in Thurston County in July of 1998, approximately 7 river miles downstream from the first discovery. These infestations of Brazilian elodea were removed and sites were marked for follow up monitoring. In 2002, a private diver was hired to assist with removing these infestations. Even with these additional efforts more sites were being found each year. By 2003, Thurston County was not able to keep up with the newly discovered infestations and in September of that year an increase in the removal effort was necessary to address the rate of spread of Brazilian elodea in the river.

In October of 2003, a survey of the Lewis County elodea infestations was conducted to determine the extent of infestation downstream and to determine the best approach for control.

This photograph, taken in 2003, depicts the most severely infested Brazilian elodea site known on the Chehalis River. This site shows nearly total cover of macrophytes (elodea covered with duckweed). The site is located at Centralia, near the infestation's source, Plummer Lake. Brazilian elodea can restrict water movement, increase sedimentation, and cause fluctuations in water quality.

In its home range of South America, Brazilian elodea prefers cool (16-18°C), slow moving, shallow waters that are somewhat acidic and enriched. These conditions are very similar to those found in the Chehalis River. Outside of the Columbia River this is the first known infestation of Brazilian elodea in a river in Washington State.

In Oregon, Brazilian elodea has infested over 10,000 acres of lakes and reservoirs, including coastal lakes that are critical habitat for Coho salmon. It is also common in Willamette reservoirs and Columbia River side channels. Brazilian elodea is responsible for the listing many Oregon lakes as "water quality limited" under the Clean Water Act. (Hanson and Sytsma 2001).

In Washington, Brazilian elodea has infested 27 lakes and rivers. As is the case in Oregon, all Brazilian elodea infestations are limited to the west side of the Cascade Mountains. (Washington Department of Ecology 2006).

Established populations of Brazilian elodea have been identified in the upper part of the Chehalis River between Centralia and Oakville. Because of the tremendous ability of Brazilian elodea grow and dominate a waterbody and the difficulty of eradication, this invasive weed poses a significant threat to the Chehalis Basin.

The slow moving waters of the middle section of the Chehalis River, as well as the Black River, are especially susceptible to colonization by this species. Brazilian elodea grows into dense monotypic stands that restrict water movement, trap sediments, and deplete dissolved oxygen and effect pH. These dense stands of Brazilian elodea displace salmonids and other fish species from critical

rearing habitat. Recreational opportunities are also lost as boating, fishing and swimming activities are restricted by weed-choked waterways.

For Brazilian elodea populations in the Chehalis River Basin, please refer to the maps in the Appendix.

PLANT CHARACTERISTICS

Brazilian elodea is a submersed, freshwater perennial herb, generally rooted on the bottom in depths of up to 20 feet, but sometimes found drifting. This species is native to Brazil, Argentina and Uruguay and was first reported in the United States in New York, in 1893. It is found in both still and flowing waters, in lakes, ponds, pools, ditches, and quiet streams. It tends to form dense monotypic stands that can cover hundreds of acres and can persist until senescence in the fall. High water temperatures (greater than 30 degrees centigrade) and high light intensities can cause senescence.

Brazilian elodea looks very much like a larger, more robust version of its commonly-found native relative, *Elodea canadensis* (waterweed). **The photograph above compares two strands of *Elodea canadensis* (upper left) to *Egeria densa* (the large robust plant to the right).**

Brazilian elodea leaves are 1-3 cm long, up to 5 mm broad. The lowest leaves are opposite or in whorls of three, while the middle and upper leaves are in whorls of four to eight. The leaves and stems are generally a bright green. The stems are erect, and they grow until they reach the surface of the water.

The 18-25 mm white flowers have three petals. The slender roots are white or pale, and they are unbranched. Adventitious roots are freely produced from double nodes on the stem. Brazilian elodea reproduces from stem fragments. Seed production has never been observed in Washington waters. This plant lacks specialized underground storage organs such as rhizomes and tubers and stores carbohydrates in the stem.

MANAGEMENT & CONTROL OPTIONS

Listed below is a range of control options, offering a combination of methods that may be suitable for site specific control of Brazilian elodea in the Chehalis River basin. These control methods may include: Prevention, Mechanical, Cultural, Chemical and Biological Controls.

Some control methods may require a review period for permit application and approval. It is the responsibility of the agency doing the control work to acquire the required permits.
Fortunately, several control methods are currently authorized and in use for Brazilian elodea.

Rare and Endangered Plants and Fish & Wildlife Resources

Always check with the Washington Department of Natural Resources Heritage Program for native flora locations and WDFW's Regional Habitat Biologist for fish stocks that could be impacted by control methods prior to pursuing control. Contact information can be found on pages 4 and 5 of the general plan.

Early Detection, Prevention, Follow-Up

There are waterways in the Chehalis River watershed that do not have Brazilian elodea. Early detection and prevention are essential for protecting this habitat because treatment is more effective for new, very small sites. An active survey program helps prevent Brazilian elodea from spreading any further and establishing in natural areas.

Knowing how and where this aquatic weed is spread is critical in preventing the expansion into new territories. Recognizing that plant fragments can be spread on boats, trailers, gear and even by flooding and by some species of wildlife is essential to prevent it from spreading any further.

Brazilian elodea (*Egeria densa*) is an attractive, robust plant well-suited to aquarium life. Up until 1996 it was commonly sold in Washington pet stores under the name "anacharis." It was also sold in plant nurseries as an "oxygen" plant. Because of its invasive properties that allow it take over in waterbodies where it is introduced, it is no longer being sold in Washington. This species is on the quarantine list and regulated by the Washington State Department of Agriculture (WSDA), and it is illegal to buy, sell or offer this plant for sale in the state of Washington. Relaying this information to the public, or other agencies will greatly assist in the control efforts.

Mechanical Control

Manual and mechanical methods such as pulling, cutting, and digging with machines, are costly, provide only temporary relief, and can simultaneously encourage spread by fragmentation. Mechanical harvesting produces thousands of viable fragments per acre (Anderson, 1998). Mechanical harvest however has been used successfully in some circumstances and is viewed as a practical tool to control *Egeria densa* by some managers.

Harvesting

Harvesting entails removing surfacing mats by cutting the plant below the waterline and collecting and removing the plant material to an upland site, thereby creating open areas of water. Harvesting has been used extensively on Long Lake, Kitsap County to control Brazilian elodea.

<u>Diver Dredging (suction dredging)</u>

Diver dredging is one method of mechanical harvest that was utilized in 2004 by Thurston County in a pilot project. Diver dredging is especially effective against Brazilian elodea because the plant and root structures can be removed entirely from the aquatic system. Diver dredging will be used again for the Chehalis River Brazilian Elodea Control Project for the 2005-2006 Season. The area to be dredged is dependant on

funding, as the infestation size is too large to tackle in a single season. Extensive work using this method is on going near River Mile 67 (near the source of the infestation) and River Mile 60, at Prather Road.

Diver dredging is a method in which divers manually dislodge Brazilian elodea and another diver uses a hose to vacuum the vegetation out of the river, capturing it in baskets for upland disposal. The purpose of diver dredging is to effectively remove all of the plant biomass including the portion of the root capable of regenerating. The divers disturb a very small amount of sediment, primarily sediment on the elodea itself, and use the suction hose for *Egeria* disposal only. The water is returned back to the water column and the plant material is retained. The plants are disposed of on shore.

The technique is consistent with the existing hydraulic permit for removing noxious weeds permitted by the Washington State Department of Fish and Wildlife.

Diver dredging has been used in British Columbia, Washington State, and in Idaho to remove early infestations of Eurasian watermilfoil. Up to 80% control of Eurasian watermilfoil has been reported. In 2005 over 44,910 pounds of Brazilian elodea was removed from a 1.5 acre area. Surveys in 2006 demonstrated more than 90% control in these areas. **The photograph shows a small barge with pontoon that was used in the pilot project for elodea control in the Chehalis River in 2004.**

Cultural Methods - Water Level Management

Drawdown on the Chehalis River is not an option because of the lack of water control structures. In general, the success of a drawdown for submerged aquatic weeds is dependent on several factors such as the degree of desiccation (drawdowns in rainy western Washington are often ineffective), the composition of substrate (sand vs. clay), air temperature (the exposed sediments need to freeze down to 8-12 inches), and presence of snow. Because of climate conditions in western Washington, drawdown would be ineffective for Brazilian elodea management even if it were feasible.

Chemical Control

The effectiveness of an aquatic herbicide depends on many factors including maintaining the concentration of the product at the label rates for the time period specified. The river systems add to the challenge of maintaining these concentrations, therefore care should be taken when choosing an applicator and implementing control projects. In addition, aquatic herbicide application requires approval by the Washington State Department of Ecology. It is the responsibility of the agency doing the control work to get the required permits.

Fluridone (Sonar®), a herbicide that inhibits carotene formation resulting in chlorophyll destruction (PNW Weed Management Handbook 2006), was used to treat Brazilian elodea in Lake Limerick in 1995 with good results. A year after treatment, Brazilian elodea biomass had declined about 95 percent throughout the lake. Some surviving stem ends initiated new growth, and Brazilian elodea continues to regrow in Lake Limerick.

However, the 2000 spring survey showed that the mean biomass of *Egeria densa* in the lake was still only 11 percent of the biomass present in the lake before treatment and five years after the whole lake Sonar® treatment.

Sonar® is also used to treat *Egeria densa* in Plummer Lake in Lewis County. Because of the extremely long contact time that is needed to effectively treat Brazilian elodea (up to 12 weeks), fluridone is not seen as a viable chemical to treat a flowing river system like the Chehalis.

Westerdahl and Getsinger report excellent control of Brazilian elodea with diquat (Reward®) and with fluridone. Diquat is a fast-acting non-selective contact herbicide that destroys the vegetative part of the plant but does not kill the roots. Typically diquat is used primarily for short-term (one season) control of a variety of submersed aquatic plants. It is very fast-acting and is suitable for spot treatment. A diquat treatment in Battle Ground Lake, Washington virtually eliminated Brazilian elodea from the lake. Anecdotal evidence from Ohop Lake also indicates the diquat may do more than just burn Brazilian elodea to the roots. Levels of this plant were reduced substantially after diquat treatments. Because diquat is very fast-acting and is labeled for use in flowing water, diquat may be a viable option for use in the Chehalis. Diquat does have salmon timing restrictions and if diquat is used for Brazilian elodea, its use will need to be timing to avoid juvenile salmon out migration.

Triclopyr (Renovate3®) is another aquatic herbicide available for use in 2004. Triclopyr is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian watermilfoil and other broad-leaved species such as purple loosestrife. However, this product cannot be used in waters with continuous outflow, although it can be used along the banks and shores of these areas. Triclopyr can be effective for spot treatment of Eurasian watermilfoil and is relatively selective to Eurasian watermilfoil when used at the labeled rate. Brazilian elodea is not susceptible to triclopyr and this is not a management option for this species.

Biological Control

It is unknown what insects or pathogens have biocontrol potential for Brazilian elodea. However, recent research in Brazil has identified a fungus (*Fusarium* sp.) that damaged Brazilian elodea in laboratory tests. This may have potential as a biological control agent for Brazilian elodea.

Triploid grass carp (when older than fingerlings) find Brazilian elodea somewhat palatable and they have been successfully employed as a management tool in Devils Lake, Oregon, Silver Lake, Washington, and Battle Ground Lake to control Brazilian elodea populations. Brazilian elodea is highly preferred over many native species and theoretically, it should be possible to remove Brazilian elodea while favoring the growth of native species. However, in practice, grass carp often remove the entire submersed aquatic community and should be used with great care. Grass carp are also not permitted for use in waterbodies where inlets and outlets cannot be screened to prevent their escape. Therefore grass carp are not recommended as a management method for Brazilian elodea in the Chehalis River (WA Department of Ecology website).

MANAGEMENT ACTIVITIES

Several management activities regarding Brazilian elodea have occurred or are being planned.

The 2005 – 2006 Chehalis River Brazilian Elodea Control Project is managed by the Thurston County Noxious Weed Control Board. In addition to Thurston County, this control project includes: the Washington Department of Natural Resources' Aquatic Invasive Species Coordinator, and the Chehalis Tribe. The project is partially funded by the U.S. Fish and Wildlife Service's Chehalis Fisheries Restoration fund.

This project is a comprehensive attempt to remove Brazilian elodea from the Chehalis River. The project begins near Plummer Lake in Lewis County from approximately river mile 67 to approximately river mile 49, covering over 15 miles of the Chehalis River main stem. It is an ongoing project over several years dependent on available resources. Projects include hand pulling, diver dredging and post dredging surveys, and educational outreach.

This project addresses goals found in the Chehalis Basin Watershed Management Plan, and strives to prevent further degradation of water quality as well as prevent degradation of habitat and improve habitat to support self-sustaining fish and wildlife populations.

More information regarding specific projects can be found by contacting the project manager (see contact list in Appendix C).

SUMMARY

The Chehalis River, its fish runs, and water quality are all dramatically impacted by Brazilian elodea. Brazilian elodea is one of the major factors that contribute to low dissolved oxygen levels and increased water temperatures at several locations of the main stem on the Chehalis River.

Progress is being made on this species through projects led by Washington Department of Ecology, Chehalis Tribe, Thurston County Weed Control, Lewis County Weed Control, Washington Department of Natural Resources, and U.S. Fish and Wildlife Service. Nearly 25 acres of infestations have been identified, and over 116,000 lbs of elodea removed through projects the past three years.

Eradication of Brazilian elodea from all areas of the Chehalis River is probably not practical, however expertise over the past several years has provided significant progress in the most heavily infested areas in Lewis and Thurston Counties. Working towards a goal of control/containment near the sources of the infestation and early detection/control in the non-infested areas, are goals for future projects on the Chehalis River.

LITERATURE CITED

Hanson E. and M. Sytsma. June 2001. Oregon aquatic nuisance species management plan. Portland State University, Center for Lakes and Reservoirs. Portland, OR.

Washington Department of Ecology, Brazilian elodea Locations in Washington--1999, http://www.ecy.wa.gov/programs/wq/plants/weeds/elocate.html

APPENDIX A

WEED MANAGEMENT PROFILE

Japanese knotweed *(Polygonum cuspidatum ~ Fallopia japonica)*
giant knotweed *(P. sachalinense ~ F. sachalinensis)*
Bohemian knotweed *(P. bohemicum ~ F. x bohemica)*
Himalayan knotweed *(P. polystachum ~ Persicaria wallichii)*

DISTRIBUTION AND IMPACTS

Japanese knotweed is a significant problem along rivers and streams in the Chehalis River Basin. The closely related giant knotweed, the hybrid Bohemian knotweed and Himalayan knotweed populations also exist in this basin, but to a much lesser extent than Japanese knotweed. All species are listed as noxious weeds in Washington State.

There is currently some dispute about the botanical nomenclature of these four species (Flora of North America North of Mexico Volume 5 2005), but the detrimental effects on the native habitat by all of these species remain unchanged.

Knotweeds have colonized large portions of riverbanks along the lower Chehalis River and its tributaries. They continue to rapidly expand into the upper watershed.

Knotweeds are capable of rapidly invading healthy riparian areas. Once established, knotweed patches compromise key ecosystem components and processes. Natural tree regeneration may be precluded. Ultimately, this will reduce shading (which increases water temperature) and impair recruitment of in-stream woody debris, both of which are important aspects of healthy salmon habitat. Because of its extensive root system and large size, knotweed can change the shape and form of river channels and gravel bars, as well as the composition and distribution of riparian vegetation. Knotweeds propensity to grow on riverbanks and gravel bars may clog off-channel wetlands that provide critical rearing habitat for salmon. Dense knotweed infestations on gravel bars and shorelines eliminate key habitats where wintering bald eagles feed on stranded salmon carcasses. These collective impacts of knotweed on keystone species such as salmon, and on critical riparian functions, can have cascading effects that may result in significant, far-reaching and long-lasting impairment of the ecosystem.

At the present time there are few dams or diversion structures on the rivers of the Chehalis River Basin. These rivers provide vital habitat for numerous species of fish and other natural communities of plants and wildlife. The existing anadramous fish resources in the basin are of regional and

national significance. Additionally, the basin provides critical migrating and wintering habitat for waterfowl and other species along the Pacific Flyway. State and federal agencies have protected significant sections of two rivers, the Black and the Elk, for their conservation values.

Stream bank stability is compromised by knotweed through excluding deep-rooted vegetation, such as trees, leading to erosion and sedimentation. The recreational value of streams has been compromised as knotweeds block access for swimming, fishing and bird watching activities, as well as blocking views of rivers from roadways and trails.

For knotweed locations, please refer to the maps in the Appendix.

PLANT CHARACTERISTICS

These knotweed species and their hybrids are tall shrub-like, perennial herbaceous plants that are listed as Class B Noxious Weeds and are on the WSDA Quarantine List. The basal root crown will produce 30-50 stout bamboo-like shoots that may reach to 15 feet tall or more (giant knotweed). The hollow stems may be an inch or more in diameter with swollen nodes three to five inches apart that are reddish-brown in color. The leaves are produced on upper stems and on the limited side branching. The leaf size and shape vary between species. Japanese knotweed leaves (see photo) have a truncated base; giant knotweed has huge elephant ear shaped leaves without a truncated base; Bohemian knotweed is a cross between the two types mentioned above; and Himalayan knotweed has elongate triangular-shaped leaves. The smooth-edged leaves of all species are green and occur singly at each node in an alternate pattern.

Tiny white or greenish flowers appear in open sprays near stem ends during July and August and produce a small winged fruit. The tiny seeds (about one tenth of an inch long) are transported by water, short distances by wind, and in attached mud. The seeds are not thought to be fertile from all knotweed species, but the seeds of hybrids are considered fertile. The Nature Conservancy has germinated knotweed seeds in the laboratory. Plants arise from fibrous roots and produce a spreading rhizome system, possibly from each major shoot, that may extend to 25 to 40 feet or much more. The rhizomes can penetrate more than seven feet into the soil. Individual plants with its 30-50 bamboo-like shoots may be 8-15 feet or more in diameter. The plants often occur in large clumps of several hundred square feet to several acres and can occupy an entire shoreline. These deciduous plants die back after a hard frost but bare stalks often remain through winter.

Knotweeds regrow very rapidly in the spring, often reaching 15 feet by June (giant knotweed). Japanese knotweed typically grows to ten feet with the smaller Himalayan knotweed only reaching four to six feet. Japanese and giant knotweeds are known to form a viable hybrid called Bohemian knotweed (*P. bohemicum*).

Growth of the knotweed plants starts in April or earlier in warmer regions, or as late as June in higher elevations. New plants can establish from seeds, broken off stem parts, or from any node along rhizomes. As little as a half inch plant piece can start a new plant. Young knotweed shoots resemble red asparagus.

MANAGEMENT & CONTROL OPTIONS

A knotweed control guide, *Controlling Knotweed in the Pacific Northwest*, was developed by The Nature Conservancy, Metro, Portland Parks, and the Northwest Chapter of the Society for Ecological Restoration in February 2002. Information about knotweed control was used extensively from this control guide in Washington State's IPM Plan, and that information is also used below (WSDA July, 2004).

Knotweeds are very difficult plants to control because they have an extensive rhizome system and an incredible ability to re-sprout. Except for small patches that may be able to be controlled non-chemically, any management of these species will likely require some herbicide use. Knotweeds are becoming increasingly problematic along riparian corridors in western Washington. An infestation along the Hoh River was traced back to a single ornamental planting where broken off plant parts entered the river and established new plants downstream. When dealing with these riparian infestations, it is imperative to start at the upstream edge of the infestation and work downstream. It is not considered possible to eradicate these knotweed species from Washington, but it may be possible to eliminate them from high quality riparian areas, particularly in areas where knotweeds may be degrading salmon rearing habitat. There is a range of control methods that may be suitable for site specific control of knotweed in the Chehalis River basin. These control methods include: Detection, prevention, mechanical, chemical and biological controls.

Some control methods may require a period for permit application and approval. Fortunately several control methods are currently authorized for knotweed.

Rare and Endangered Plants and Fish & Wildlife Resources

Always check with the Washington Department of Natural Resources Heritage Program for native flora locations and WDFW's Regional Habitat Biologist for fish stocks that could be impacted by control methods prior to pursuing control. Contact information can be found on pages 4 and 5 of the general plan.

Early Detection, Prevention, Follow-Up

There are waterways in the Chehalis River watershed that do not have knotweeds. Early detection and prevention is the preferred control method for new sites, or when very small sites are found. Surveys and follow up surveys are essential to prevent knotweeds from spreading any further and from establishing in natural areas.

Knowing how this weed is spread and knowing the current distribution is critical in preventing the expansion into new territories. Recognizing that plant fragments can be spread is essential to prevent it from spreading any further.

These large, dramatic knotweed species were originally introduced as garden ornamentals. Because of their invasive properties in natural area lands, they are no longer being sold in Washington. These species are regulated by the Washington State Department of Agriculture and it is illegal to buy, sell

or offer this plant for sale in the state of Washington. Relaying this information to the public will greatly assist in control efforts.

Mechanical Control

Mechanical removal can be used on single plants and larger infestations, but it is costly and time consuming depending on the type of equipment used (e.g. excavator, shovel). All above ground vegetation and rhizomes must be removed and disposed of appropriately (e.g. do not compost or pile onsite) to avoid re-sprouting from plant fragments. Once this operation is completed, revegetate the area with appropriate native or desirable plants that cast heavy shade on the ground. Plan for at least annual monitoring for new knotweed plants regenerating from missed plant parts and seed, and treat or remove immediately.

Hand pulling and digging

Hand pulling and digging knotweeds is an option only if the soil is soft, the plants are young, there are only a few plants, and the effort can be maintained regularly for an extended time period. Once the plants have developed extensive roots and rhizomes they will be nearly impossible to completely remove. Any rhizomes remaining in the soil will produce new plants at each node. Also any knotweed vegetation must be disposed of in such a manner that it cannot take root because even small plant fragments can root if they are in moist soil. In England, compost containing knotweed rhizomes is considered to be an environmental contaminant!

In soft soil or sand, pull up the plant by the root crown, trying to remove as much of the rhizomes as possible. About a week after this effort, search for and pull up any re-sprouting plants and as much of the rhizome as possible. Search for re-sprouts at least 20 feet around the location of the original plant. Continue this effort until frost and then start again in the spring. The Nature Conservancy reports that it can take up to three years of consistent effort to eradicate a small patch of plants using this method. Knotweed plants and their rhizomes might possibly also be dug out, but this is a slow labor intensive process and probably not practical with anything more than a very small infestation of several plants. Tilling also produces many re-sprouts but could be used in combination with a hand pulling effort. It is important that the project leader evaluates the potential events, like floods or vehicle traffic, which may easily move small fragments off site when planning control activities.

Cutting/Mowing

It is possible to eradicate small patches of knotweed with repeated and persistent cutting of the plants. The patches must be mowed or cut twice a month between April and August and then at monthly intervals until frost. Like pulling/digging this effort will need to be maintained for at least two to three years. Using a hand pruner, lopper, or weed eater cut the stalks as close to the ground as possible. Do not let the regrowth exceed six inches in height before cutting the stalks to the ground. Stack the cut stalks where they will dry out and not root (away from moist ground). When using a weed eater, ensure that scattered plant parts do not land in moist areas where they can take root.

Covering

There have been anecdotal reports of successful control of small patches of plants using a combination of cutting, hand pulling, and/or tilling, followed by covering. After cutting the plants down to ground level, cover the area with several layers of black plastic or several layers of cardboard. Extend the area of coverage to at least 20 feet or more around the outside of the plant and check at intervals to make sure that shoots are not coming up outside of the cover or through the cover. Knotweeds have been known to grow through asphalt! The cover needs to be left in place for

at least one full year and probably longer. Inspect the site on a frequent basis to locate new growth or seedlings and remove re-growth immediately to maintain major management gains.

Burning

Japanese knotweed is not killed nor significantly impacted by burning, however, burning removes dense herbaceous litter and opens access to dense stands for other treatments, such as herbicide application or grazing. Burning should be considered only for stands of one half acre or larger and planned carefully relative to surrounding ownerships, features and improvements.

Cultural Control

Very little work has been done using cultural controls and revegetation once knotweed has been controlled.

Chemical Control

Aquatic herbicide application requires approval by the Washington State Department of Ecology. It is the responsibility of the agency doing the control work to get the required permits.

Glyphosate (Rodeo® and other glyphosate brands with aquatic labels) has been used to effectively control Japanese knotweed in aquatic situations. Glyphosate is not selective and will damage most other plant species. When desirable vegetation is nearby, applicators should try to minimize its loss by focusing their application just on the target plants. The combination of 2% Glyphosate and aquatic labeled Imazapyr (Habitat®) at 1% in a foliar spray has shown an increase in effective control, and is the preferred method for The Nature Conservancy's Chehalis Basin project.

Foliar application, using backpack sprayers or similar methods, is more efficient on larger monoculture stands of more than a few plants to several acres in size. Using the combination of herbicides has shown that treatments later in the growing season to be more effective than those applied in early spring. June through September, or the first killing frost, is the preferred treatment window.

Cut stem application can result in up to 95 percent mortality according to the Clark County Noxious Weed Control Board. In the summer or fall, cut each stem within one to three joints of their base (internodes). Add herbicide into the exposed hollow stem cavity following label recommendations. Cut stem application is labor-intensive, both to cut each stem and to apply herbicide, but it will assure that the herbicide is only applied to target weeds and not to other desirable vegetation. It has also been shown to be an effective way to kill this extremely persistent weed. Dispose of the cut stems away from moist environments where they might root.

Stem injection of Japanese knotweed for some formulations of glyphosate has been successful. A syringe or commercial injection gun can be used to deliver a metered dose of herbicide in the first or second node of each stem. Having a second hole allows displaced air in to escape the hollow stem as the glyphosate is injected. The Clark County Weed Control Board reports that the plant takes up the herbicide within 20 minutes of injection. They also report that each stem appears to be supported by a separate rhizome. This means that to kill the entire plant, each stem must be injected! For large plants, the Weed Board suggests injecting the outer most stems, coming back later to remove the dead stems and then injecting the remaining stems. Although, like the cut stem method, this is labor intensive, 100 percent kill has been reported.

An aquatic labeled formulation of triclopyr has been approved for use in Washington in 2004. The Nature Conservancy reports that triclopyr will control Japanese knotweed, but there are no specific control recommendations for Japanese knotweed on the Renovate3® label. *Controlling Knotweed in the Pacific Northwest* (Soll 2004) advises that for successful translocation to occur, some herbicides should be used at the lowest effective concentration in order to avoid damaging the above ground tissues of the plant before the herbicide can be translocated to the root system. This guide indicated that triclopyr (Garlon 3a) at five percent solution appeared to give good top-kill on Japanese knotweed but resulted in mediocre long-term control on large patches. However, there are reports of successful control using triclopyr at rates as low as ¾ percent in high volume application.

In Nature Conservancy field experiments, a 3-5 per cent triclopyr application (Garlon 3a) eradicated about 50 per cent of small patches after two treatments. In controlled experiments comparing treatments on small patches (30-200 stems), triclopyr (Garlon 3a) provided 90+ percent control in one year and 100 percent control within 2 years. Renovate3® is the aquatic labeled formulation of Garlon 3a and presumably should provide similar results. Always use the aquatic labeled formulation under an NPDES permit when you may get herbicide into the water.
A formulation of imazapyr labeled for aquatic use has been approved for use in Washington in 2004. Because imazapyr is known to translocate readily to rhizomes, this non-selective herbicide will likely play a role in knotweed management in the future (WSDA July, 2004).

The Nature Conservancy reported on the lessons learned from six years of knotweed control along the Sandy River in Oregon. Although the impact is greatly reduced, they are finding that plants persist and re-appear much more than you would expect from the reduction in above-ground growth. Unfortunately, what happens is that knotweed produces only small shoots and leaves after several years of treatment and no longer translocates enough herbicide into the remaining rhizome. However, after treatment stops, the knotweed re-emerges from the rhizome and can eventually build back up to full size plants if left alone. Their current strategy is to treat new sites the same way they have been but try a new approach for treated sites with small shoots. They plan to either wait a year or two before treating again so there will be enough re-growth for sufficient herbicide uptake or, for small sites, dig up the remaining rhizomes in spring as the new shoots emerge. Their current treatment plan for the first year is to either spray in early to late summer with 1% imazapyr plus 4% glyphosate or for smaller stands to inject 3 to 5 ml of glyphosate. If needed, they will retreat in late summer. All treatment sites are monitored for at least 3 years after knotweed is last seen (King County Noxious Weed Control Board September 2006).

Biological Control

Grazing

The knotweed alliance website indicates that the young shoots of Japanese knotweed are palatable to sheep, goats, cattle and horses and grazing may be used in suitable situations to keep the plant under control. Goats will eat most plants down to the stems. Grazing will not eradicate Japanese knotweed and the plant will continue to grow once grazing ceases. Grazing may be suitable for quarter acre and larger infestations when the plants have put up enough top growth to support the livestock. Contain the animals on the area by fencing. When all weed growth has been grazed, remove the animals and let the plants develop new shoots. When growth becomes abundant enough to support grazing again, let the animals eat it down a second time. Continue this throughout the growing season and at least through next summer. This may kill some plants and greatly weaken others, as well as breakup the dense mat of rhizomes extending out from each plant. Under an IPM plan,

grazing could be followed by herbicide application to kill existing re-growth, then re-vegetation with suitable native plants to create dense shade. Plan on at least annual monitoring for re-growth from seed, rhizomes or broken off stems and treat or remove immediately.

Insects

Japanese knotweed has been considered an attractive ornamental plant and has been deliberately planted. It is increasingly being recognized as an aggressive weed in North America and in the United Kingdom and there is interest in bio-control research. A number of insects are found to utilize Japanese knotweed in its native range. Fungus infections also impact this plant. A combination of fungus and insects appear keep the knotweed species under control in Japan. Work on biological controls is in the early stages with surveys needed in the native range of this plant. Some surveys for natural insect enemies were started in the northeastern U.S. in 2000.
The Europeans have completed the exploration phase and are in the middle of testing several promising agents (both insects and pathogens). CABI-Biosciences in the U.K. is the agency carrying out the program with funding primarily from the Welsh Development Agency.

The U.S. Forest Service is the primary sponsor for a program in the U.S. and includes scientists from Cornell University and University of Washington. The Canadians (BC ministry of Forestry) have pledged a contribution for next year. The U.S. programs plans to begin testing two insects later this year, a chrysomelid beetle and a psyllid, both from Japan. The completed exploration and initial testing by the European program has greatly reduced the cost for a U.S. program. However, the U.S. program is currently insufficiently funded to complete the project (Dr. Fritzi Grevstad per comm.). At this point much more work and funding is needed for biological control to become a control option (WSDA July, 2004).

MANAGEMENT ACTIVITIES

Several management activities regarding knotweed have occurred or are being planned.

The 2006 Chehalis River Basin Knotweed Control Project is managed by The Nature Conservancy. This project, begun in 2004, will continue managing knotweed on three priority watersheds (the Elk, Newuaukum and Black Rivers) and The Nature Conservancy will begin surveying and treating two new watersheds (Scatter Creek, Newaukum and Skookumchuk Rivers) within the Chehalis River Basin. The mainstream of the Chehalis River from the town of Chehalis to Elma will also be surveyed to document the current infestation levels on the river and determine potential tributaries that may be sources of knotweed infestation. The expanded project will implement knotweed control and cooperative strategies and techniques to involve landowners and resource agencies.

More information regarding specific projects can be found by contacting the project manager (see contact list in Appendix C).

SUMMARY

The Chehalis Basin is severely threatened by the invasive knotweeds. The current project outlined by The Nature Conservancy with partners is making progress toward a complete picture of the infestation levels throughout the Basin. As a priority watershed in Washington State, efforts for early-action survey, outreach and control in the Chehalis Basin should be continued through the abatement of the knotweeds.

At currently known levels, knotweed can be controlled in priority watersheds, given the resources and a realistic time frame, as control is a multi-year investment. Current project areas include: North and South Forks of the Newaukum River, Skookumchuck, Black, and Elk Rivers, Scatter Creek, and preliminary surveys on Lincoln Creek and the Satsop River.

As a project goal, all sub-basins in the Chehalis Basin should be surveyed for infestation levels, associated with outreach to landowners regarding the threat to property and habitat. Control measures should be undertaken in all priority habitats leading to action on the mainstem of the Chehalis River.

LITERATURE CITED

Dumont, Jason. 2006. Persistence of Polygonum cuspidatum: Lessons Learned From 6 Years of Field Trials. Meeting the Challenge: Invasive Plants in PNW Ecosystems Conference at the University of Washington Center for Urban Horticulture. Seattle, WA.

Freeman, Craig C. 2005. Flora of North America: North of Mexico Volume 5: Magnoliophyta: Caryophyllidae, Part 2. Oxford University Press.

Grevstad, Fritzi. June 5, 2006. E-mail regarding knotweed biocontrol. University of Washington, Olympic Natural Resources Center, Long Beach, WA.

Soll, Jonathan. 2004. Controlling Knotweed (*Polygonum cuspidatum*, *P. sachalinense*, *P. polystachyum* and hybrids) in the Pacific Northwest. The Nature Conservancy, Portland.

Washington Department of Agriculture and Washington Department of Ecology. July 2004. Integrated Pest Management Plan for Freshwater Emergent Noxious and Quarantine Listed Weed. Olympia, WA.

APPENDIX A

WEED MANAGEMENT PROFILE

parrotfeather (*Myriophyllum aquaticum*)

DISTRIBUTION AND IMPACTS

Parrotfeather is a milfoil species native to the Amazon River in South America. This attractive plant is easy to cultivate, and it has been introduced worldwide for use in indoor and outdoor aquaria. It is a popular aquatic garden plant.

Western Washington's parrotfeather infestations are found in coastal lakes and streams and in the southwest Washington portion of the Columbia River. This aquatic weed is found throughout the drainage system in the Longview/Kelso area, it infests many of the drainage ditches in Wahkiakum County, and was discovered growing in the Chehalis River in 1994, although there are herbarium records of parrotfeather in Grays Harbor from the 1940's. **The photograph shows the Christmas-like tree emergent growth form of parrotfeather.**

Parrotfeather is also found in Yakima County in eastern Washington, where they have an active control program. This is the only known population of parrotfeather in eastern Washington.

Parrotfeather is found in freshwater lakes, ponds, streams and canals, and appears to be adapted to high nutrient environments. It tends to colonize slow moving or still water. While it grows best when rooted in shallow water, it has been known to occur as a floating plant in the deep water of nutrient-enriched lakes. The emergent stems can survive on wet banks of rivers and lakes shores, so it is well-adapted to moderate water level fluctuations (Lewis County Noxious Weed Program 1997).

Parrotfeather threatens the emergent and aquatic ecosystems of the Chehalis River. It threatens habitat for fish and other aquatic organisms because it changes the physical and chemical characteristics of lakes and streams. For instance, parrotfeather lowers pH and decreases available oxygen, which can negatively affect many desirable species. Parrotfeather provides mosquito larvae habitat. It forms floating mats that transform mudflats, sloughs and bars into shallow, weed-choked areas. These mats choke sloughs and backwaters, reducing fish passage, degrading juvenile fish rearing areas, and slowing water movement. Plant fragments are easily spread and have the potential to colonize the majority of the sloughs and backwater areas of this river system if action is not taken.

Infestations can alter aquatic ecosystems by shading out the algae in the water column that serve as a basis of the aquatic food web. Parrotfeather can have a serious impact on salmonids since it colonizes and occupies fry rearing habitat, as well as habitat for the Olympic mudminnow. According to the Department of Ecology (Jennings 1996):

> "Typically, many of the flood plain wetlands (in the Chehalis River Basin) with hydrologic connectivity to the streams provide essential off-channel rearing habitat for juvenile salmonids. Riverine wetlands and those which provide direct or indirect fisheries benefit merit special protection."

Because of the impacts to natural area waterways, parrotfeather is listed as a Class B noxious weed in Washington State. It is also a State Department of Agriculture (WSDA) quarantine species, and it is illegal to buy, sell or offer this plant for sale in Washington.

A distribution map of parrotfeather in the Chehalis River Basin is found in Appendix E.

PLANT CHARACTERISTICS

Parrotfeather gets it name from its featherlike leaves, which are arranged around the stem in whorls of four to six. Parrotfeather has both submersed and emergent leaves, with the submersed form being easily mistaken for Eurasian watermilfoil (*M. spicatum*), a close relative.

All parrotfeather plants outside of their native range are female and infertile. No seed is produced from parrotfeather plants. Parrotfeather propagates through fragmentation, with the ability to establish in new locations from small floating pieces. The stems of parrotfeather are brittle and fragment easily. These fragments settle in sediments and produce new plants (Orchard 1981, Kane et al. 1991). Fragments can be spread by boats, trailers, and by dumping aquarium plants in waterways. Fragments can also be spread by waterfowl and other wildlife. Adventitious roots form at the nodes. When attached to a bank, parrotfeather stems can extend out several yards over the water surface. Although periodic flooding does scour it and prevent it from being as big a problem as initially feared, parrotfeather removal should be as high a priority for removal as Brazilian elodea.

MANAGEMENT & CONTROL OPTIONS

There is a range of control methods that may be suitable for site specific control of parrotfeather in the Chehalis River basin. These control methods include: Detection, prevention, mechanical, chemical and biological controls.

Some control methods may require a period for permit application and approval. Fortunately several control methods are currently authorized for parrotfeather.

Rare and Endangered Plants and Fish & Wildlife Resources

Always check with the Washington Department of Natural Resources Heritage Program for native flora locations and WDFW's Regional Habitat Biologist for fish stocks that could be impacted by control methods prior to pursuing control. Contact information can be found on pages 4 and 5 of the general plan.

Early Detection, Prevention, Follow-Up

There are wetlands and waterways in the Chehalis River watershed that do not have parrotfeather. Early detection and prevention is the preferred method for maintaining these sites, or for treatment when very small infestations are found. The bright green emergent tips (they look like miniature pine trees) of parrotfeather are a good way to identify suspicious plants for further identification. Hand pulling or raking out water-suspended plants is manageable and effective on small patches. Take great care to avoid creating new fragments and try and remove the rhizomes. Surveys and follow up surveys are essential to prevent parrotfeather from establishing in natural areas.

Knowing how and where parrotfeather is spread is critical in preventing the expansion into new territories. Recognizing that parrotfeather fragments can be spread on boats, trailers, gear and even by flooding and by some species of wildlife is essential to prevent it from spreading any further.

Parrotfeather was introduced as an aquarium plant, or for use in outdoor ponds and aquatic gardens. However, it is now quarantined by WSDA and is illegal to buy, sell or offer this plant for sale in the state of Washington. Relaying this information to the public, or other agencies will greatly assist in the effort of parrotfeather control.

Mechanical Control

Mechanical control is not recommended in the Chehalis River System. Mechanical harvesting causes extensive fragmentation and broken plant pieces. These small pieces are very difficult to remove with machinery. Any plant fragment that is not removed will regrow rapidly. Underwater rototilling will only enhance the rate of spread in the Chehalis River system.

In closed water systems (slough, ponds) mechanical control can be implemented. Parrotfeather can be successfully cut and harvested, but the dense and extensive rhizomes are very difficult to manages, and any fragments left behind will regrow rapidly.

Hand Pulling or Raking

Hand pulling or raking out water-suspended plants is manageable and effective on small patches. Hand pulling the parrotfeather that is rooted into the substrate or entangled in woody debris will result in the stems breaking and stimulating new shoots to emerge. Follow-up treatments are essential. Take great care to avoid creating new fragments and try and remove the rhizomes.

The best method for disposal is to remove the plant material upland or off site. If left on site, parrotfeather can be placed in plastic bags (not paper) and allowed to decompose, particularly in warm summer months.

Bottom Barriers

In Thurston County, while surveying for purple loosestrife in 1994, 47 sites of parrotfeather were found. By manually removing these plants and using burlap to cover a severely infested area, the number of sites dropped to 13 in 1999.

Dragline

In the Longview Diking District a dragline is utilized with a truck-mounted crane with a special attachment to clean the ditches of parrotfeather. The dragline operates from August to December, and control generally lasts for one growing season. Permits are required for this type of operation. (Permits from where? Bridget)

Diver Dredging (suction dredging)

Diver dredging is one method of mechanical harvest that has been effective against Brazilian elodea and may be appropriate for parrotfeather control.

Diver dredging is a method in which divers manually dislodge rooted aquatic plants and another diver uses a hose to vacuum the vegetation out of the river, capturing it in baskets for upland disposal. The purpose of diver dredging is to effectively remove all of the plant biomass including the portion of the root capable of regenerating. The divers disturb a very small amount of sediment, primarily sediment on the elodea itself, and use the suction hose for target weed removal only. The water is returned back to the water column and the plant material is retained. The plants are disposed of on shore.

The technique is consistent with the existing hydraulic permit for removing noxious weeds permitted by the Washington State Department of Fish and Wildlife.

In addition, diver dredging has been used in British Columbia, Washington State, and in Idaho to remove early infestations of Eurasian watermilfoil. The fact that parrotfeather tends to inhabit shallow sloughs with other submersed vegetation may make implementing diver dredging difficult or not cost effective if not planned carefully.

Chemical Control

Aquatic herbicide application requires a permit from the Washington State Department of Ecology and aquatic herbicide application must be performed by a state-licensed applicator. It is the responsibility of the agency doing the control work to get the required permits.

Five herbicides, imazapyr (Habitat), triclopyr (Renovate), 2,4-D (DMA 4IVM), diquat (Reward), and glyphosate (e.g. Rodeo, Aquaneat, etc.) are discussed for controlling parrotfeather. As with any pesticide, the user should completely read and understand the label prior to use. Although parrotfeather is considered by some to be susceptible to herbicides, it is difficult to achieve complete control with a single application. The emergent stems and leaves have a thick waxy cuticle and it requires a wetting agent to penetrate this cuticle. In general, herbicide efficacy seems to improve if applications are made in August and September when river levels are typically lowest and more of

parrotfeather's emergent leaf surface is exposed. However no treatment with any herbicide results in 100 percent control after just one treatment. Parrotfeather has been shown to need several follow-up chemical applications over several seasons, followed by some hand removal of remaining plants to result in eradication.

Field experiences and research (Kim Patten per comm.) has indicated that imazapyr seems more effective for treating parrotfeather than other herbicides although all the herbicides discussed here provide some degree if control. For best results the applicator should make one application to the above-water foliage of at least half the label rate and return in 2-4 weeks to resurvey the effects. It should be noted that imazapyr symptoms appear very slowly. Any regrowth should then be treated, with care being taken to not exceed the per acre label rate for the site.

Triclopyr has shown mixed result in regard to efficacy, providing initial kill but then showing regrowth. However, California Fish and Game has reported good results using Renovate® (triclopyr) at two quarts per acre for surface applications. Triclopyr may be applied directly to the water and to the above-water foliage.

Glyphosate provides between 80-90% control depending on a variety of application and environmental factors. Glyphosate should only be applied to the above-water foliage. Control of parrotfeather using glyphosate would be expected to take several years of follow-up treatment.

Finally, Westerdahl and Getsinger (1988) report excellent control of parrotfeather with 2,4-D, diquat, and diquat and complexed copper (copper is not allowed for use in Washington waters of the state). Control of parrotfeather may be achieved with low-volatility ester of 2,4-D at 4.4-8.9 kg ha, sprayed onto the emergent foliage. The granular formulation of 2,4-D was needed to control parrot feather for periods greater than 12 months. It is more effective when applied to young, actively growing plants. Restrictions using 2,4-D near salmon bearing streams should be checked early in the planning process, since these rules can change frequently. Diquat can be applied to the emergent foliage and/or applied to the water.

Biological Control

While biological control agents are not presently available, potential agents do exist. A complex of insects feed on parrotfeather in its native habitat. Research in California is working with a fungal agent, an isolate of *Pythium carolinianum* Matt.

Grass carp are also not permitted for use in waterbodies where inlets and outlets cannot be screened to prevent their escape. Because of the high tannin content of parrotfeather, it is found to be unpalatable to grass carp. Therefore grass carp are not recommended as a management method for Brazilian elodea in the Chehalis River.

MANAGEMENT ACTIVITIES

Several management projects have occurred on the Chehalis, including:

1) Lewis County Noxious Weed Program's Integrated Aquatic Plant Management Plan for Parrotfeather Management on the Chehalis River (January 1997).

2) Chehalis River Surge Plain Inventory, Early Detection and Control of Purple Loosestrife and Parrotfeather (1997 – 1998), by DNR.

More information regarding specific projects can be found by contacting the project manager (see contact list in Appendix C).

SUMMARY

The distribution of parrotfeather on the Chehalis River occurs from the City of Chehalis downstream to Montesano. The population was first surveyed and documented in a 1997 report prepared by the Lewis County Weed Board. The weed populations are associated with slow moving or slack water in sloughs or old river channels throughout the system.

Control of very small infestations has been accomplished on the Chehalis River by pulling individual floating and rooted plants or through covering small patches of parrotfeather. Larger infestations may be best treated with an application of an aquatically labeled herbicide, such as imazapyr, which has shown good efficacy on emerged vegetation.

The parrotfeather infestation appears to be increasing, especially at several sites on the lower Chehalis and a comprehensive, follow-up survey is needed to re-evaluate the distribution of this noxious weed. A treatment program, based on the survey, should seek to eliminate pioneering parrotfeather infestations and restore and maintain off-channel slough habitat.

LITERATURE CITED

Jennings, K. 1996. Watershed Approach to Water Quality Management, Water Quality Needs Assessment for the Western Olympic Water Quality Management Area. Department of Ecology, Olympia, WA. Publication No WQ-96-12.

Kim Patten per communication. WSU Extension - Long Beach, 2907 Pioneer Road, Long Beach, WA 98361-0633. pattenk@wsu.edu.

Lewis County Noxious Weed Program. 1997. Integrated Aquatic Plant Management Plan for Parrotfeather Management on the Chehalis River.

Westerdahl, H. E., and K. D. Getsinger, ed. (1988). Aquatic plant identification and herbicide use guide; Vol II: Aquatic plants and susceptibility to herbicides (Technical Report A-88-9). U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

APPENDIX A

MANAGEMENT PROFILE

purple loosestrife (*Lythrum salicaria*)

Distribution and Impacts

Purple loosestrife poses a significant threat to the Chehalis River riparian communities, and has spread prolifically in recent years in the Chehalis River Basin. Loosestrife appears to be tolerant of some salinity and grows in a wide range of inundation regimes, making the lower Chehalis River and Chehalis River surge plain especially vulnerable to invasion and establishment by this species. Large established populations of purple loosestrife already exist in the lower Chehalis River. At Friends Landing, near Montesano, purple loosestrife choked off waterways, resulting in a loss of recreational opportunities.

Wetland communities can be transformed to a loosestrife dominated monoculture over a short period of time. Habitat loss occurs when native and beneficial plants are replaced by non-native plants that provide neither food, nesting material, or shelter for local wildlife and waterfowl.

Unfortunately, new areas are infested every year, as this noxious weed produces enormous quantities of persistent seed that spreads readily in aquatic systems and remain viable for many years.

Long-term control of targeted weed species will be a priority for the Chehalis River IAVMP. Total eradication may not be feasible for some aquatic weed species, but containment and protection of native habitat from further degradation is certainly within reach for all aquatic weed species. Purple loosestrife will be managed to reduce existing infestations and restore native vegetation and habitat.

PLANT CHARACTERISTICS

Purple loosestrife is a European native that has been widely introduced throughout North America. It is an emergent noxious weed (Class B) that grows in shallow, fresh or brackish water in wetlands and along streams, lakes or ditch banks, in water from about 14 inches deep to approximately 12 inches above the water table. It is also known as a garden ornamental, and will grow in cultivated areas.

This large, dark green perennial plant has new growth each year that originates from a spreading woody root mass that sometimes has a taproot. Each plant can produces 30 or more stems, and each stem can be from five to twelve feet tall. The stems are square, and when viewed in cross section, they usually have four to six nearly flat sides. The leaves grow 1.5 to 4 inches long. They are longer than wide and taper to a narrow point, somewhat resembling a willow leaf. The leaves are opposite, and the leaf pairs occur at 90 degrees from the pair below. Lower down the stems the leaves sometimes grow in threes.

Each stem is topped by a 4 inch to 16 inch long spike-like flower cluster with hundreds of bright magenta flowers. The individual flowers are small, and usually have 6 petals.

Purple loosestrife blooms from June to October depending al climates. Flowers are produced on a long flowering stem, and the flowers mature first on the bottom of the stem and continue to mature up towards the tip of the stem. The lowest flowers may produce mature seed while the upper flowers are still in bloom.

Robust plants can produce over 2 million seeds. Each seed is about the size of ground pepper. These seeds can travel a few feet out from stems as the seed capsule dries and snaps open. However, most seed transport is probably by water movement, in mud sticking to people, equipment or animals, or by being eaten and excreted by animals. Since purple loosestrife is a prolific seed producer, it creates a seed bank with the ability to generate new infestations each year, even after complete control has been achieved in a previous growing season.

New plants often get started from broken off plant parts because each node can develop roots if it lands in a moist environment. The lower stems and root crowns have adventitious buds that can generate new plants if the top receives damage.

The best time to survey for purple loosestrife is in July and August when the plants are blooming, since the magenta flowers are easy to spot at a distance. For large populations, aerial surveys provide good information, whereas ground surveys are more feasible for tracking small populations and finding newly established populations. Start looking for seedlings in June.

The best time to control purple loosestrife will depend on the site and the size of the populations. Once flower petals start to drop from the bottom of the spike, the plant begins to produce seed. Control activities can continue during this time, but it requires greater care so that seeds are not shaken from the plant.

MANAGEMENT & CONTROL OPTIONS

There is a range of control methods that may be suitable for site specific control of purple loosestrife in the Chehalis River basin. These control methods may include: Detection, prevention, mechanical, chemical and biological controls.

Some control methods may require a period for permit application and approval. Fortunately several control methods are currently authorized for purple loosestrife.

Rare and Endangered Plants and Fish & Wildlife Resources

Always check with the Washington Department of Natural Resources Heritage Program for native flora locations and WDFW's Regional Habitat Biologist for fish stocks that could be impacted by

control methods prior to pursuing control. Contact information can be found on pages 4 and 5 of the general plan.

Early Detection, Prevention, Follow-Up

Early detection and prevention is the preferred control method for new sites, or when very small sites are found. There are wetlands and waterways that do not have purple loosestrife. Continued surveys, monitoring and early detection will prevent purple loosestrife from establishing in natural areas. Follow up surveys will ensure that plants do not generate from the seed bank.

Mechanical Control

Handpulling

Handpulling is appropriate for isolated young plants or for the removal of seedlings that may have germinated after other control measures. Purple loosestrife can generally be successfully hand pulled only during the first or second year after establishment. At this stage the plants typically have not developed their full woody root mass. Careful hand pulling can remove most of the roots so that any remaining material should not generate a new plant. Hand pulling is easiest when the water is at or just above the surface of the soil.

Hand pulling is usually not effective for older plants because the root mass cannot be completely removed. Breaking off the stems during an unsuccessful hand pulling effort can stimulate adventitious buds to produce new shoots. Even digging out mature plants may not be successful, since the root mass is large and heavy and new shoots will readily develop from remaining large roots or broken off plant parts left in a moist site. However, it is sometimes possible to dig out older plants by teasing the roots loose with a cultivator.

The Nature Conservancy reports that hand pulling in winter (in Western Washington) is more effective than summer pulling because 1) the area is much wetter and plants uproot more easily and completely; 2) less biomass has to be removed and disposed of; and 3) the area can be revisited the following summer for removal of remaining roots that have re-sprouted. By pulling in the winter, volunteers were able to effectively remove quite large plants. After two years of winter hand pulling at a specific western Washington wetland site, the area was mostly clear of purple loosestrife.

Covering (solarization)

Covering plants with a material such as heavy black plastic sheeting or 100 percent shade cloth can help eliminate small patches of purple loosestrife by preventing photosynthesis and producing high undercover temperatures. Covering will also affect any non-target plants that are covered.

This technique will be used on small, dense infestations of about ten to twenty feet in size which contain mostly target weeds, although the Thurston County Weed Board staff reported that they had successfully controlled a much larger area of purple loosestrife by covering it with landscape fabric. They found that native hardhack species colonized the area even through the fabric, whereas loosestrife growth was almost completely suppressed. The few purple loosestrife plants that returned were easily hand removed.

Covering can be done with any opaque material that eliminates all light. The cover should be installed in early spring before the plants have produced much top growth. Remove any above ground vegetation from the site using a weed whacker or similar cutting device before laying the sheeting over the weeds. Cover the edges with rocks, wood or natural material. Use at least two layers of plastic sheeting because wind or other disturbances can cause tearing of the top sheet. If the

cover is torn, the weeds may recover. The area covered should exceed the plant area by at least a meter in each direction.

The cover must be left in place for at least one full growing season. At the end of this period, all seedlings and some mature plants will have died, but some plants will survive and appear as short white shriveled stems. If left, these plants may survive. Hand removal may be effective or let these greatly weakened plants start growth, and as the weather warms, treat them with a very small amount of herbicide.

Mowing

Mowing purple loosestrife can effectively weaken tall plants if the plants are cut close to the ground (most of their leaves are above mowing height). This forces the plants to produce new shoots by using root carbohydrate reserves for initial stem production. Mowing once or more during the growing season can greatly reduce seed production. Mowing may also enhance the effectiveness of other control techniques by weakening the plant and making is more susceptible to these measures. It is important to time the mowing to occur just before the plant flowers. Mowing too early may result in regrowth and flowering. Mowing too late in the season may result in seed set. Mowing dense monoculture stands will create a lot of biomass on the ground. This biomass will discourage new seedling development the following year by shading out the ground. Mowing should not affect lower growing desirable vegetation in open weed stands. It is important to ensure that cut plant material is disposed of properly to eliminate sprouting from adventitious buds or moving offsite to new locations.

Cutting Single Plants

A single mature purple loosestrife plant can produce over two million seeds per year. If it is not possible to kill or remove mature plants, removing the flower spikes can prevent seed production and seed set. Along with the flower spike, previous year's dry seed heads should also be removed because they may still contain seeds. Cutting the stems to the ground also inhibits growth. At sites where plants have already gone to seed, remove all of the flowering spikes first by bending them over a plastic bag and cutting them off into the bag. Further cutting of stems or pulling can then take place without fear of spreading the tiny seeds. (http://www.seagrant.umn.edu/exotics/purple.html) Proper disposal of plant material is important. Put all plant pieces in plastic bags (vegetation rots quickly in plastic) and take the bags to a sanitary landfill site. Be sure the landfill site does not require the bags to be broken open for composting. Composting is not advised, because purple loosestrife seeds may not be destroyed and the thick, woody stems and roots take a long time to decompose. If facilities exist in your area, incineration is an effective way to dispose of plant material. Be aware that clothes and equipment may transport the small seeds to new areas. Thoroughly brush off clothes and equipment before leaving the site.
(http://www.seagrant.umn.edu/exotics/purple.html)

Site Modification (Excavation/Dredging)

This method is suitable for use on large, dense, or open weed stands growing in open water wetlands where permits can be obtained. However, mechanical removal greatly modifies the wetland because plants, roots, and the surrounding soil are physically removed, thus deepening or creating water areas several feet deep. This method is not recommended in high quality wetlands or if listed plants or animals use the site because the site is permanently modified.

Site modification can be done with large floating machines that excavate plants and sediments and collect them on a barge for removal. This process changes wetland contours, lowers bottom elevation, and removes purple loosestrife growing sites. This treatment leaves steep shores and deeper water, which limits any future weed occurrence to a narrow band along the waters edge. Monitoring and potential future control efforts can then focus on these small, narrow areas with a better chance to prevent weed reoccurrence. The technique will affect all aspects of the site including desirable plant potential. Follow-up may be necessary to assure all plant parts are removed. Equipment contracting will be expensive. Some re-vegetation of disturbed areas will be necessary after weed removal has been completed.

This method would require extensive planning and permitting and the excavated plant material must be disposed of properly to avoid contamination of uninfested dumpsites by viable plant material and seeds.

Burning

Fire has generally not been used to control loosestrife, mostly due to problems with burning in wetlands and the lack of continuous fuels to carry a fire. In areas with cold dry winter weather, burning purple loosestrife vegetation may be possible in the late winter where burning permits can be obtained. Winter burning does not damage desirable vegetation or purple loosestrife but it does reduce the dry biomass. The exposed new growth may be more accessible for mowing or herbicide treatment.

Cultural

Water Level Management

Water level management can be effective in weakening or killing dense, monotypic stands of purple loosestrife. However, water management may adversely affect desirable competing vegetation depending on the flooding regime. If water in a wetland or pond can be drained or its level increased for a growing season or two, this can greatly weaken established purple loosestrife plants. Even a short period of water management to disrupt the growth cycle of weeds may complement other control methods, like mowing or herbicide application. Care should be taken if water level management is being considered because inadequate planning can exacerbate the purple loosestrife infestation by stimulating germination.

Chemical Control

Herbicide applications in wetland or aquatic sites require that the applicator have a valid WSDA pesticide applicators license with an aquatic endorsement. In addition, if herbicide applications result in product entering the water a National Pollution Discharge Elimination System (NPDES) permit issued by the Washington State Department of Ecology must cover the application.

For purple loosestrife control, only four active ingredients labeled for aquatic applications may be used: Glyphosate, imazapyr, triclopyr, and 2,4-D. These active ingredients are sold under a variety of trade names, so it is important for the applicator to completely read the label to see if aquatic applications are permitted and to abide by rates and conditions set by the label. Any reference to products, percentages, and rates in this section of the IAVMP plan is for illustration and should not be applied in the field because labels and product formulations can change frequently.

A chemical control program for purple loosestrife requires a multi-year plan to control surviving plants and to kill seedlings. Herbicide control should include three to four years of active management, followed by close annual monitoring to detect and remove seedlings.

Purple loosestrife has been successfully treated in the Chehalis River using glyphosate (many aquatically registered trade names) in a 1.5% solution. Glyphosate is a non-selective herbicide. This herbicide should be used when treating a monoculture of purple loosestrife, where there are few non-target plants to be damaged. As the stands open up and native species return, a selective herbicide such as triclopyr or 2,4-D can be used to target purple loosestrife while having little impact on native grass species. However, if carefully wicked or wiped onto individual plants, glyphosate can be made selective through application techniques.

Apply up to four pints per acre of glyphosate as a broadcast spray; or a 1 to 1.5 percent solution when using hand held equipment. Individual herbicide labels should be completely read by the applicator prior to use. Best results are obtained when the herbicide is applied when the plants are actively growing at or beyond the bloom stage of growth. Fall treatments must be applied before a killing frost. Application after flowering starts and after some seed cases have formed will not prevent development of at least some viable seed. Spraying even later in the season will not prevent most current year's seed production. If possible, remove the seed heads from these plants.

Imazapyr (Habitat®) is newly registered for aquatic use. Like glyphosate, it is non-selective and systemic. It appears to move rapidly into the rhizomes making it potentially very effective in controlling rhizomatous species. The label calls for the application of one pint per acre to actively growing vegetation to control purple loosestrife. At this time Habitat® is the only imazapyr formulation that has an aquatic label. Imazapyr has residual properties, so this should be considered when planning revegetation.

Triclopyr (Renovate 3®) is a selective herbicide that can control broadleaf herbaceous plants, trees, and shrubs, but should not affect grasses, sedges, rushes, or similar monocotyledonous plants. Renovate 3® is currently the only triclopyr formulation that has an aquatic label. According to label information Renovate 3® can be effective if applied to seedling purple loosestrife plants through full bloom growth stage. For best effect apply from bud to mid-flowering stage of growth. Thorough wetting of the leaves and stems is necessary to achieve good control. If using a back pack sprayer, a 1-1.5 percent solution of Renovate 3® is recommended on the label. For broadcast applications, six to eight quarts of Renovate® per acre is recommended. Follow-up applications should be made the following year. Like glyphosate, triclopyr should be applied selectively to target plants to prevent damage to existing desirable competing broadleaf vegetation. The Nature Conservancy reports that control results using triclopyr have been inconsistent in the field. Sometimes it is better to use less herbicide than the label rate. If used at a high rate, triclopyr can sometimes cause a plant to "shut down" and not translocate the herbicide to the roots.

2,4-D herbicides (read label carefully for registered use) are selective chemicals that will control broadleaf herbaceous plants, trees, and shrubs, but should not affect grasses, sedges, rushes or similar monocotyledons. According to The Nature Conservancy, 2,4-D is most effective in controlling first-year seedlings and preventing seed production in mature plants. It does not kill mature plants and it should be applied before flowering in May. However, there are use restrictions

on 2,4-D in eastern Washington. In addition a recent court decision limits the use of 2,4-D near salmon-bearing waters. Buffers and other conditions to limit drift are in effect, so check with WSDA before applying 2,4-D (WSDA July 2004).

Biological Control

Insects

Biological control is suitable for extensive infestations of purple loosestrife. It is not a suitable technique for isolated plants or small populations, and those smaller sites should be controlled through other methods. The successful establishment of biocontrol populations varies from site to site across western Washington. Areas of fluctuating water levels have been problematic in establishing insect populations. It sometimes takes several insect releases before a breeding population can become established in an area.

Some releases have been made in the Lower Chehalis River area of *Galerucella* and *Hylobius*. The Galerucella has established itself, but control by this insect is not as dramatic as in Eastern Washington. This may be due to the tidal influence of these coastal sites in Western Washington. If additional releases are needed in the Chehalis River Basin, the *Galerucella* beetles are available for collection in eastern Washington as a result of extensive releases made in the mid-1990s.

Purple loosestrife is native to central Europe, and several insects that feed on this plant were collected from central Europe, and then screened for their specificity to purple loosestrife.
• *Hylobius transversovittatus*: A small beetle that attacks the roots and leaves of purple loosestrife;
• *Galerucella calmariensis*: A very small beetle that attacks flower heads and leaves of purple loosestrife;
• *G. pusilla*: Similar to *G. calmariensis* above;
• *Nanophyes marmoratus*: An extremely small weevil that attacks the buds and flowers of purple loosestrife;
• *N. brevis*: Similar to *N. marmoratus* above, but not released in Washington, due to the presence of a nematode contamination; and
• *Bayeriola salicariae*: A gall midge not released in Washington and also not as host-specific as the other insects.

The two *Galerucella* species, *Hylobius*, and *Nanophyes marmoratus* were approved for general release in Washington in the early 1990's (WSDA July 2004).

For more information on biological controls of purple loosestrife, please refer to:
http://www.invasiveplants.net/InvasivePlants/PurpleLoosestrife/PurpleLoosestrife.asp

Grazing

For many weeds grazing will remove top growth, weaken plants, and reduce seed production. Depending on the animal chosen, grazing can be effective on open or monoculture stands of several acres. However, there are no published studies that indicate livestock grazing can effectively control purple loosestrife (Noxious Emergent Plant Management EIS 1993) and grazing animals in wetlands also contributes nutrients and fecal bacteria to waterways and animals may trample and alter wetland characteristics. Choose sites and animals appropriate for this control activity and monitor efficacy carefully to ensure you are meeting your weed control objectives.

MANAGEMENT ACTIVITIES

Several agencies actively control purple loosestrife and or have implemented projects to control loosestrife on lands managed by them.

1) The Lewis and Thurston County Noxious Weed Board have relatively small populations and work with landowner to control them
2) The Grays Harbor Noxious Weed Board has worked with private landowners, businesses, non-profits, and state agencies to develop management options for their properties and to release biological controls for larger infestations.
3) DNR has been active in annually surveying and controlling loosestrife on the surge plain.
4) WDFW has received Ecology grants to map, control and establish purple loosestrife biocontrol populations for the Chehalis River. The agency has been very active at the Chehalis Wildlife Area, but needs to ramp up efforts for purple loosestrife infestations on other properties along the river. It is hoped that a new biocontrol insect, in time, will help control these infestations.

More information regarding specific projects can be found by contacting the project manager (see contact list in Appendix C).

SUMMARY

Purple loosestrife is currently a problem on the tidally influenced lower reaches of the Chehalis River. Several large infestations are present with individual plants being scattered along the shoreline.

Individual purple loosestrife plants and even small infestations can be controlled effectively with the methods outlined in this plan. However, large monocultures are more problematic. Daily fluctuations in water levels and the long-lived seed bank make herbicide control and revegetation of these sites problematic.

The *Galerucella* beetle has effectively controlled large infestations in Eastern Washington and insect releases have been made along the Chehalis River. To date, these insect populations have not increased as dramatically, nor exerted the desired level of control. However, a suite of biocontrols are available for purple loosestrife that should be released to improve long-term control of our large infestations. *Nanophyes marmoratus*, a small gall fly that attacks the flowers and seeds of purple loosestrife, were just released near Friends landing in 2006 to see if this insect is more successful for tidally influenced purple loosestrife infestations.

LITERATURE CITED

Ebasco Environmental, Gary Piper, Department of Ecology, Department of Agriculture, Department of Wildlife, Department of Fisheries, Corps of Engineers, Seattle District, and Herrera Environmental Consultants Inc. November 1993. Noxious Emergent Plant Management Environmental Impact Statement (EIS). Washington State Department of Ecology, Lacey, WA.

Minnesota Sea Grant. 2004. Purple loosestrife: What you should know, what you can do. http://www.seagrant.umn.edu/exotics/purple.html

APPENDIX B

8-16-04

STATE OF WASHINGTON

DEPARTMENT OF NATURAL RESOURCES

DOUG SUTHERLAND, Commissioner of Public Lands

MEMORANDUM OF UNDERSTANDING

FOR THE

CHEHALIS RIVER COOPERATIVE WEED MANAGEMENT AREA

This Memorandum of Understanding (MOU) is between the Pacific Cascade Region and Aquatics Division of the Washington Department of Natural Resources (DNR), the Washington Department of Fish and Wildlife (DFW), the U.S. Fish and Wildlife Service, Nisqually National Wildlife Complex, the Grays Harbor County Noxious Weed Control Board (GHCNWCB), the Thurston County Noxious Weed Control Board (TCNWCB), the Lewis County Noxious Weed Control Board (LCNWCB); The Nature Conservancy (TNC), the Chehalis River Council, the Quinault Indian Nation (QIN), and the Confederated Tribes of the Chehalis.

The DNR and WDFW enter into this Agreement under authority of Chapter 39.34 RCW of Washington State, Interlocal Cooperation Act, and specific RCW 77.12.10; while the Thurston, Lewis, and Grays Harbor Noxious Weed Control Boards enter into this agreement under authority of Chapter 17.10 RCW. The USFWS enters into the agreement under the authority of the National Wildlife System Administration act of 1967, as amended (16 USC 668dd-668ee), and Fish and Wildlife Act of 1956, as amended (16 USC 742a-742j). The QIN and the Confederated Tribes of the Chehalis enter into this agreement under the authority of their Constitutions and Bylaws, the ordinances, resolutions, and laws of their individual Tribe and the provisions and policies of the Indian Self Determination Act, 25 USC 450-450n and 455-458c.

PURPOSE

The Parties listed above have weed management interests or responsibilities on adjacent and co-mingled lands associated with the tributaries and main-stem of the Chehalis River of Lewis, Thurston, and Grays Harbor Counties. Each of the Parties has a common interest in weed management within the Chehalis River basin. Weed populations in one jurisdiction affect the ability of other land managers to manage weeds on lands they administer, especially in an aquatic environment. The Parties desire to work together to promote an integrated and coordinated approach to weed management through information exchange, education and training, coordination of inventory and management techniques, and sharing of resources when appropriate. The purpose is also to minimize spread of invasive species, identify high priority areas for control, and act to prevent economic and ecological impacts from these species.

1.01 Definitions

Chehalis River CWMA – The Cooperative Weed Management Area is the geographic area contained within The Chehalis River Basin, WRIA 22 and 23. This agreement is specifically directed toward management of riparian and aquatic weeds that infest or threaten the water-body of the Chehalis River and it's tributaries.

Department of Natural Resources - an agency of the state of Washington.

Department of Fish and Wildlife - an agency of the state of Washington.

County Noxious Weed Boards – Appointed members of the County Noxious Weeds Control Boards, authorized by the County Commissions.

U.S. Fish and Wildlife Service, Nisqually National Wildlife Complex – which includes the Grays Harbor National Wildlife Refuge (NWR) and the Black River Unit of the Nisqually National Wildlife Refuge.

Working Group - The working group shall be comprised of one representative of each of the Parties to this MOU, and will be comprised of persons with expertise or interest in integrated weed management. The working group will be open to recommendations and suggestions from any interested landowner/operator. The working group will guide the activities of the Chehalis River CWMA including planning, organization, and project identification.

Memorandum of Understanding – The Parties listed above enter into memoranda of understanding, in good faith, with public and private agencies to collaborate on and/or coordinate programs and to define institutional linkages along broad areas of concern. Memoranda of understanding are not legal contracts and do not strictly obligate the resources of the Parties. Parties to the CWMA shall voluntarily agree to the priorities as agreed upon, but shall not be required to perform work as part of the agreement.

Noxious weeds are non-native plants introduced to Washington through human actions. The Washington State Noxious Weed Control Board adopts a State Noxious Weed list each year. This list categorizes weeds into three major classes –A, B, and C– according to their geographic

distribution and the threat they pose to the state or region of the state. The Chehalis River is affected by a number of aquatic weeds listed as Class B in the 2004 Washington State Noxious Weed List.

2.01 Objectives

- Create a formal cooperative agreement between the Parties that encourages joint planning and operations in support of Chehalis River weed management.
- Build an efficient working group that sets priorities on an annual basis and coordinates efforts to accomplish priority management actions. It will be a forum for communication regarding weed control concerns and resource protection activities such as restoration of areas degraded by weeds.
- Develop an Integrated Weed Management Plan (IWMP) for the Chehalis River and tributaries thereof.
- Develop and implement inventory and control measures for the CWMA.

3.01 Duties of the Working Group

- Identify and prioritize species to be managed in the CWMA.
- Share information regarding weed inventories, management, and maps on an annual basis.
- Develop and maintain an integrated weed management plan for aquatic, emergent, and riparian weeds of the Chehalis River. The plan will include methods for monitoring and evaluation of treatments and restoration activities.
- Share existing educational program materials and develop new resources that fill gaps in the resources available for public education, in particular educational/training resources for landowners.
- Promote restoration and release of native vegetation associated with riparian and aquatic areas.
- Identify and pursue opportunities for long term funding of the weed management area programs described herein.

The Grays Harbor, Lewis, and Thurston County Noxious Weed Boards shall:

- Retain discretionary prerogative for areas under their individual authority. (RCW 17.10)

4.01 Terms and Conditions

(1) (1) Effective Dates. This MOU takes effect on September 21, 2004, until December 31, 2010, unless terminated sooner. This agreement will be reviewed at least every two years.

(2) New parties may be added to the MOU with the approval of the working group.

(3) Amendments. This MOU shall be amended only by written mutual consent of the parties.

(4) Termination. Any Party may terminate their participation in this MOU by notifying the other parties in writing.

Table 1. RARE WASHINGTON PLANTS ASSOCIATED WITH WETLANDS, LAKES, RIVERS, AND MARINE AREAS IN THE CHEHALIS RIVER BASIN

(5) It is recognized that each Party has the primary responsibility to its own governing body and lands under its jurisdiction. It is agreed to voluntarily share resources with each other as legal authorities may permit.

Scientific name	Common name	State status[1]	Plant Type[2]	Soil Type	Habitat
Arenaria paludicola	Swamp sandwort	X - Federally listed	emergent, submersed	wetland	ponds
Cardamine penduliflora	Willamette Valley bittercress	T	emergent	wetland	wet meadows, ditches
Carex comosa	Bristly sedge	S	emergent	wetland	wet meadows, streams, lakes
Carex macrochaeta	Large-awn sedge	T	emergent	wetland	wet meadows, streams, lakes
Cicuta bulbifera	Bulb-bearing water-hemlock	S	emergent, submersed	wetland	ponds, lakes
Erigeron peregrinus ssp *peregrinus* var *thompsonii*	Thomsons' wandering daisy	S	emergent	wetland	bogs, wet forest
Howellia aquatilis	Howellia	T - Federally listed	submersed	wetland	ponds
Hydrocotyle ranunculoides	Floating water pennywort	S	submersed, floating leaved	wetland	lakes, salt marshes
Isoetes nuttallii	Nuttall's quillwort	S	emergent	wetland	vernal pools, wet meadows
Lycopodiella inundata	Bog clubmoss	S	emergent	wetland	wet meadows, lakes?
Parnassia palustris var *neogaea*	Northern grass-of-parnassus	S	emergent	wetland	wet meadows
Plantago macrocarpa	Alaska plantain	S	emergent	wetland	wet meadows, salt marshes
Puccinellia nutkaensis	Alaska alkaligrass	S	emergent	wetland	salt marshes, wet meadows
Sanguisorba menziesii	Menzies' burnet	S	emergent	wetland	wet meadows, lakes, bogs
Sidalcea hendersonii	Henderson's checker-mallow	S	emergent	wetland	Upper salt marshes
Utricularia gibba	Humped bladderwort	R1	submersed	wetland	ponds, lakes
Utricularia minor	Lesser bladderwort	R1	submersed, floating leaved	wetland	lakes, ponds
Woodwardia fimbriata	Chain-fern	S	shoreline	upland	saltwater banks

APPENDIX D

Status Classifications: Watch, Sensitive, Threatened, Endangered

APPENDIX F

PLANTS AND SEEDS WHOSE SALES ARE PROHIBITED IN WASHINGTON STATE

Wetland and Aquatics
WAC 16-752-505

It is prohibited to transport, buy, sell, offer for sale, or to distribute plants or plant parts of these regulated plants, into or within the state of Washington. It is further prohibited to intentionally transplant wild plants and/or plant parts of these species within the state of Washington.

Common name(s)	Scientific name
african elodea	*Lagarosiphon major*
australian swamp stonecrop	*Crassula Helmsii*
brazilian elodea	*Egeria densa*
cordgrass, common	*Spartina anglica*
cordgrass, dense-flowering	*Spartina densiflora*
cordgrass, salt meadow	*Spartina patens*
cordgrass, smooth	*Spartina alterniflora*
delta arrowhead	*Sagittaria platyphylla*
eurasian watermilfoil	*Myriophyllum spicatum*
european frog-bit	*Hydrocharis morsus-rana*
fanwort	*Cabomba caroliniana*
flowering rush	*Butomus umbellatus*
garden loosestrife	*Lysimachia vulgaris*
grass-leaved arrowhead	*Sagittaria graminea*
hairy willow herb	*Epilobium hirsutum*
hydrilla	*Hydrilla verticillata*
marsh dew flower; Asian spiderwort	*Murdannia keisak*
mud mat	*Glossostigma diandrum*
parrotfeather	*Myriophyllum aquaticum*
reed sweetgrass, tall manna grass	*Glyceria maxima*
slender-leaved naiad; brittle naiad	*Najas minor*
swollen bladderwort	*Utricularia inflata*
water caltrap; devil's pod; bat nut	*Trapa bicornus*
water chestnut; bull nut	*Trapa natans*
water primrose	*Ludwigia hexapetala*
yellow floating heart	*Nyphoides peltata*

Terrestrial Noxious Weed Seed and Plant Quarantine WAC 16-752-610

It is prohibited to transport, buy, sell or offer for sale, or distribute all plants or plant parts, seeds in packets, blends or "wildflower mixes" of these regulated species:

Common name(s)	Scientific name
Blueweed; viper's bugloss; blue devil	*Echium vulgare*
buffalobur	*Solanum rostratum*
clary sage	*Salvia sclarea*
common bugloss	*Anchusa officinalis*
common crupina	*Crupina vulgaris*
dalmatian toadflax	*Linaria dalmatica* ssp. *dalmatica*
dwarf snapdragon	*Chaenorrhinum minus*
dyers woad	*Isatis tinctoria*
eggleaf spurge	*Euphorbia oblongata*
garlic mustard	*Alliaria petiolata*
giant hogweed	*Heracleum mantegazzianum*
goatsrue	*Galega officinalis*
gorse; furze	*Ulex europaeus*
hawkweed, mouseear	*Hieracium pilosella*
hawkweed, orange; red daisy; flameweed; devil's weed	*Hieracium aurantiacum*
hawkweed, yellow; devil's paintbrush; yellow paintbrush	*Hieracium caespitosum*
hawkweed, yellow devil	*Hieracium floribundum*
hedgeparsley	*Torilis arvensis*
Indigobush; lead plant	*Amorpha fruticosa*
johnsongrass	*Sorghum halepense*
knapweed, bighead; lemon fluff; globe centaury	*Centaurea macrocephala*
knapweed, black	*Centaurea nigra*
knapweed, brown; rayed knapweed; hard-heads; brown centaury; horse-knobs	*Centaurea jacea*
knapweed, diffuse	*Centaurea diffusa*
knapweed, meadow	*Centaurea jacea x nigra*
knapweed, spotted	*Centaurea biebersteinii*
knapweed, Vochin	*Centaurea nigrescens*
Kochia; burning bush; summer-cyprus; Fireball; Mexican fireweed	*Kochia scoparia*
knotweed, Giant	*Polygonum sachalinense*
knotweed, Himalayan	*Polygonum polystachyum*
knotweed, Japanese	*Polygonum cuspidatum*
kudzu	*Pueraria montana* var. *lobata*
lawnweed	*Soliva sessilis*
leafy spurge	*Euphorbia esula*
meadow clary	*Salvia pratensis*
mediterranean sage	*Salvia aethiopis*
oxeye daisy; white daisy; field daisy	*Leucanthemum vulgare*
perennial pepperweed	*Lepidium latifolium*
policeman's helmet; Himalayan balsam; jewelweed	*Impatiens glandulifera*
purple starthistle	*Centaurea calcitrapa*
saltcedar	*Tamarix ramosissima*
scotch broom	*Cytisus scoparius*
silverleaf nightshade	*Solanum elaeagnifolium*
spanish broom	*Spartium junceum*
spurge flax	*Thymelaea passerina*

syrian bean-caper	*Zygophyllum fabago*
tansy ragwort	*Senecio jacobaea*
texas blueweed	*Helianthus ciliaris*
thistle, Italian	*Carduus pycnocephalus*
thistle, milk	*Silybum marianum*
thistle, musk; nodding thistle	*Carduus nutans*
thistle, plumeless	*Carduus acanthoides*
thistle, Scotch	*Onopordum acanthium*
thistle, slenderflower	*Carduus tenuiflorus*
unicorn plant	*Proboscidea louisianica*
velvetleaf	*Abutilon theophrasti*
venice mallow; flower-of-an-hour	*Hibiscus trionum*
wild carrot; Queen Anne's lace	*Daucus carota*
wild chervil	*Anthriscus sylvestris*
wild four o'clock; umbrella-wort	*Mirabilis nyctaginea*

Lythrum **Quarantine**
WAC 16-752-400 - 415

It is prohibited to transport, buy, sell, offer for sale or to distribute plants, plant parts or seeds of *Lythrum salicaria* or *L. virgatum* into or within the state of Washington. It is also prohibited to transplant wildplants and/or plant parts of these species in the state of Washington.

The *Lythrum* quarantine applies to all *Lythrum* species including any hybrid cross and all named cultivars, including but not limited to plants with the horticultural names: morden pink, morden gleam, morden rose, the beacon, fire candle, brightness, lady sackville, Mr. Robert, Robert's happy, roseum superbum, purple spire, rose queen, the rocket, dropmore purple and tomentosum.

Common name(s)	**Scientific name**
purple loosestrife	*Lythrum salicaria*
wand loosestrife	*Lythrum virgatum*

For more information contact:

WSDA Nursery Inspection Program (360) 902-1874
WSDA Weed Specialist - Yakima Office (509) 225-2604
Washington State Noxious Weed Control Board(360) 902-2053
Your Local Noxious Weed Control Board

Information in this appendix taken from the pamphlet:

PLANTS AND SEEDS WHOSE SALES ARE PROHIBITED IN WASHINGTON STATE, A Summary of Current Regulations on Sales of Noxious Weeds and Other Invasive Exotic Plants. 2006. Washington State Department of Agriculture Plant Protection Division. Olympia,