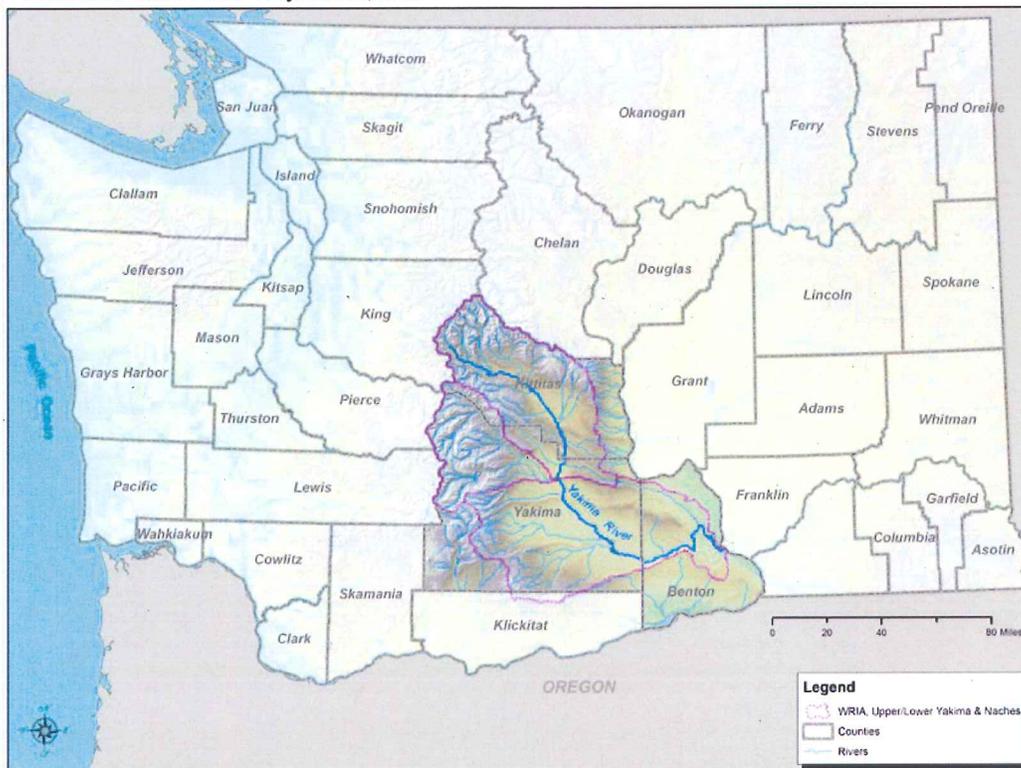


YAKIMA RIVER BASIN INTEGRATED AQUATIC VEGETATION MANAGEMENT PLAN

Yakima River Basin IAVMP Project Area, 2011



April 30, 2012

By

Bridget Simon, WSDA
Greg Haubrich, WSDA
Jill Severn, SPSCC

Edited by

Lizbeth Seebacher, Department of Ecology
Jenifer Parsons, Department of Ecology
Yakima River CWMA Members

Ecology Grant # G1000560

TABLE OF CONTENTS
Yakima River Basin IAVMP
April 30, 2012

I. Statement of Purpose	1
II. The Cooperative Weed Management Area (CWMA)	1
III. Yakima River Basin and Associated Lakes	4
Lakes	5 - 6
Native and Rare Plants	6
Fish and Wildlife	7
IV. Problem Statement	9
V. Management Goals	11
VI. Integrated Pest Management (IPM)	12
VII. Aquatic Noxious Weeds	13
VIII. Action Plan	14
IX. Summary	15
X. References, Literature Cited	15
XI. Appendices	16
Appendix A: Weed Management Profiles	
1. Flowering rush	17
2. Parrotfeather	23
3. <i>Phragmites</i> (nonnative genotype)	28
4. Purple loosestrife	35
5. Yellow flag iris	42
Appendix B MOU – Under development	47
Appendix C Contact information for CWMA	51
Appendix D Noxious Weed List	52
Quarantine Weed Lists	56
Appendix E Maps	60
– Yakima River Basin with 5 targeted weed species	
– Flowering rush distribution map	
– Parrotfeather distribution map	
– <i>Phragmites</i> distribution map	
– Purple loosestrife distribution	
– Yellow-flag iris distribution map	
– Rare plant species and endangered ecosystems map	

Yakima River Basin Integrated Aquatic Vegetation Management Plan

I. Statement of Purpose

The purpose of this project is to develop an Integrated Aquatic Vegetation Management Plan (IAVMP) for the Yakima River Basin. The Yakima River has been the focus of a number of invasive aquatic plant control projects over the last 20 years by several different entities. The control efforts have generally not been well coordinated. Part of the difficulty has been that the Yakima River extends through three counties and several jurisdictions.

This project was conceived as a way to address persistent invasive weeds that require a regional plan of attack to control effectively. Lacking this higher level of concentration on control, the five targeted weed species in this plan have the potential to do lasting damage to the Yakima River basin, its economy, and its environmental integrity.

An IAVMP will facilitate the coordination of effort and ensure the most effective use of limited resources across management jurisdictions, resulting in more thorough control of invasive, aquatic weeds.

This plan will have particular emphasis on five targeted invasive, aquatic noxious weed species:

- Flowering rush (*Butomus umbellatus*)
- Phragmites*, nonnative genotype (*Phragmites australis* ssp. *australis*)
- Parrotfeather (*Myriophyllum aquaticum*)
- Purple loosestrife (*Lythrum salicaria*)
- Yellow flag iris (*Iris pseudacorus*)

The 2003 Chehalis River IAVMP and the 2007 Fio Rito and Mattoon Lakes Management Plans were reviewed and used as models for this plan. Funding for this plan was provided by the Washington State Department of Ecology (WDOE) with match from the Washington State Department of Agriculture (WSDA).

II. The Yakima River Cooperative Weed Management Area (CWMA)

The Yakima River Task Force began meeting in 1994, and members included the Yakima, Benton and Kittitas County weed boards, the Yakama Nation and WSDA. Their weed control focus was purple loosestrife, yellow flag iris and parrotfeather. Over time this Task Force evolved into the Yakima River Cooperative Weed Management Area. The purpose of this CWMA and of the Yakima Basin 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 Yakima River CWMA continues to meet to discuss data gaps and prioritize survey needs.

The Yakima River CWMA members include:

- Benton County Weed Board (BCWB) - Marc Stairet, Sharlene Vowels
- Kittitas County Weed Board (KCWB) - Todd Davis, Marc Eylar
- Yakima County Weed Board – (YCWB) Dick Jacobson, Jeff Knutson

Washington State Department of Agriculture – (WSDA) Greg Haubrich, Bridget Simon
Washington State Department of Ecology – (WDOE) Jenifer Parsons
Washington State Department of Fish and Wildlife – (WDFW) Dave Heimer, Mike Keller
Washington State Department of Transportation - (WSDOT) James Morin
Washington State Noxious Weed Control Board - (WSNWCB) Alison Halpern
Washington State University IWCP - (WSU) Jennifer Andreas
Yakama Nation Wildlife, Range and Vegetation Resource Management Program – (Yakama Nation) Katrina Strathmann, Jason Newquist
(See Appendix C - Contact information for the Yakima River CWMA)

It should be noted that other agencies and organizations participate in CWMA meetings and projects as necessary. The omission of their name from this list of participants does not diminish their importance as weed management partners.

The CWMA members have weed management interests or responsibilities on adjacent and mingled lands associated with the tributaries and main-stem of the Yakima River in Yakima, Benton and Kittitas Counties. Weed distributions in one jurisdiction affect the ability of other land managers to manage weeds on lands they administer, especially in an aquatic environment.

By working together, the members of this CWMA 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.

WSDA is the lead for the Yakima River CWMA, as well as lead for the Yakima River Basin IAVMP. WSDA staff was in contact with all of the land managing agencies to coordinate survey and data collection efforts. WSDA processed and entered data into the State Weed and Pest (SWAP) data base. Marc Eylar from the Kittitas County Weed Board assisted in the processing of the data. Appendix E includes 7 maps - one map of the Yakima River Basin showing the distribution of all 5 targeted weed species, one map for the distribution of each of the 5 species and one map indicating approximately where rare plant species occur and that identifies endangered ecosystems using data from the Washington Department of Natural Resources Natural Heritage Program. While not included in this IAVMP, WSDA also collected data and points for other noxious weeds including wild four o'clock (*Mirabilis nyctaginea*), Oriental clematis (*Clematis orientalis*), knotweed (*Polygonum* spp.), Eurasian watermilfoil (*Myriophyllum spicatum*) and curly leaf pondweed (*Potamogeton crispus*). This data is available from WSDA.

The County Noxious Weed Control Boards share information on plant characteristics, distribution and control methods; develop and maintain landowner contact; and work with landowners and land managers to control weeds on both a short term and long term basis. Yakima County continues to manage the parrotfeather control project; Benton County continues to manage the flowering rush project; and Kittitas County manages the Fio Rito and Mattoon Lakes control projects along with the Washington Department of Fish and Wildlife (WDFW). All three county weed boards continue annual surveys to control and map noxious weed species.

Since the Yakima River Task Force/CWMA was formed, weed removal projects benefiting the Yakima River Basin, include:

- Mid 1990's and currently on-going: The Yakima County Weed Board works in cooperation with The Yakama Nation Wildlife, Range and Vegetation Resource Management Program, WSDA, WDFW and the WDOE. Annual surveys, monitoring and control treatments are carried out by canoe, by air boat and by walking along the Yakima River system. The noxious weeds targeted include purple loosestrife, yellow-flag iris, parrotfeather, *Phragmites*, Japanese knotweed, Oriental clematis and wild four o'clock. Biological controls for purple loosestrife are released within the main corridor of the river and in the nearby wetlands.
- 1998 and on-going: The Kittitas County Weed Board was part of the original Purple Loosestrife Task Force to control purple loosestrife along the Yakima River. KCWB staff conducts annual surveys to control and map noxious weed species in the Yakima River from the Teanaway River near Cle Elum down to the Roza Dam. Target species for this IAVMP include parrotfeather, purple loosestrife, yellow flag iris, flowering rush and non-native *Phragmites*. No parrotfeather, flowering rush or nonnative *Phragmites* sites were located during these surveys. Some funding for herbicide and surveys funding was provided by WSDA and through the grant with the Department of Ecology. Weed sites have been included in the State Weed and Pest (SWAP) data base.

2011 – a wild four-o-clock site was found and mapped in Kittitas County. This is the first record of this Class A weed in this County. The infestation is located along the Yakima River on a cattle ranch in the Yakima River Canyon. It covers approximately 2 acres and all known plants were treated in August of 2011 by weed board staff.

- 2009 - 2012: Benton County and Weed District #1 Weed Boards received the Aquatic Weeds Management Fund Grant, funded by the Department of Ecology, for flowering rush control. 96 miles of the Yakima River and canal shorelines were surveyed for flowering rush, and in 2010 all sites were treated. GPS points were taken and entered into the SWAP data base. In 2011 additional surveys of previously non-surveyed areas were conducted by staff from the Kittitas and Benton County Noxious Weed Control Boards and WSDA. These areas were selected as priorities for survey by the CWMA at its meeting in February, 2011. The data collected was entered into the SWAP database, and all data is currently available for sharing with all CWMA partners. A flowering rush distribution map is included in Appendix E.
- 2003 and on-going: Yakima County Weed Board manages the parrotfeather control project in the Buena/Zillah area, with grant funding and assistance from the Department of Ecology. Annual surveys, control and monitoring continue along a 2 mile stretch of the Yakima River that includes the small settling ponds and sloughs. GPS points were taken and are now part of the SWAP date base. A parrotfeather distribution map is included in Appendix E.

- 2010, 2011: Yakama Nation Wildlife, Range and Vegetation Resource Management Program collected GPS derived locations of infested areas and of noxious weed species present. Weed data and points were downloaded onto the SWAP data base.
- 2007 Fio Rito Lakes and Mattoon Lake Management Plans – CWMA partners working on this include the Kittitas County Weed Board, Department of Fish and Wildlife, Department of Ecology, WSDA and included a WSU Cooperative Extension Herbicide Screen. The management goal, depending on distribution, is to control or eradicate listed weed species that include Eurasian watermilfoil, purple loosestrife, yellow flag iris, and curly leaf pondweed.
- WSU Integrated Weed Control Program – biological controls were released for purple loosestrife. GPS data and points were taken, and will be entered into the SWAP data base as part of a cooperative project with WSDA to consolidate noxious weed location data with biocontrol release data.

III. The Yakima River Basin and Associated Lakes

The primary area of concern for the Yakima River CWMA is the Naches and Yakima Rivers, and Mattoon and Fio Rito Lakes. However, the CWMA is also cognizant of the fact that reducing and managing invasive plant species in the rivers also requires more aggressive management of these species in the irrigation canals that return water to the rivers. And, conversely, that keeping weeds out of the irrigation canals that flow from the river requires more aggressive measures in the rivers themselves.

The Yakima River is a 214 mile-long tributary of the Columbia River. It flows southeast from Keechelus Lake near Snoqualmie Pass to Richland, where it joins the Columbia River.

Its largest tributary is the Naches River. The Little Naches River and the Bumping River in the Cascade Mountain range join to create the beginning of the Naches. Following its descent from the mountains, the Naches is augmented by the Tieton River, and it then flows through valleys and towns with irrigated orchards, and flows into the Yakima River northwest of the city of Yakima. The Yakima River is a Heritage River and a Federal Waters River.

The Yakima River Basin comprises over 6,000 square miles, or nearly 4 million acres, in the south-central portion of the state and the diverse landscape includes rivers, ridges and mountains. The basin is bounded on the west by the glaciated peaks of the Cascade Mountains and the deep valleys with elevations over 8,000 feet. Bound on the east by the Rattlesnake Hills and on the south by Horse Heaven Hills, the elevation decreases to broad valleys and lowlands of the Columbia Plateau. Precipitation varies from 140 inches per year near the Cascade crest to about 7 inches per year in the eastern portion of the basin.

Private land ownership totals about 1.2 million acres. The U.S. government is the largest landowner with 1.5 million acres. Federal lands include the Wenatchee National Forest, the U.S. Army Yakima Training Center, a portion of the Department of Defense Hanford Nuclear Reservation and Bureau of Land Management lands. State, county and local governments own

more than 400,000 acres. The Yakama Nation reservation comprises about 15%, or 1,573 square miles of the Basin.

“The basin’s population is projected to increase about 45 percent by 2020. Most of the growth is anticipated to occur in the cities and communities along the river corridor and floodplains, from the city of Cle Elum downstream to the confluence with the Columbia River. Projected population growth in the subbasin will continue to put pressure on natural resources that provide habitat for fish and wildlife. Conversion of land and water resources to uses such as housing, roads, agriculture, industry, commercial development, recreation, energy, and related infrastructure means increased pressure on fish and wildlife habitat.”

“Six major reservoirs are located in the subbasin and form the storage component of the federal Yakima Project, managed by the Bureau of Reclamation. Total storage capacity of all reservoirs is approximately 1.07 million acre feet, total diversions average over 2.5 million acre feet. The construction and operation of the irrigation reservoirs have significantly altered the natural seasonal hydrograph of all downstream reaches of the mainstem and some tributaries.”
(Source: May 28, 2004, Yakima SubBasin final Plan)

Irrigated agriculture is the economic base of the area, and includes pasture, orchards, grapes, hops, hay and field crops. Seventy five percent of all hops grown in the U. S. come from the Yakima basin. The Valley’s wine industry has grown rapidly over the last few decades. The Yakima Valley is now a designated American viticultural area.

The Yakima River and its tributaries are also heavily used for recreational activities such as river rafting, fishing, and boating. Population growth in both urban and rural areas has led to increasing recreational use of the river, its tributaries and associated lakes.

The Yakima basin supports at least 48 species of anadromous, resident native and introduced species of fish, as well as more than 250 species of wildlife. Historically, the Yakima was one of the major producers of salmon and steelhead in the Columbia River Basin. Two fish species in the Yakima Basin are listed for protection under the Endangered Species Act – bull trout and mid-Columbia steelhead. (Source: May 28, 2004, Yakima SubBasin final Plan).

North and South Fio Rito Lakes are located along Interstate 82 approximately five kilometers south of Ellensburg, Washington, in Kittitas County. The two lakes were the result of gravel mining operations during the construction of Interstate 82 in the early 1970's. The northern lake is 47 acres and the southern lake 25 acres in size respectively. Land around the lakes is both private and state owned. The majority of the eastern and southern shoreline is private rangeland used for grazing; however, a single private residence is located on South Fio Rito Lake. Public access to the lakes is available along the northern and western shoreline of the lakes through a WDFW owned and maintained site. The access provides excellent bank access. There is no developed boat ramp on either lake; however, small boats can be launched at an unimproved boat launch on North Fio Rito and walk in access allows for carrying in small boats, canoes, or float tubes to South Fio Rito.

The Fio Rito Lakes and its surrounding habitats support a variety of fish, birds, and animals by providing nesting, forage, and cover. According to the Washington Department of Fish and Wildlife (WDFW) the resident fish species in the Fio Rito Lakes include rainbow trout, brown trout, black crappie, largemouth bass, pumpkinseed sunfish, yellow perch, largescale sucker, bridgelip sucker, common carp and chiselmouth. The Fio Rito Lakes are open all year to recreational angling. Most visits occur in early spring when the lakes are stocked.

Mattoon Lake is located near the town of Ellensburg in Kittitas. This 26 acre lake is relatively shallow, with a maximum depth of about four meters. It is a former gravel pit created when I-90 was constructed and is now owned entirely by WDFW. The lake is managed primarily as a put-and-take trout fishery that is open year-round. Both rainbow trout and brown trout are stocked periodically. Surveys have shown that the lake also contains additional warm water and non-game species including largemouth bass, pumpkinseed sunfish and northern pikeminnow (Eric Anderson, WDFW District Fish Biologist). Recreational access at Mattoon Lake is available to the public. A boat launch and dock are located on the west side of the lake. The north shoreline offers good access to shore anglers.

Mattoon Lake and its surroundings support a variety of recreational activities to humans. These include fishing, boating (no combustion motors), bird watching, and wildlife viewing. A public boat launch maintained by WDFW allows everybody to benefit from this beautiful resource.

Native and Rare Plants

Native Plants - Some riparian habitats within the Yakima River Basin are subject to periodic disturbance through annual flooding and scouring, and many native species are adapted to these conditions. Invasive plants can interrupt natural processes, for example, by occupying and artificially stabilizing habitat that would have been open for annual colonization by native plants each year. In this way, invasive plants can quickly have effects on native plant regeneration and populations.

Many native plants have important cultural uses to Native Americans. As an example, *Sagittaria* sp. (wapato or Indian potato) is found in wetlands in and around the rivers and tributaries of the Yakama Basin. Another commonly found wetland species, *Schoenoplectus acutus* (tule), continues to be used for weaving mats and other traditional Native American items.

Rare Plants

http://www.dnr.wa.gov/ResearchScience/Topics/NaturalHeritage/Pages/amp_nh.aspx

Appendix E: Rare plant species and endangered ecosystems map for Yakima River Basin

To protect our state's most imperiled resources, the Washington State Department of Natural Resources Natural Heritage Program provides accurate, up-to-date information to landowners, land managers, planners, and consultants. To aid the protection of rare species, they provide information that includes location information on rare species populations. However, distributing precise locations of vulnerable species could compromise their protection and compromise landowners' interests as well. For these reasons, precise locations of rare species populations are treated as sensitive information by the Natural Heritage Program.

In order to balance the interests of data users with species protection, the locations of rare plant and animal populations in the WNHP GIS Data Set are represented as generalized 'areas-of-concern'. Some known element occurrences have been removed from this data set before distribution to protect landowner interests. Locations of high-quality wetland and terrestrial ecosystems are not considered sensitive information. The WNHP GIS data set was used to produce a general map indicating rare plants and associated endangered ecosystems and the map is included in Appendix E.

Fish and Wildlife

The Yakima River Basin supports at least 48 species of anadromous, resident native and introduced species of fish, as well as more than 250 species of wildlife. Historically, the Yakima was one of the major producers of salmon and steelhead in the Columbia River Basin. Two fish species in the Yakima Basin are listed for protection under the Endangered Species Act – bull trout and mid-Columbia steelhead.

Fish Species and Stocks

The Yakima Subbasin Fish and Wildlife Planning Board identified six fish species and stocks to be considered as focal species for their subbasin planning. The table and all fish information listed below are directly taken from the May 28, 2004, Yakima SubBasin final Plan.

Focal species criteria	bulltrout	Steelhead Rainbow trout	Spring Chinook	Fall Chinook	Sockeye	Pacific lamprey
ESA Status	Threatened	Threatened	None	None	None*	None
Ecological Significance	Yes	Yes	Yes	Yes	Yes	yes
Cultural Significance		Yes	Yes	Yes	Yes	yes
Anadromous and/or Resident	R	A and R	A	A	A	A

*Sockeye were extirpated from the Yakima Subbasin ca 1920

Bull trout populations were listed as threatened under the ESA, effective July 10, 1998, in the Yakima Basin. WDFW identified nine distinct bull trout stocks in the Yakima Basin. Six are classified as “Critical,” one as “Depressed,” one as “Healthy,” and one as “Unknown”.

Spring chinook populations are greatly reduced from earlier times (pre-1850). Spring Chinook are being introduced from the Cle Elum Supplementation and Research Facility (CERSF). As a result, there are more spawning fish in the Upper Yakima.

“**Fall chinook** populations have also been dramatically reduced from pre-1850s abundance levels. There are two genetically distinct stocks recognized in the Yakima Basin. 7 mainstem stock is found throughout the lower Yakima River (roughly the lower 100 miles), and a stock is endemic to the Marion Drain, a man-made drainage ditch for the Wapato Irrigation Project (WIP). Environmental conditions have changed since the early 1930s, which has resulted in decreased production of fall chinook and a shift in juvenile out-migration shifting to earlier in the year.”

“**Steelhead** was listed as threatened by the ESA, effective May 24, 1999 in the Yakima Basin. Steelhead and rainbow trout are widely but thinly distributed across the Yakima Basin and have been dramatically reduced from pre-1850s abundance levels. Production of steelhead within the Yakima Basin is heavily weighted towards Satus and Toppenish Creeks, which have healthy populations. Anadromy in rainbow trout populations, and the overall size of the population in the Upper Yakima River is presently much decreased from historic levels.”

“The historical total run size of Yakima River **sockeye salmon** has been estimated at either 100,000 or 200,000. Because sockeye salmon were extirpated from the Yakima Subbasin so long ago, little is known about genetic or life history variation that may have occurred in individual stocks or populations.”

“**Pacific lamprey**, once an important food source for Native Americans in the subbasin, is a Washington State species of concern and is under consideration for ESA listing by USFWS. They are currently found in the mainstem Yakima and Naches Rivers, but fewer than 15 have been observed in the Yakima system since 1992.” (Source: May 28, 2004, Yakima SubBasin final Plan.)

The Yakima River Basin is designated as critical bull trout habitat. It is important to start a continuous connection of bull trout habitat “ between lakes and reservoirs and mainstem rivers, including the Columbia River. Fish habitat enhancement actions would help create improved spawning, incubation, rearing, and migration conditions for all salmonid species in the Yakima Basin.” (Source: April 2011, Yakima River Basin Study, USBR and DOE)

Wildlife Habitats and Species

The following wildlife species were selected in the 2004 Yakima Subbasin Final Plan because of their status as listed as threatened and endangered at either the federal or state level, cultural significance, and/or their value as indicators of overall habitat conditions. Planners also felt that their habitats (not shown in this table) are ecologically important for healthy fish and wildlife populations.

The table below is modified from the 2004 Yakima Subbasin Final Plan to show the federal or state listed wildlife species in the Yakima River Basin.

Common Name	Status Federal	Status State	Native species	PHS**	Game Species
Western toad	SC	C	Yes	Yes	No
Sandhill crane		E	Yes	Yes	No
White-headed woodpecker		C	Yes	Yes	No
Lewis’ woodpecker		C	Yes	Yes	No
Western Gray squirrel	SC	T	Yes	Yes	No
Mule deer			Yes	Yes	Yes

Sage grouse	C	T	Yes	Yes	No
Brewer's sparrow			Yes	No	No
Yellow warbler			Yes	No	No
Mallard			Yes	No	Yes
American beaver			Yes	No	Yes

* C = Candidate; SC = Species of Concern; T = Threatened; E = Endangered

** Priority Habitat Species (Washington Department of Fish and Wildlife)

IV. Problem Statement – Yakima River Basin IAVMP

The purpose of the Yakima River Basin IAVMP is to develop a coordinated control effort of invasive, aquatic noxious weed species found in the Yakima River Basin. An Integrated IAVMP will ensure the most effective use of limited resources across management jurisdictions, resulting in more thorough control. This IAVMP will also act as a working guide for future control activities.

Aquatic noxious weeds

Data collection and observation over the years have led the CWMA to conclude that while it is necessary to collect data for all noxious weeds within the project area, this IAVMP will focus limited resources on five problem species to produce the largest long-term benefit to the Naches and Yakima Rivers, their associated lakes and to the Yakima Basin.

Flowering rush (*Butomus umbellatus*)

Phragmites, nonnative genotype, (*Phragmites australis* ssp. *australis*)

Parrotfeather (*Myriophyllum aquaticum*)

Purple loosestrife (*Lythrum salicaria*)

Yellow flag iris (*Iris pseudacorus*)

These five species were chosen both because of the extensive damage they will do if they are not controlled, and because of the potential for effective control measures that can reduce and prevent harm if taken in a timely manner.

The highest priority will be to eradicate small populations of new invasions of parrotfeather, nonnative *Phragmites* and flowering rush. Parrotfeather and *Phragmites* are to be controlled and eradicated when possible anywhere they are found in the river system. Currently flowering rush has not been found above the Prosser Dam pools and will be eradicated if found in future surveys.

Purple loosestrife and yellow flag iris are fairly widespread, but there are still areas where they do not occur or are rare. The long term goal for these species is to stop their spread, prevent their occurrence in currently un-infested areas, and to progressively reduce existing populations, especially in areas where there are large infestations.

During surveys and control work in the Yakima River basin, sites and data points are taken for other noxious weeds, including but not limited to: wild four o'clock, Oriental clematis, knotweed, Eurasian watermilfoil and curly leaf pondweed. Control work or eradication is carried out as necessary.

Aquatic noxious weed impacts

It is very important to note that by removing these invasive noxious weed species, the CWMA will produce a lasting improvement in the habitat for native plant and animal species. In addition, reducing or eliminating these invasive plants will serve to benefit the agricultural economy of the entire Yakima Basin.

It is often difficult to imagine or quantify these benefits, but it is clear from experience that lack of effective countermeasures against invasive plant species results in devastating harm to vital ecosystems that support fish, wildlife, recreation and agriculture.

Irrigated agriculture is the economic base of the area. The Yakima River and its tributaries are heavily used for recreational activities such as river rafting, fishing, and boating. Population growth in both urban and rural areas has led to increasing recreational use of the river, its tributaries and associated lakes.

Protection of agriculture is vitally important to the economy of the Yakima River Basin. Irrigated agriculture requires the free movement of water both from the river into irrigation canals and from the irrigation canals back to the river. Clogged canals can reduce the efficiency of agricultural production and pose serious problems for orchardists and farmers. To protect agriculture, it is necessary to control invasive weeds throughout the river and its associated canals, since they are all connected, and moving water carries infestations wherever the water flows.

Recreational uses of the rivers and their associated lakes are also threatened by reduced access to shorelines, entanglement of fishing gear in submersed weeds, reduced fish populations and reduced native wildlife.

The Yakima River, its tributaries, associated lakes and its surrounding agricultural communities are harmed by invasive aquatic and riparian plant species that out-compete native vegetation, disrupt fish and wildlife habitat, reduce recreational opportunities, and pose a threat to irrigation. Fio Rito Lakes and Mattoon Lakes and their surrounding habitats support a variety of fish, birds, and animals by providing nesting, forage, and cover. These associated lakes also support a variety of recreational activities to humans. These include fishing, boating (no combustion motors), bird watching, and wildlife viewing.

Invasive aquatic and riparian plants can clog lakes, streams and irrigation canals, reduce oxygen levels, reduce food sources for fish and wildlife, and endanger rare and threatened native plants and fish. If these threats are not addressed, the damage will continue to mount, and the cost of remediation will continue to rise.

Research suggests that in areas with flowering rush populations, there will be a negative impact to the restoration and maintenance of native salmonid habitat in Montana and in the Pacific Northwest. Flowering rush stands create the habitat necessary for introduced fish species (small and large mouth bass, yellow perch, northern pike) that are considered predators to cutthroat trout, bull trout and juvenile salmon (2009, Rice and Dupuis).

Preserving the integrity of the Yakima River system is vital to the state's efforts to protect and restore threatened and endangered salmon and other native fish. Invasive weeds that alter the river system can cause changes in river flow and temperature and displace native vegetation that provides habitat for food sources that fish require.

V. Management Goals

The overall long term goal of this plan is to adapt as necessary to accelerate and coordinate control measures for the five named aquatic weed species. The primary areas of concern for the Yakima River CWMA are the Naches and Yakima Rivers, and the associated Fio Rito and Mattoon Lakes.

The CWMA members agree that the best approach for a coordinated control effort of aquatic noxious weeds in the Yakima River Basin is to:

- Continue to meet regularly to make decisions that benefit the river basin.
- Share expertise and resources among jurisdictions as available and as necessary.
- Continue to monitor control strategies already in place, and modify as necessary.
- Apply for funding to implement on the ground projects.

The Yakima River Basin IAVMP will focus to achieve several goals through aquatic noxious weed management. They include:

1. To preserve and help restore via natural processes the remnant riparian communities, wetlands, estuarine and freshwater aquatic systems throughout the full length of the Yakima River, its tributaries, associated lakes and floodplain by the removal or suppression of targeted invasive plant species. This includes: preserving the riparian community with a focus on plant species composition by removing targeted invasive plants; preserving and restoring natural river and slough hydrology to the extent that the removal of invasive species can affect these processes; and alleviating bank instability problems where targeted invasive species are present and having a detrimental effect. Special attention will be given to protecting and enhancing habitat essential to rare or endangered species that occur in this community.
2. Aggressive Early Detection Rapid Response (EDRR) when a new species is found, and when current weeds are found outside of areas where it is already known or already wide spread. The highest priority will be to eradicate small populations or new invasions of parrotfeather, nonnative *Phragmites* and flowering rush. The second priority is to continue to address the already widespread populations of purple loosestrife and yellow flag iris by continuing a long term control plan of containment and use of education strategies.

3. The State Weed and Pest (SWAP) database was developed using Microsoft Access and ESRI ArcGIS software to house plant survey and inventory data throughout the Yakima River Basin and Washington State. This data is available to all CWMA partners and has been made available in a generalized form to the citizens of Washington State.
4. Coordinate the collection of all pertinent survey and inventory data for the Yakima River Basin. CWMA partners will continue to collect data for all noxious aquatic weeds occurring within the system with a particular emphasis on the 5 target species listed above and WSDA will enter the data into SWAP.
5. Produce and use distribution maps for control guide lines. Maps - Appendix E.
6. The continued use of biological control agents on purple loosestrife in heavily infested areas. Kittitas and Yakima Counties also release biological controls for Dalmatian toadflax.

VI. Integrated Pest Management (IPM)

Aquatic weed control in the Yakima River Basin will follow the guidelines of Integrated Pest Management as defined in Washington State law. IPM and Integrated Aquatic Vegetation Management Plan (IAVMP) 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 plants legal status (in regards to the noxious weed list) and to know your management goals for the site.

There are at least two definitions of IPM in Washington State Law.

Chapter 16-752 WAC defines IPM as 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 costs, greater ease of maintenance and lower environmental impacts from control activities. (References listed).

VII. Aquatic Noxious Weeds in the Yakima River Basin

These five invasive aquatic weed species were selected as a consensus decision by members of the CWMA. These species were selected based both on their threat to the Yakima River system, and on the current known distribution. Ecology prefers no more than 5 species be included in this plan.

Flowering rush (*Butomus umbellatus*)
Phragmites, nonnative genotype (*Phragmites australis* ssp. *australis*)
Parrotfeather (*Myriophyllum aquaticum*)
Purple loosestrife (*Lythrum salicaria*)
Yellow flag iris (*Iris pseudacorus*)

The highest priority will be to eradicate small populations of new invasions of parrotfeather, nonnative *Phragmites* and flowering rush. Currently there are no known flowering rush populations above the Prosser Dam pools. Parrotfeather and *Phragmites* are to be controlled and eradicated when possible anywhere it is found in the river system.

Purple loosestrife and yellow flag iris are fairly widespread in some parts of the Yakima River Basin, however, there are still areas where they do not yet occur. The goal is to contain them and hopefully reduce their populations gradually over time. Purple loosestrife has a somewhat effective biological control, but yellow flag iris has few if any natural enemies.

Management methods for each of these five species will be carefully chosen to protect water quality and to prevent harm to the river system, its associated lakes and wetlands and irrigated agriculture.

Appendix A of this plan contains a Weed Management Profile for each species. Each Weed Management Profile contains specific information on plant identification, distribution, impacts

and a list of control options that can be considered for each species, depending on the control site. The Weed Management Profiles also reference any projects undertaken in the Yakima River Basin for that species.

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

Appendix A – Weed Management Profiles

1. Flowering rush (*Butomus umbellatus*)
2. Parrotfeather (*Myriophyllum aquaticum*)
3. *Phragmites*, nonnative genotype, (*Phragmites australis* ssp. *australis*)
4. Purple loosestrife (*Lythrum salicaria*)
5. Yellow flag iris (*Iris pseudacorus*)

VIII. Action Plan

In addition to the control projects already underway in the Yakima River Basin, the CWMA recognizes the importance of long term control strategies, and realizes they will continually change. The CWMA members 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.

This Action Plan will continue to use and develop the strategies below:

1. To continue to meet as necessary to share resources and information and to review what is working and what is needed. The weed removal projects already undertaken by the CWMA will continue. The data, maps and information generated from these projects will be used to update the overall plan.
2. The Yakima River CWMA recognizes the importance of long-term control strategies for each targeted weed species. Management methods for each of these five species will be carefully chosen to protect water quality and prevent harm to the river system, its associated lakes and wetlands, and irrigated agriculture.
3. The Weed Management Profiles are a species specific resource for past and current projects and they are a guide for long-term control when necessary. Each Weed Management Profile will cover all control options, using Integrated Pest Management as a coordinated decision making and action process. The most appropriate control methods and strategy will be used in an environmentally and economically sound manner to meet programmatic pest control objectives.

The range of available control options or a combination of these options suitable for site specific control include: Prevention (to include Early Detection Rapid Response), Mechanical, Cultural, Chemical and Biological Controls.

Updating the Weed Management Profiles as necessary is an efficient way of keeping this Plan current with new information on weed distribution or control. When a new noxious weed species

is added for control in the Yakima River Basin a new Weed Management Profile will be created and attached. Appendix A contains all Weed Management Profiles.

4. Funding directly affects the ability to implement on-the-ground projects. This IAVMP is a working document about the efforts of the Yakima River CWMA to gather information about weed distribution and impacts to the Yakima River Basin and to outline and implement effective control methods. This IAVMP can be used as a resource for granting organizations to verify the use of their funding.

Summary

The implementation of this plan will produce important, long term benefits to the health of the Yakima River system, the recreational opportunities available in the river, its associated lakes and tributaries, and to the agricultural economy of the area. Effectively managing invasive aquatic noxious 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 Yakima River Basin CWMA continues to work through these obstacles through cooperative action and planning. Decisions are made to protect the whole basin.

The future goals of this Yakima River Basin IAVMP include:

- 1 - WSDA will continue to coordinate the collection of survey and inventory data to include all noxious weeds, with a particular emphasis on the targeted species of parrotfeather, purple loosestrife, yellow flag iris, flowering rush and non-native *Phragmites*. The State Weed and Pest (SWAP) database will be continually updated and made available to all CWMA partners.
- 2 – WSDA will identify additional survey needs by holding one or more meetings of the Yakima River CWMA to discuss data gaps and to prioritize survey needs. The CWMA will identify areas that need to be surveyed, identify resources available for that work and identify the resources that would be needed. Necessary equipment will be purchased for priority survey work.
3. Apply for funding to implement on the ground projects.

References, Literature Cited

1. April 2011, Yakima River Basin Study, US Bureau of Reclamation and DOE, <http://www.usbr.gov/pn/programs/yrbwep/2011integratedplan/plan/integratedplan.pdf>
2. May 28, 2004, Yakima SubBasin final Plan, Prepared for NW Power and Conservation Council, Prepared by Yakima Subbasin Fish and Wildlife http://www.nwcouncil.org/fw/subbasinplanning/yakima/plan/0_ExecSumm.pdf
3. December 2006, Integrated Aquatic Plant Management Plan for the Chehalis River Basin, WDFW, WSDA.

4. Sept 2007, Fio Rito Lakes Management Plan, WDFW, Kittitas County
5. April 2007, Matoon Lake Management Plan, WDFW, Kittitas County
6. Washington State Department of Agriculture/IPM
<http://agr.wa.gov/PlantsInsects/IPM/>
7. Washington State Department of Ecology – IPM Plan for Freshwater Emergent Noxious Weeds and Quarantine Listed Weeds
http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/Noxious%20Emergent%20IPM.pdf
8. Integrated Aquatic Plant Management Plan for the Chehalis River Basin
<http://graysharbor.wsu.edu/weeds/documents/INTEGRATEDAQUATICPLANTforweb.pdf>
9. Washington State Noxious Weed Control Board
<http://www.nwcb.wa.gov/>

Appendices

Appendix A – Weed Management Profiles

1. Flowering rush
2. Parrotfeather
3. *Phragmites* (nonnative genotype)
4. Purple loosestrife
5. Yellow flag iris

Appendix B MOU - Under development

Appendix C CWMA Contact Information

Appendix D 2012 Noxious Weed List <http://www.nwcb.wa.gov>
 WSDA Quarantine Lists
<http://agr.wa.gov/PlantsInsects/PlantQuarantines/PlantQuarantines.aspx>

Appendix E Maps

- Yakima River Basin with 5 targeted weed species
- Flowering rush distribution map
- Parrotfeather distribution map
- *Phragmites* distribution map
- Purple loosestrife distribution
- Yellow-flag iris distribution map
- Rare plant species and endangered ecosystems map

APPENDIX A-1
Yakima River Basin IAVMP

WEED MANAGEMENT PROFILE
Flowering rush (*Butomus umbellatus*)

DISTRIBUTION AND IMPACTS

General Distribution in Washington State

<http://agr.wa.gov/PlantsInsects/Weeds/WeedMapLists/docs/FloweringRush.pdf>

Appendix E – distribution map of flowering rush in the Yakima River Basin

Flowering rush has a limited distribution in Washington. As of 2011 it is known from Whatcom County in western WA, and from Benton, Franklin, Stevens, Pend Oreille and Walla Walla Counties in eastern WA. Flowering rush is currently a Class A noxious weed in Washington.

In the Yakima River Basin, it was first discovered in Benton County in 2003 during a weed/plant survey along the Yakima River. Current plant populations along the river are from just above the Prosser Dam continuing down to the Columbia River. No flowering rush is found above the Prosser Dam pools. In the Columbia River there are scattered sites from the Yakima/Columbia confluence down to Wallula Gap.

Impacts

Research suggests that in areas with flowering rush populations there will be a negative impact to the restoration and maintenance of native salmonid habitat in Montana and in the Pacific Northwest. Flowering rush stands create the habitat necessary for introduced fish species (small and large mouth bass, yellow perch, northern pike) that are considered predators to cutthroat trout, bull trout and juvenile salmon (2009, Rice and Dupuis).

Flowering rush can rapidly disperse and colonize new areas through rhizome fragments and rhizome buds, allowing it to form dense stands in previously un-vegetated areas. Flowering rush can impact irrigation systems, and wetlands. It will colonize the littoral zone of freshwater lakes and slow moving river edges. This plant may hinder recreational uses such as swimming, fishing and boating. It can impact the industrial uses of shallow water. Because this species has monotypic tendencies, it may affect native shoreline species or other shallow water emergent plants, possibly altering aquatic food webs.

The Yakima River is a Heritage River, a Federal Waters River, and an important salmon stream. Its fluctuating water levels may provide an ideal habitat for the spread of this invasive plant. Fluctuating water levels facilitate flowering rush colonization and increase in stand abundance. Draw-downs to un-vegetated sediments provide ideal sites for new establishment from rhizome bulblets and lateral rhizome fragments. In addition, the warmer water temperatures of exposed sediment or the water/sediment interface at shallow depths promotes sprouting and growth of bulblets, rhizome fragments and any seeds. Warmer sediment and shallow water column

temperatures also promote new sprouting from established rhizomes and lead to stand thickening.



Flowering rush flower. R - Plants along the Yakima River in Benton Co. 2009. M. Stairet.

PLANT CHARACTERISTICS

Flowering rush is not a true rush. This emergent, aquatic perennial is considered a wetland obligate and grows only in freshwater habitats, where it roots in the mud and grows in shallow waters to a depth of about 10 feet. It is most often in wetlands and along shoreline of lakes and slow-moving rivers.

Flowering rush has both an emerged and completely submerged form.

The emerged form supports flower stalks that can grow up to 3 feet above the water and bears a single cluster of white to pink flowers, each with 3 petals and 3 sepals. Not all plants flower, so it is important to also recognize the leaves.

The emergent leaves are rigid, and can be 6 feet long. They are 3-sided at the base and then flatten out towards the tip. They have a distinctive, slow spiral, or twist. Leaves can grow above the water's surface or can be completely submersed.

The submerged form has lax leaves, up to 10 feet long and they can float on the surface.

Flowering rush reproduces both by seed and clonally through vegetative inflorescence bulbils and rhizome bulblets (also called bulbils). The very small seeds are in follicles, and long distance spread is attributed to seed dispersal. It can also spread by small scale lateral rhizome fragments. Warmer sediment and shallow water column temperatures also promote new sprouting from established rhizomes and lead to stand thickening.

Flowering rush has an extensive monopodial rhizome. "The rhizomes are extremely friable. Lateral rhizome buds develop a constriction between the bud and main rhizome itself. This constriction allows spontaneous release of lateral rhizome structures by flowing water, waves, ice scour, passing boats, waterfowl, animals and any other disturbance of the littoral zone and the rhizome mat. The same disturbances, including waterfowl feeding on the rhizomes, break the rhizomes into pieces. These rhizome propagules are buoyant and this facilitates their dispersal. "

(Marie-Victorin 1938 as cited in 2009, Rice and Dupuis).

MANAGEMENT AND CONTROL OPTIONS

Integrated Pest Management, as defined by RCW 17.15, is a coordinated decision making and action process that uses the most appropriate pest control methods and strategies in an environmentally and economically sound manner to meet programmatic pest control objectives. When following this IAVMP, site-appropriate control methods must be used.

Quarantine List

Plant quarantines are a preventative measure to keep noxious weed species introduced as garden or aquatic ornamental plants from spreading to natural areas. All Class A noxious weeds are on this list (WAC 16-752-610). Flowering rush is known and sold as a garden ornamental.

As a wetland and aquatic quarantine species, it is illegal to transport, buy, sell, offer for sale, or to distribute 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 (WAC 16-752-505). As a Class A noxious weed eradication is required by all landowners.

WEED MANAGEMENT PROJECTS

2009 – 2012, The Benton County Weed Board received an Aquatic Weeds Management Fund Grant from DOE for a flowering rush control project. In 2009, surveys began and flowering rush was found scattered for about 96 miles of river and canal shorelines. A total of about 6 miles (3 river miles on each side) were treated. GPS points and data were taken for flowering rush and other weed species were noted. In 2010 all plants were treated. CWMA member agencies conducted surveys, provided GPS units and air boats with crews.

WSDA staff was in contact with all of the land managing agencies to coordinate survey and data collection efforts. This information was entered into the State Weed and Pest (SWAP) database, and is available to all CWMA members.

The Yakima River CWMA continues to meet to discuss data gaps and prioritize survey needs for flowering rush. WSDA continues to provide oversight and staff for the project. The surveys continue from the Yakima/Benton County line to the Columbia River. The CWMA members met several times and held several phone conferences in 2011. For 2012, control is planned to start in July above the Prosser Dam pools and behind all diversion dams for irrigation districts.

Research

- **2008-2011**, Emergent growth herbicide trails at Silver Lake, Whatcom Co (T. Miller, WSU).
- **2010**, Emergent growth, greenhouse shading trials (S. Link)
- **2011**, Submersed growth herbicide field trials (J. Parsons, DOE).

- **2012**, Phone conference (source: J. Parsons, DOE) with various states, Army Corps to discuss and better understand flowering rush control strategies around the country. These strategies include:
 - **For submersed plant growth**, current recommendations for some sites are to try repeated treatments with contact herbicides diquat or endothall (or combinations) to try to wear out the plant. Several additional product combinations were tried in Flathead Lake, MT last summer. Results from those plots (expected summer, 2012) could yield insight into other methods that may hold promise.
 - **Summer 2012 planned trials**, using repeated treatments of the contact herbicide diquat on submersed plants in Silver Lake (Whatcom Co).
 - **Bottom barrier**, 2012, hope to use on the flowering rush patches upstream of Prosser Dam. Benton Co plans to spray other large patches.
 - **Columbia River survey**, plan to survey and control from the downstream end of the populations in the Columbia River.

CONTROL METHODS

Listed below are a range of options that may be suitable for site specific control of flowering rush. These control methods are listed in the following order, and include: Prevention, including Early Detection Rapid Response (EDRR), Mechanical, Cultural, Chemical and Biological Controls.

Prevention, Early Detection, Follow-Up

Flowering rush has a limited distribution in our state. Early detection and prevention is still a control option in some areas. Flowering rush is considered a garden ornamental however it is listed on the Washington State Quarantine list making it illegal to sell or transport plants. EDRR post-cards were produced to help with identification and to educate about the negative impacts of this plant.

- Familiarize yourself with plant characteristics and impacts.
- Do not buy flowering rush and do not plant this species in your garden.
- For larger sites, develop a long term Integrated Pest Management Plan.

In the Yakima River Basin, surveys continue along 96 miles of Yakima River shoreline in Benton County from the Yakima/Benton County line to the Columbia River. Small infestations are spot sprayed with glyphosate.

Mechanical Control

Digging or suction dredging by hand as a control option for isolated or individual plants in areas of low density populations. This method is not used in the Yakima River.

To be successful, the entire rhizome must be removed without dislodging the rhizome bulbs. Even a slight bottom disturbance can cause the rhizome bulbils to release. Land disposal of plant material is necessary. No plants or sediments can be returned to the water.

Hand pulling has largely been ineffective.

Covering with bottom barrier will work so long as the barriers are properly installed.

Shading trials on emergent growth suggest this may control flowering rush, but it will not kill the plant.

Chemical Control

For specific information on herbicides and recommendations for control, please see the [Pacific Northwest Weed Management Handbook](#).

Please note, in Washington State, aquatic herbicides are all restricted use. Any person purchasing or applying aquatic herbicides in Washington State is required to have a valid Washington State Applicators License with all applicable endorsements. In addition, if herbicides are applied in areas where they may enter the water, coverage under an applicable National Pollutant Discharge Elimination System (NPDES) permit is required. See the Washington State Department of Ecology website for more information on permits and for other legal requirements necessary to apply aquatic herbicides in Washington State.

http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/noxious_index.html

Chemical control of flowering rush in the Yakima River is very limited, especially for plants that are mostly submerged. Imazapyr and glyphosate are for use on emergent plants in aquatic situations, but neither is 100% effective. While imazapyr offers somewhat better control than glyphosate, it cannot be used near irrigation water outtakes.

Imazapyr – works best on emergent growth. At least 2 feet of leaf are required to be above water, the more the better. Imazapyr offers somewhat better control than glyphosate, but imazapyr cannot be used near irrigation water outtakes.

Glyphosate – a 5% solution of glyphosate with a suitable surfactant provides fairly good control in some areas and is the only chemical option available for use near irrigation water outtakes.

Benton County Herbicide Treatments:

- 2010 – 100% of the plants were treated in the Yakima River by staff from the Benton County Noxious Weed Control Board (BCNWCB). BCNWCB started with a 2% solution of glyphosate and a suitable surfactant and later switched to a 5% solution of glyphosate with a suitable surfactant. Treatments were conducted from mid-July to mid-August.
- 2011 – The BCNWCB treated plants from Benton City to the Columbia River with a 5% solution of glyphosate. This resulted in very little control, estimated at less than 50%. Fewer plants produced flowers than in 2010 however it should be noted that plants do not tend to flower annually anyway.
- 2012 – The BCNWCB plans to implement control measures behind all irrigation district diversion dams using a 5% solution of glyphosate starting in July when the water level in the river decreases.

Biological Control

Jennifer Andreas, Director of the Washington State University IWCP has investigated the potential for classical biocontrol research. This tends to be a very long term process; however the consensus from the CWMA and others in the Pacific Northwest working on flowering rush is that this option would be worth exploring further.

- Two insects have been identified as being host specific for flowering rush.
- Jennifer Andreas has been in contact with CABI scientists who have estimated it would take \$40,000 to \$60,000 to initiate a research program.
- A consortium is being organized to explore funding options.

LITERATURE, REFERENCES CITED

1. Washington State Noxious Weed Control Board – flowering rush,
<http://www.nwcb.wa.gov/detail.asp?weed=16>
2. Washington State Quarantine List:
<http://www.nwcb.wa.gov/searchResultsQuarantine.asp>
<http://www.nwcb.wa.gov/siteFiles/ProhibitedPlants.pdf>
3. Rice, P. M. and V. Dupuis, 2009. Flowering Rush: An Invasive Aquatic Macrophyte Infesting the Headwaters of the Columbia River System.

APPENDIX A-2
Yakima River Basin IAVMP

WEED MANAGEMENT PROFILE
Parrotfeather (*Myriophyllum aquaticum*)

DISTRIBUTION AND IMPACTS

General Distribution in Washington State

<http://agr.wa.gov/PlantsInsects/Weeds/WeedMapLists/docs/Parrotfeather.pdf>

Appendix E – distribution map of parrotfeather in the Yakima River Basin

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 with the ability to thrive in some natural areas.

In Washington State, parrotfeather is currently listed as a Class B noxious weed. Parrotfeather is found mainly on the west side of the state, in freshwater lakes, ponds, streams and canals. It tends to colonize slow moving or still water, and it appears to be adapted to high nutrient environments. 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 or rivers and lake shores, so it is well adapted to moderate water level fluctuations.

Parrotfeather populations are found in the southwest Washington portion of the Columbia River. It is also found throughout the drainage system in the Longview/Kelso area, in drainage ditches in Wahkiakum County, and was discovered growing in the Chehalis River in 1994. Herbarium records identify parrotfeather in Grays Harbor from the 1940's.

In the Yakima River Basin, parrotfeather has a very limited distribution in Yakima and Benton Counties. Asotin County is the third site of parrotfeather in eastern Washington.

The original Yakima River Basin site was located in 2002 in Yakima County in a WDFW pond along I-82 in the Buena/Zillah area (between exits #50 and 52). That drain starts in Buena, comes down into the Yakima River area and ponds. Parrotfeather is currently found in small settling ponds and sloughs along a 2 mile stretch along the Yakima River.

Two sloughs drain into the Yakima River, and in the past, one parrotfeather plant was found. That plant was dug up and removed. Currently there are no known sites in the Yakima River.

Parrotfeather was eliminated from several ponds, and overall there is an estimated 90% reduction of plants. However, some sites did increase this past year (2011-12). Surveys and control efforts continue.

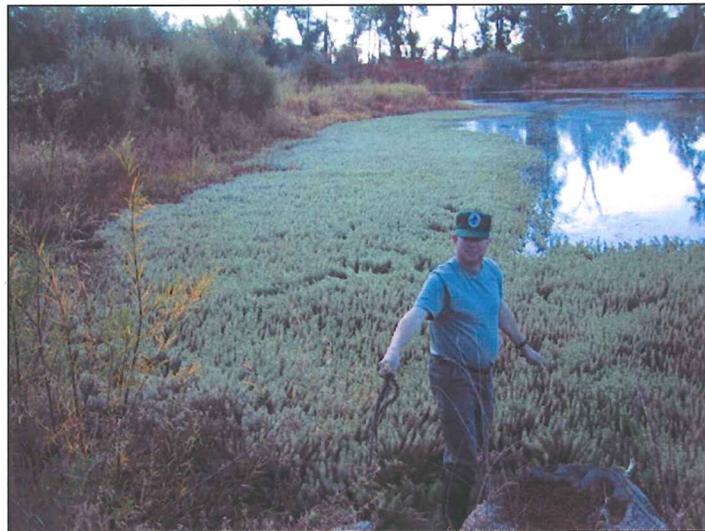
Benton County: Parrotfeather was identified in 2010 site visit to ponds/drain area after a landowner called. In 2011, the landowner treated the site with glyphosate. In 2012, Benton County Weed Dist #1 plans to treat the site with herbicide provided by a CWMA partner.

Impacts

Parrotfeather threatens the emergent and aquatic ecosystems. 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 the pH and decreases available oxygen, which can negatively affect many desirable species. 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 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. Parrotfeather can have a serious impact on salmonids since it colonizes and occupies fry rearing habitat.

Plant fragments are easily spread and have the potential to colonize the majority of the associated ponds, sloughs and backwater areas of the Yakima River basin if no control action is taken.



Parrotfeather sites from Yakima County. Photos from J. Parsons

L – ditch near Buena right after discovery.

R – 2002 at the original pond site.

PLANT CHARACTERISTICS



Parrotfeather gets its 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. 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. 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.

MANAGEMENT AND CONTROL OPTIONS

Integrated Pest Management, as defined by RCW 17.15, is a coordinated decision making and action process that uses the most appropriate pest control methods and strategies in an environmentally and economically sound manner to meet programmatic pest control objectives. When following this IAVMP, site-appropriate control methods must be used.

Quarantine List

Plant quarantines are a preventative measure to keep noxious weed species introduced as garden or aquatic ornamental plants from spreading to natural areas. All Class A noxious weeds are on this list (WAC 16-752-610).

Because of the impacts to natural area waterways, parrotfeather is a State Department of Agriculture (WSDA) quarantine species – it is illegal to buy, sell or offer this plant for sale in Washington.

Parrotfeather is sometimes sold as an aquarium plant, or for use in back yard ponds. As a wetland and aquatic quarantine species, it is illegal to transport, buy, sell, offer for sale, or to distribute 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 (WAC 16-752-505). As a Class B noxious weed control is required by all landowners.

WEED MANAGEMENT PROJECTS

2003 – 2007 Yakima County applied for an Aquatic Weeds Management Fund Grant from DOE for parrotfeather control. Sites were noted with GPS coordinates and data points, and maps were produced. This information was entered into the State Weed and Pest (SWAP) database, and is available to all CWMA members. The Yakima County weed board continues to manage control strategies for parrotfeather with surveys, site monitoring and controlling any parrotfeather sites.

Overall it is estimated that parrotfeather sites have been reduced by about 90%. Parrotfeather has been eliminated from several ponds in Yakima County. One drain site was reduced to about 5 – 6 plants. However this past year about 100 new plants were found at the site.

2010 –Benton County identified a parrotfeather site. The landowner controlled in 2011. Benton Weed Dist #1 will chemically control in 2012.

CONTROL METHODS

Listed below are a range of options offering a combination of control strategies that may be suitable for site specific control of parrotfeather. These control methods are listed in the following order, and include: Prevention (including Early Detection Rapid Response), Mechanical, Cultural, Chemical and Biological Controls.

Prevention, Early Detection, Follow-Up

Parrotfeather has a very limited distribution in the Yakima River Basin. Early detection and prevention is still a control option. Since parrotfeather is known to occur in backyard ponds in the Yakima area, educational material is planned. Post cards will be produced to help landowners with identification and to educate them about the negative impacts of this plant. The “Garden Wise” handout produced by the Washington State Noxious Weed Board includes options to use instead of parrotfeather.

- Familiarize yourself with plant characteristics and impacts.
- Do not buy parrotfeather and do not plant this species in your garden.
- For larger sites, develop a long term Integrated Pest Management Plan.

Mechanical Control

In the past, one parrotfeather plant was found in the Yakima River. That site was treated with herbicide, and the plant was hand-pulled and removed from the site. That site is monitored. No subsequent plants have been found. Other plants have been hand-pulled during cold weather.

Chemical Control

For specific information on herbicides and recommendations for control, please see the [Pacific Northwest Weed Management Handbook](#).

Please note, in Washington State, aquatic herbicides are all restricted use. Any person purchasing or applying aquatic herbicides in Washington State is required to have a valid Washington State Applicators License with all applicable endorsements. In addition, if herbicides are applied in areas where they may enter the water, coverage under an applicable National Pollutant Discharge Elimination System (NPDES) permit is required. See the Washington State Department of Ecology website for more information on permits and for other legal requirements necessary to apply aquatic herbicides in Washington State.

http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/noxious_index.html

Chemical control was initially conducted by the Yakima County Weed Board using glyphosate. Currently, chemical control is with a 1% solution of imazapyr, using a suitable aquatic surfactant. Small infestations are spot sprayed with glyphosate.

Biological Control

Biological control is not currently an option for parrotfeather in the Yakima River Basin as the sites are small and scattered and eradication is the goal.

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 feasible as they are not permitted for use in waterbodies where inlets and outlets cannot be screened to prevent their escape. Also due to the high tannin content of parrotfeather, it is found to be unpalatable to the grass carp. (Source: 2006 Chehalis River IAVMP Plant Profile).

References

1. 2006, Chehalis River IAVMP Parrotfeather Weed Management Profile.
2. Washington State Noxious Weed Control Board, parrotfeather
<http://www.nwcb.wa.gov/detail.asp?weed=94>
3. Washington State Quarantine List:
<http://www.nwcb.wa.gov/searchResultsQuarantine.asp>
<http://www.nwcb.wa.gov/siteFiles/ProhibitedPlants.pdf>

APPENDIX A-3
Yakima River Basin IAVMP

WEED MANAGEMENT PROFILE

Phragmites (nonnative genotype)
(*Phragmites australis* ssp. *australis*)

DISTRIBUTION AND IMPACTS

General Distribution in Washington State

<http://agr.wa.gov/PlantsInsects/Weeds/WeedMapLists/docs/CommonReedNonNativeGeno.pdf>

Appendix E – distribution map of *Phragmites* in the Yakima River Basin

Phragmites, also known as common reed, occurs throughout the world except in Antarctica. This species may be more widely distributed than any other flowering plant. It is currently listed as a Class B noxious weed in Washington State.

It has many genotypes adapted to the environmental conditions where they are native. The Pacific Northwest native genotype (*Phragmites australis* ssp. *americanus*) grows in wetlands, on stream and ditch banks, on lake, pond and on some estuary shores. It occurs as part of the natural plant community and does not spread aggressively. There are some remnant populations of the native genotype in the Yakima River Basin.

Although physically similar to the native variety, the nonnative *Phragmites* (*Phragmites australis* ssp. *australis*) has some distinctive features, including an aggressive, dominant, growth habit. This aggressive genotype is recognized as a nonnative weed and currently appears on Washington's noxious weed list as a Class B Noxious Weed.

Phragmites is found in both eastern and western Washington. The nonnative genotype is aggressively invading in some locations such as along the Snake River and in the Winchester Wasteway. It is probably not possible to eradicate the nonnative genotype from Washington, but outlier populations should be eradicated and wider-spread infestations should be contained and prevented from further spread.

In the Yakima River Basin, the nonnative *Phragmites* type is only known in Benton County. There are two sites on the Yakima River, close to the mouth of the Columbia River. Currently there are no known nonnative genotypes in Yakima or Kittitas Counties or on Yakama Nation lands.

Impacts of the nonnative types

Phragmites prefers sites near stagnant water or where wave action is minimal. New plants often get started on disturbed sites, in areas with considerable water fluctuation or with new sediment accumulations. Dense, monotypic stands are formed in wetlands. Wildlife is displaced when

wetland hydrology, structure and function are altered. Water quality deteriorates when water flow or circulation is adversely affected by this species

Mature stands can reach densities of 200 culms per meter square in wet areas, and up to 300 culms per meter square in dry areas. These dense *Phragmites* stands are poorly utilized by mammals or birds and species diversity is low.

PLANT CHARACTERISTICS

The nonnative type of *Phragmites* or common reed is a very large, perennial grass with creeping rhizomes that grows to 15 feet tall under favorable conditions. This tall grass has distinctive dense, feathery flower heads that are tawny or purplish, they can range from 1 to 16 inches long, and they are visible from July through October.

The nonnative type has large hollow stems which produce lance-shaped leaves 8 to 16 inches long and ½ -1½ inches wide along most of their length. Leaf blades are smooth, and the loose blades will twist to the wind to one side. Ligules (short papery bracts growing from the leaf where it bends out from the stem) look yellow or green, and the stems on the weedy genotype are ribbed, rougher, and larger than native plants.

The native *Phragmites* tends to grow in less dense stands, the stems are thin and shiny, and flowers are less dense.

Native *Phragmites* characteristics

Red colored basal stems in the spring and summer
Stems smooth, appear polished
Leaf sheaths fall off in fall, or are easily removed

Nonnative Characteristics

Generally have tan stems
Stems ribbed, visible 'ridges'
Leaf sheaths remain on plant

Other distinguishing characteristics such as stem density and inflorescence density are somewhat subjective, and experience with both the native and nonnative varieties is needed for these traits to be apparent.

The website for the Cornell University Ecology and Management of Invasive Plants Program, with work by Dr. Bernd Blossey, offers information and pictures. This information is updated as more samples are collected nationwide.

<http://invasiveplants.net/Phragmites/nativeandintroduced.asp>

The literature and references at the end of this *Phragmites* Weed Management Profile has web links to help with plant identification.

Reproduction: Common reed is a clonal grass species that reproduces both vegetatively and by seed dispersal. The seeds are generally dispersed from November to January, and they are distributed by wind, water or birds, and by attaching to animals. However, the plant generally spreads by rhizomes. Many seeds are sterile

Seedlings may be produced on nearly any site that has some surface water (even somewhat brackish or alkaline water). *Phragmites* seedlings may germinate and develop some top growth and remain as relatively small plants for several years. They blend in with existing grasses and

are very difficult to spot during a weed inventory or when doing follow-up monitoring. Once well established, they produce massive top growth in a very dense stand, which eliminates most other competing plants

Mature plants produce stout rhizomes five to fifteen feet or longer. The rhizomes may live three to six years, but new rhizomes are also produced every year. New plants develop at each node, allowing spread into adjacent plant communities. In some cases, plants also produce stolons (horizontal above ground stems) that also produce additional plants.

MANAGEMENT AND CONTROL OPTIONS

Integrated Pest Management, as defined by RCW 17.15, is a coordinated decision making and action process that uses the most appropriate pest control methods and strategies in an environmentally and economically sound manner to meet programmatic pest control objectives. When following this IAVMP, site-appropriate control methods must be used.

WEED MANAGEMENT PROJECTS

Before starting a control program, distinguish between the native and introduced genotypes of *Phragmites*. WSDA conducted a survey and inventory of *Phragmites* populations in Washington in 2003 and 2004. WSDA continues to survey and identify the native and nonnative populations and to map *Phragmites* sites in the state.

Only the aggressive introduced genotype should be controlled. Controlling native strains of this species may have a detrimental affect on this limited species.

CONTROL METHODS

Listed below are a range of options, offering a combination of control strategies that may be suitable for site specific control of *Phragmites*. These control methods are listed in the following order, and include: Prevention (including Early Detection Rapid Response), Mechanical, Cultural, Chemical and Biological Controls.

Phragmites is generally controlled with the herbicides imazapyr or glyphosate. Because of its extensive rhizomes, hand pulling or digging is difficult. Burning can be useful to reduce the biomass and permit better penetration of the herbicides.

Prevention, Early Detection, Follow-Up

Phragmites is not very widespread in the state of Washington, and very few wetlands have large infestations. Early detection and prevention is still an effective control option for most areas. Familiarize yourself with plant characteristics and impacts. Please call local county noxious weed control boards, or WSDA, to report new sites.

MECHANICAL CONTROL

Hand pulling: Hand pulling is only suitable for seedlings and young plants that have not established much top growth or developed an extensive root system or rhizomes. Larger, older plants generally cannot be hand pulled or even dug out because some rhizomes will be left to propagate new plants.

Mowing: Mowing is possible on sites that can accommodate a tractor and mower or in smaller stands, weed whackers can be used. In many areas, *Phragmites* is growing with its feet in the water and may be difficult to access. It may take a heavy duty tractor mounted mower to cut mature *Phragmites*, with its large coarse stems. Younger plants are easier to mow. To be effective, start mowing plants at the end of July before seed heads form, cutting the plants as low as possible. A single mowing may stimulate more production from root crowns and rhizomes. Repeated mowing of at least several times each year, for a minimum of two growing seasons is needed to reduce growth.

It may take up to eight cuttings per year to kill perennial grasses. However, mowing does reduce plant energy reserves each time since plants must re-grow and over time the plant depletes its carbohydrate reserves. Mowing will reduce stand density and minimize seed production. Herbicide application to these smaller weakened plants will result in better coverage, increasing potential effectiveness and may require lower chemical volumes.

Cutting has been used successfully for control. Multiple cuttings of common reed at the wrong times of the year may increase stand density. Cutting can be used for successful control by cutting it just before the end of July when most of the food reserves produced that season are removed and the aerial portion of the plant reducing the plant's vigor. This regime may eliminate a colony if carried out annually for several years. Care must be taken to remove cut shoots to prevent re-growth.

Disking can be used but it can result in an increase of plants since rhizome fragments can sprout new plants.

Burning does not reduce the growing ability of common reed unless the roots are burned, which is difficult to achieve. While burning is not an effective control technique used alone, it can be useful in reducing the very dense biomass overstory of monoculture stands. These sites may be dry enough in late winter or early spring so they can be burned. At this time the soil will be cool and moist allowing the top material to burn without killing any desirable plant seed still remaining in the soil. Once this dense plant cover has been removed, access will be improved for herbicide application on new plant growth.

CULTURAL CONTROL

Site Modification: If *Phragmites* occupies most of a wetland or pond shoreline or has grown into tall dense, monoculture stands, site modification can be considered.

However, this greatly alters the wetland because plants, roots, and the surrounding soil are physically removed; deepening or creating water areas several feet deep. Site modification is not recommended in high quality wetlands or if listed plants or animals use the site because the site is permanently modified.

Grazing may be used in some situations on new weed growth to further reduce plant vigor, to open the site for desirable plants, and to increase effectiveness of spot herbicide application. Grazing is effective only on new *Phragmites* growth, because it becomes unpalatable when it is more than two feet high.

CHEMICAL CONTROL

For specific information on herbicides and recommendations for control, please see the [Pacific Northwest Weed Management Handbook](#).

Please note, in Washington State, aquatic herbicides are all restricted use. Any person purchasing or applying aquatic herbicides in Washington State is required to have a valid Washington State Applicators License with all applicable endorsements. In addition, if herbicides are applied in areas where they may enter the water, coverage under an applicable National Pollutant Discharge Elimination System (NPDES) permit is required. See the Washington State Department of Ecology website for more information on permits and for other legal requirements necessary to apply aquatic herbicides in Washington State.

http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/noxious_index.html

Applications of appropriately labeled herbicides can be used for control. However, because of its size, both horizontal and vertical density, and extensive rhizomes and stolons, it may be very difficult to get adequate herbicide coverage and follow-up treatment will be necessary.

For aquatic applications, glyphosate and imazapyr that are labeled for aquatic use may be used. Glyphosate and imazapyr are non-selective systemic herbicides. Ideally these herbicides should be applied to *Phragmites* plants after the tasseling stage when the plants are translocating nutrients to their roots. Glyphosate is most effective if applied in late summer through late fall. A successful control option used on wildlife refuges appears to be the application of glyphosate late in the growing season, followed by burning or mechanical removal of the dead vegetation the following spring. Retreatment is often necessary every two to three years.

On seedlings and small patches of mature plants a backpack sprayer or wicking may work best. In large monotypic stands, aerial application may be the most economical method to apply herbicides. The Nature Conservancy in Indiana reports success using 1.5% Rodeo® applied from backpack sprayers with five foot wand extensions (to reach the tall plants). They treat just before the plant senesces in monotypic stands of up to twenty acres. They have gotten 97 percent mortality after one year of treatment. The treated vegetation is burned the following spring to make follow-up treatment easier and to promote the germination of native seeds. (<http://tncweeds.ucdavis.edu/moredocs/lytsa01.html>)

In areas without monotypic stands where overspray may kill desirable species, plants can be cut and an appropriate solution of glyphosate can be dripped (or injected with a large hypodermic needle) into the hollow stem. This technique has been reported by The Nature Conservancy to result in 50-75 percent mortality. Although this application method is very labor intensive, it preserves remaining desirable plants and can protect rare plant species.

BIOLOGICAL CONTROL

Please refer to the following website for a good overview of insects that feed on *Phragmites*: http://invasiveplants.net/Phragmites/new_insects.aspx

This website reports that research into biological control agents for *Phragmites* is still in the early stages and no approved bio-control insect releases have been made in the U.S for *Phragmites* management. Some experts feel it may be possible to isolate insects that will only attack the weedy *Phragmites* genotype. Researchers have identified at least 140 European insects which feed on or in other ways affect the invasive *Phragmites* genotype. Of these insects, 50 percent use this plant for a major part of their life cycle and 40 percent use *Phragmites* almost exclusively. Twenty-one species from this European group have been identified in some states in the eastern U.S. The source of their introduction is unknown, although some insects were probably introduced in shipping materials in ports.

The study and screening of insect impact on desirable and native plants continues for species that show promise of having a major impact on *Phragmites*. Several European insects are being evaluated as potential control agents for *Phragmites*. These insects were selected based on their life history and impact of *Phragmites* populations in Europe.

These potential bio-control agents include:

- *Archanaria geminipuncta*, a shoot-boring moth;
- *Phragmataecia castaneae*, a large shoot and root mining moth;
- *Chilo phragmitella*, another shoot and root mining moth;
- *Schoenobius gigantella*, a moth that mines underwater shoots; and
- *Platycephala planifrons*, attacks shoots early in the year and stunts growth. This is one of the most damaging species found during a European survey.

LITERATURE, REFERENCES

1. Washington State Department of Ecology – IPM Plan for Freshwater Emergent Noxious Weeds and Quarantine Listed Weeds, *Phragmites* Plant Profile, 200
http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/Noxious%20Emergent%20IPM.pdf
2. Washington State Noxious Weed Control Board, *Phragmites*/Common reed
<http://www.nwcb.wa.gov/detail.asp?weed=101>
3. The Cornell University Ecology and Management of Invasive Plants Program website has this link for further information and additional photographs:
<http://www.invasiveplants.net/Phragmites/Default.htm>
4. Morphological characteristics to distinguish native from nonnative genotypes:
<http://www.invasiveplants.net/Phragmites/phrag/morph.htm>
5. [Saltonstall, K. 2002. Cryptic invasion by a nonnative genotype of *Phragmites australis* into North America. *Proceedings of the National Academy of Sciences, USA*. 99\(4\): 2445-2449.](#) To access this paper follow the link on this web page:
<http://invasiveplants.net/Phragmites/nativeandintroduced.asp>
6. A Landowner's Guide to *Phragmites* Control, This publication produced by the Office of the Great Lakes, Michigan Department of Environmental Quality.

7. Interim Report, *Phragmites australis* (common reed), Bridget Simon and Greg Haubrich, WSDA, December 27, 2004
8. Native and Nonnative *Phragmites australis* in Washington State, *Douglasia* Article (WNPS), Vol. 28, No. 2, Greg Haubrich and Bridget Simon, Spring 2004

APPENDIX A-4
Yakima River Basin IAVMP

WEED MANAGEMENT PROFILE
Purple loosestrife (*Lythrum salicaria*)

DISTRIBUTION AND IMPACTS

General Distribution in Washington State

<http://agr.wa.gov/PlantsInsects/Weeds/WeedMapLists/docs/LoosestrifePurple.pdf>

Appendix E – distribution map of purple loosestrife in the Yakima River Basin

Purple loosestrife is widespread and well-established in Washington. While it is not possible to eradicate this plant from the state, it is possible control it in some areas to contain it from spreading any further. Eradication is possible from specific sites such as high quality wetlands or lake shores that have very few or newly discovered plants. Purple loosestrife is currently listed as a Class B noxious weed in Washington State.

In the Yakima River Basin purple loosestrife is widespread in some areas, and limited or non-existent in other areas.

Yakima County – purple loosestrife is found intermittently along the entire Yakima River and in the Toppenish Creek watershed area. Annual surveys and control work by CWMA members are done in August and September. There is very little purple loosestrife above the Naches River.

Kittitas County – the purple loosestrife distribution is very limited and the County Weed Board has an aggressive control program. All sites are controlled and new sites are eradicated. The loosestrife plants found in the Fio Rito and Mattoon Lakes were eradicated. Site monitoring continues, with control as necessary to keep loosestrife from establishing.

Benton County – purple loosestrife is distributed along the Yakima River and in the Spring Creek area.

Impacts

Purple loosestrife is considered one of the worst noxious weed invaders of wetland habitat and its impact on various regions of Washington State has been significant. Purple loosestrife is invasive and competitive and unavailing to native wildlife. Seed banks build for years since seeds may remain viable for up to 3 years. Monospecific stands are long-lived in North America as compared to European stands, illustrating the competitive edge loosestrife has over other plant species.

Wetland ecosystems are altered. Purple loosestrife can quickly adapt to environmental changes and expand its range to replace native plants used for ground cover, food or nesting material.

Loosestrife stands are dense at the top, and open at the base. The root mass structures create a 3 foot opening in the water, between plants. This provides no cover for nesting ducks. Large loosestrife infestations are hard to mow and manage. Recreational hunting or trapping grounds are lost, decreasing the land value to those that own or manage operational wetlands. Threatened and endangered species are impacted by monotypic stands of purple loosestrife that replace native vegetation.

Agriculture is also impacted by a loss of wild meadows, hay meadows and wetland pastures. Economic impacts are high in agricultural communities when irrigation systems are clogged or when wet pastures are unavailable for grazing. Purple loosestrife is aggressive and competitive, taking full advantage of disturbance to natural wetland vegetation caused by anthropogenic alterations of the landscape.

PLANT CHARACTERISTICS

Purple loosestrife is a perennial, emergent aquatic plant that grows from a persistent tap root and spreading root stock. Plant stems can reach 10 feet tall and the crown can be 5 feet wide.

The showy magenta flowers are densely clustered on a 4 – 16 inch terminal flowering spike. Each flower has 5 to 7 petals. The leaves are alternate, opposite or in whorls of 3. They are 1.5 to 4 inches long, lance shaped to narrowly oblong and covered in fine hairs. Stems are somewhat square, with 4 to 6 sides. The stems are herbaceous and upright, either branched or unbranched. Each plant may have 30 50 stems with flowers growing at the ends, and stems can reach 10 feet tall. The taproot develops early in the seedling state. When mature, the taproot and major root branches become thick and woody.

The seeds are in capsules. A mature plant can produce 2.7 million thin-walled, flat seeds. Water dispersal is by floating seedlings and by floating un-germinated seeds. Purple loosestrife also spreads vegetatively. Buried stems harbor adventitious buds with the ability to produce shoots or roots. Disturbance to the plant initiates bud growth. Other distribution methods include transport through wetland mud by animals, humans, boats or vehicles. Spread also occurs when seeds are eaten by birds.

Purple loosestrife may be confused with native spirea (*Spirea douglasii*), or fireweed (*Chamerion angustifolium*, syn. *Epilobium angustifolium*)

MANAGEMENT AND CONTROL OPTIONS

Integrated Pest Management, as defined by RCW 17.15, is a coordinated decision making and action process that uses the most appropriate pest control methods and strategies in an environmentally and economically sound manner to meet programmatic pest control objectives. When following this IAVMP, site-appropriate control methods must be used.

Quarantine List

Plant quarantines are a preventative measure to keep noxious weed species introduced as garden or aquatic ornamental plants from spreading to natural areas. All Class A noxious weeds are on this list (WAC 16-752-610).

Purple loosestrife is sometimes sold as a garden ornamental. As a Class B noxious weed, control is required by all landowners.

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. Also prohibited is transportation of wild plants or plant parts of these species in the state of Washington. This includes hybrid crosses and named cultivars of *L. salicaria* and *L. virgatum* (WAC 16-752-400-415).

WEED MANAGEMENT PROJECTS

Purple loosestrife is widespread in Yakima County. The purple loosestrife task force started almost 20 years ago. The river often floods, and is an issue for weed control from year to year. As the river changes and as the course changes it is often difficult to get access in back area sloughs and wetlands. One year it is possible to treat weeds, and one year it is not.

The Yakima County Weed Board - conducts annual loosestrife surveys and control work during August and September throughout the river system. Crews float the river, all sloughs and tributaries along the river using canoes and a jet boat. The Yakima River CWMA members contribute herbicide, staff time, funding and boats.

Plants are treated with herbicides from Selah down to the Benton/Yakima County line. Biological controls have been distributed in the past, and the insects are present up and down the river doing some damage. Since the river floods regularly, the bio controls rarely become established well enough to do appreciable damage to the plants.

The Yakama Nation Wildlife, Range and Vegetation Resource Management Program works in cooperation with the Yakima County weed board for surveys and noxious weed control on their lands. All weed sites have GPS and data points, starting near the town of Parker and ending near the town of Mabton at the Mabton Bridge, continuing downstream along the entire stretch of the Yakama Nation boundary. This information is included in the State Weed and Pest (SWAP) data base and is available for all CWMA members. In 2011 first time control by canoes of yellow flag iris and purple loosestrife on Toppenish Creek from Highway 22 to the entrance of the Yakima River. Biological controls for purple loosestrife were released within the main corridor of the river and in the nearby wetlands, and a gradual yet steady increase was noticed in biological control insects and an increase in purple loosestrife plant mortality.

The Benton County Weed Board – annually treats the main channel of the Yakima River.

The Kittitas County Weed Board - surveys, controls and maps noxious weed species in the Yakima River from the Teanaway River near Cle Elum down to the Roza Dam. WSDA provided herbicide and funding. No parrotfeather, flowering rush or non-native *Phragmites* were found in the surveys. This information is included in the SWAP data base. 2012 surveys are planned for the Lower portion of the Yakima River below the Roza Dam.

At Fio Rito and Mattoon Lakes – the goal is to eradicate purple loosestrife. Purple loosestrife was first discovered at Mattoon Lake in 2001 and in Fio Rito Lakes in 2002. At Mattoon Lake three mature plants were found and controlled on the east end of the lake in a seasonally marshy area between Mattoon Lake and Wilson Creek. In the years 2002 – 2006, at least one single plant has been discovered and controlled annually. Preventing establishment is critical and continued introduction is likely.

Annual surveys and site monitoring will continue. Plants are either spot treated with an aquatic herbicide (triclopyr or imazapyr) or mechanically removed, depending on site conditions and plant phenology. Treated plants are checked one month after control. Any flowering stalks are cut at the base and removed from the site.

CONTROL METHODS

Listed below are a range of options, offering a combination of control strategies that may be suitable for site specific control of name your weed. These control methods are listed in the following order, and include: Prevention (including Early Detection Rapid Response), Mechanical, Cultural, Chemical and Biological Controls.

Prevention, Early Detection, Follow-Up

In natural areas where purple loosestrife is not well established, early detection and prevention is still a control option.

Purple loosestrife is a dramatic, showy plant that was often introduced as a garden ornamental. Education and outreach over the years has reached many gardeners, but sometimes purple loosestrife still shows up in gardens (private and public), and sometimes it is found for sale. As a Class B noxious weed control is required by all landowners. As a quarantine species, it is illegal to buy, sell, offer for sale or transport in the state of Washington. Plant quarantines are a preventative measure to keep new infestations from originating from garden ornamentals.

Mechanical Control

Hand pulling 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 soil surface.

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 may be used on small, dense infestations of about ten to twenty feet in size which contain mostly target weeds.

Cutting: A single mature purple loosestrife plant can produce over two million seeds per year. 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.

Proper disposal is important. 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. Be aware that clothes and equipment may transport the small seeds to new areas. Thoroughly brush off clothes and equipment before leaving the site.

Chemical Control

For specific information on herbicides and recommendations for control, please see the [Pacific Northwest Weed Management Handbook](#).

Please note, in Washington State, aquatic herbicides are all restricted use. Any person purchasing or applying aquatic herbicides in Washington State is required to have a valid Washington State Applicators License with all applicable endorsements. In addition, if herbicides are applied in areas where they may enter the water, coverage under an applicable National Pollutant Discharge Elimination System (NPDES) permit is required. See the Washington State Department of Ecology website for more information on permits and for other legal requirements necessary to apply aquatic herbicides in Washington State.

http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/noxious_index.html

Glyphosate that is labeled for aquatic use can be used to effectively control purple loosestrife in aquatic situations. 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 some seed cases have formed will not prevent development of at least some viable seed. Treating even later in the season will not prevent most current year's seed production. If possible, remove the seed heads from these plants. 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 purple loosestrife plants.

Because glyphosate is non-selective this is a better choice of herbicide 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 amine can be used to target purple loosestrife while having little impact on native broad leaved species. However, if carefully wicked or wiped onto individual plants, glyphosate can be made selective through application techniques.

Imazapyr like glyphosate, is non-selective and systemic. It appears to move rapidly into the rhizomes making it potentially very effective in controlling rhizomatous species

Triclopyr TEA is a selective herbicide that can damage broad leaf herbaceous plants, trees, and shrubs, but should not affect grasses, sedges, rushes, or similar monocotyledonous plants. According to label information it 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. As with glyphosate, triclopyr should be applied selectively to target plants to prevent damage to existing desirable competing broad leaf vegetation. The Nature Conservancy reports that control results using triclopyr have been inconsistent in the field.

2,4-D herbicides are selective chemicals that will damage broad leaf herbaceous plants, trees, and shrubs, but should not affect grasses, sedges, rushes or similar monocotyledons plants. 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. Currently only the amine formulation of 2,4-D is approved for use in emergent control of noxious weeds in Washington State.

Biological Control

Since the Yakima River floods regularly, biological controls may not have the chance to get established in some areas. In Benton County the *Galerucella* is widespread; in Kittitas County *Galerucella* are found, although they were not specifically released in this area.

In 1992 three beetles were released in Washington. Their damaging impact on purple loosestrife populations was evident in the Winchester Wasteway area of Grant County in 1997. Depending on the site, biological control agents may provide the long term success in controlling this noxious weed.

Galerucella californiensis and *G. pusilla* - both leaf-feeding chrysomelids. These beetles defoliate, and attack the terminal bud area, drastically reducing seed production. The mortality rate to purple loosestrife seedlings is high. Evidence of *Galerucella* ssp. damage is round holes in the leaves. 4-6 eggs are laid on the stems, axils or leaf underside. The larvae feed constantly on the leaf underside, leaving only the thin cuticle layer on the top of the leaf. By 1996 populations of *Galerucella* ssp. visibly impacted purple loosestrife stands in the Winchester Wasteway.

Hylobius transversovittatus - root-mining weevil that also eats leaves. This beetle eats from the leaf margins, working inward. The female crawls to the lower 2-3 inches of the stem then bores a hole to the pithy area of the stem, where 1 -3 eggs are laid daily from July to September. Or, the female will dig through the soil to the root, and lay eggs in the soil near the root. The larvae then work their way to the root. *H. transversovittatus* damage is done when xylem and phloem tissue are severed, and the carbohydrate reserves in the root are depleted. Plant size is greatly reduced because of these depleted energy reserves in the root. The larvae evidence is the zig-zag patterns in the root.

Several other biological control agents have been studied for release:

Nanophyes marmoratus - a seed eating beetle. Young adults feed on new leaves on shoot tips, later feeding on the flowers and closed flower buds. 60 - 100 eggs are laid in the immature flower bud. Seed production is reduced by 60%. There were two test sites releases in 1996.

N. marmoratus is being propagated at WSU, Pullman, to increase their numbers. A possible field release is planned in 1998.

N. brevis - is another seed beetle that attacks the seed capsules. They have not been released in the United States yet. (Piper, 1997).

LITERATURE, REFERENCES CITED

1. Washington State Department of Ecology – IPM Plan for Freshwater Emergent Noxious Weeds and Quarantine Listed Weeds. Purple loosestrife Plant Profile.
http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/Noxious%20Emergent%20IPM.pdf
2. Washington State Noxious Weed Control Board: purple loosestrife
<http://www.nwcb.wa.gov/detail.asp?weed=90>
3. Washington State Quarantine List: Appendix D2
<http://www.nwcb.wa.gov/searchResultsQuarantine.asp>
<http://www.nwcb.wa.gov/siteFiles/ProhibitedPlants.pdf>
4. Chehalis River IAVMP Purple Loosestrife Weed Management Profile, 2006
5. Conversations with the Yakima county Noxious Weed control Board, 4/12
6. Fio Rito and Mattoon Lakes Weed Mgmt Plan, WDFW, 2007
7. The Yakama Nation Wildlife, Range and Vegetation Resource Management Program, End of Season Reports, 2010 and 2011.

APPENDIX A-5
Yakima River Basin IAVMP

WEED MANAGEMENT PROFILE
Yellow flag iris (*Iris pseudacorus* L.)

DISTRIBUTION AND IMPACTS

General Distribution in Washington State

<http://agr.wa.gov/PlantsInsects/Weeds/WeedMapLists/docs/YellowFlagIris.pdf>

Appendix E – distribution map of yellow flag iris in the Yakima River Basin

Yellow flag iris is a Class C noxious weed with a widespread distribution throughout Washington State. In many cases yellow flag iris has been deliberately planted as an ornamental species, and it is found along shorelines in both eastern and western Washington. It is sometimes offered for sale as a garden ornamental.

In a 2005 county survey by WSDA, yellow flag iris was known to occur in at least 30 of 39 counties. Thurston and Pend Oreille Counties reported over 1,000 acres of this species. Many counties reported having very few acres of yellow flag iris at that time. It is imperative that these small populations be controlled before they spread to uninfested areas. While it is not possible to eradicate yellow flag iris from Washington, it may be possible to eradicate it from specific sites such as high quality wetlands or lake shores.

In the Yakima River Basin, yellow flag iris is widespread in most areas, but there are areas where it is not currently present. In Kittitas County yellow flag iris was found to be non-existent along the Yakima River above Ellensburg. However it is well established in the Yakima Canyon. In Yakima County yellow flag iris is widespread, but a control program is planned for the upper part of the Naches River and small creeks and drains, where there are no known plants at this time. In Benton County yellow flag iris is found in pockets along the Yakima River.

Impacts

Yellow flag iris is a robust perennial herb that spreads aggressively, and it can get started in areas with fully developed stands of other emergent vegetation. Large, dominant stands of yellow flag iris are commonly found along the wetland shorelines of ponds and streams, and it quickly forms a monoculture in this type of habitat. As long as it is planted in backyard ponds and gardens, yellow flag iris will continue to escape and naturalize into new wild land areas. Once established, yellow flag iris can spread through wetland habitat by seeds or by slowly colonizing the shoreline via rhizomes.

PLANT CHARACTERISTICS

When flowering, yellow flag is unmistakable with its showy yellow flowers colorfully displayed along the edge of water and in wetlands. In Washington, the flowers occur in late spring or early

summer. Several flowers can occur on each stem, along with one or two leafy brackets. The plant, including flower stalk, is 4 to 5 feet tall.

Yellow flag iris is perennial, and will remain green during winter where the weather is mild. When no flowers are present the leaves of yellow flag iris can be mistaken for common cattail, and both plants often share habitat. Yellow flag iris has emergent leaves, 20 to 36 inches long, with a prominent mid-rib. They clasp the stem to form a fan-like base. The leaves are mostly basal, with the shorter leaves toward the outside of the plant. At the base of each plant are thick, stout rhizomes with roots that can extend to 12 inches deep. These rhizomes grow together in a tight cluster, forming a massive root base that can be three to four feet in diameter. The seed pods are a glossy green capsule, resembling short green bananas when mature. The 7mm seeds are brown and flattened and corky. Yellow flag iris spreads by seeds and by rhizomes.

This iris prefers to grow in wet conditions, and it is widely sold in nurseries and on the internet as a popular ornamental for wet areas. However, this species will grow in many soil types since the rhizomes can survive dry habitat, and it is often used in dry flower beds and in roadside gardens. This species tolerates high soil acidity and it can grow in salt marshes. It has often been planted in wastewater and storm water treatment ponds. It thrives on sites with full sun and in partial shade, and it can survive winter temperatures to well below zero degrees Fahrenheit.

Yellow flag iris is toxic. The sap can cause severe blistering or irritation, and if ingested it can cause vomiting and diarrhea. It will sicken livestock if ingested, and is generally avoided by herbivores (although muskrats will eat the rhizomes).

MANAGEMENT AND CONTROL OPTIONS

Integrated Pest Management, as defined by RCW 17.15, is a coordinated decision making and action process that uses the most appropriate pest control methods and strategies in an environmentally and economically sound manner to meet programmatic pest control objectives. When following this IAVMP, site-appropriate control methods must be used.

WEED MANAGEMENT PROJECTS

Yakima County: Yellow flag iris is very widespread. However a control plan could be implemented on the upper Naches River and include any small creeks and drains that flow into the Yakima River which would serve to prevent spread from these site into the mainstem of the Yakima River.

In other areas along the river, the timing for future yellow flag iris control projects could coincide with purple loosestrife control. However Yakima County prefers to use a different herbicide for purple loosestrife (triclopyr) than is used for yellow flag iris (glyphosate or imazapyr). A long term (5 year+) control plan could be implemented in conjunction with the Yakima County invasive knotweed control program.

Kittitas County: yellow flag iris is aggressively controlled on the Yakima River upstream (north) of the confluence of Wilson Creek, at the south end of the Yakima River Canyon. Downstream of Wilson Creek yellow flag iris is well established along both shorelines.

Fio Rito and Mattoon Lakes: Yellow flag iris was the dominant species around the entire shoreline of these lakes when a 2007 Management Plan went into effect. Since then, control efforts were implemented and shoreline plant diversity is much greater now. The long term control plan includes applying spot applications as needed of an aquatic formulation of imazapyr. Plants were checked 1 month after herbicide application, and any that have produced flowers were manually controlled before they set seed. These plants were cut at the base and disposed of in a landfill. Since yellow flag iris grows mainly along the shoreline in wetland areas where rapid re-colonization by native plants should occur after treatment, there should be no need to re-vegetate these sites.

CONTROL METHODS

Listed below are a range of options, offering a combination of control strategies that may be suitable for site specific control of yellow flag iris. These control methods are listed in the following order, and include: Prevention (including Early Detection Rapid Response), Mechanical, Cultural, Chemical and Biological Controls.

Prevention, Early Detection, Follow-Up

In natural areas where yellow flag iris is not well established, early detection and prevention is still a control option. Familiarize yourself with plant characteristics and impacts.

Yellow flag iris is often planted as a garden ornamental, and there was a statewide effort (2008) to educate landowners and the nursery industry with post cards and educational material about the widespread distribution and the negative impacts of this plant in many wetland habitats.

- Do not buy yellow flag iris and do not plant this species in your garden.
- If you have plants that need to be removed, clip and remove the seed pods. Remove individual plants, including rhizomes when possible. Yellow flag iris spreads by seeds and by rhizomes.
- Wear gloves for protection, the sap is toxic.
- For larger sites, develop a long term Integrated Pest Management Plan that combines several control methods.

Mechanical Control

Hand pulling may be effective only for seedlings or immature plants. While it is possible to dig out established plants, it is not practical unless there are just a few mature plants in the waterbody or wetland. Once an infestation has developed beyond this point, other methods of eradication or control should be considered.

When pulling or digging yellow flag iris, be aware that the resin in the leaves can cause skin irritation. Immature plants can be hand pulled as long as the leaves stay firmly attached to the roots. Young plants will not have formed bulky rhizomes and pulling should completely remove most roots. Once the plant is firmly established (during the second year and later), it will be nearly impossible to hand pull, and digging is required. Dig out a fairly wide area around the plant so all roots and rhizomes can be removed. Nearly any plant material left in the soil can develop into a new plant.

Covering (solarization) is recommended for small patches of Iris that can be completely covered. In all treatments where re-growth was monitored after the covers were removed, seedlings began to sprout, and there was encroachment of plants from the edges.

Use several layers of an opaque material such as very strong black plastic sheeting because this tough plant may penetrate weaker material. Of the different fabrics used, the tarp held up the best. The landscape fabric tended to tear; the clear and black plastics were brittle and disintegrating by the time they were removed.

Cover the plants in the early spring before growth starts after removing all the top vegetation. Completely cover each plant or group of plants with the plastic sheeting, sealing the edges with rocks, heavy boards, or other natural materials. The seal must be complete, blocking all light from entering for at least one to three growing seasons. Because yellow flag iris usually grows at the waters edge, it may be necessary to seal the water side with heavy rocks. (Source: Test plots at Buena Creek, Yakima Co., 2005 by J. Parsons, DOE, cited in 2008 IPM Yellow Flag Iris Plant Profile Update, WSDA).

Cutting: Many people who live along lake shores enjoy this Iris and do not want to eradicate this plant. In fact many lake residents have deliberately planted this showy perennial. Cutting off the seed heads after the plant flowers can help minimize its spread to other areas of the waterbody. Lakeside gardeners will also have to manage the spread of this plant from creeping rhizomes to keep it from taking over their shoreline.

Underwater cutting reduced stem density of yellow flag iris for one year after initial treatment. The plots that were cut in spring before flowering showed the best result.

Chemical Control

For specific information on herbicides and recommendations for control, please see the [Pacific Northwest Weed Management Handbook](#).

Please note, in Washington State, aquatic herbicides are all restricted use. Any person purchasing or applying aquatic herbicides in Washington State is required to have a valid Washington State Applicators License with all applicable endorsements. In addition, if herbicides are applied in areas where they may enter the water, coverage under an applicable National Pollutant Discharge Elimination System (NPDES) permit is required. See the Washington State Department of Ecology website for more information on permits and for other legal requirements necessary to apply aquatic herbicides in Washington State.

http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/noxious_index.html

Glyphosate and imazapyr labeled for aquatic use may be used anytime plants are actively growing. Glyphosate and imazapyr are non-selective and should be applied with hand held equipment to minimize non-target impacts and water contact. Cutting followed by wicking with glyphosate may be the best treatment method in sensitive areas and will also minimize the amount of herbicide needed. Because yellow flag iris has large rhizomes, one application of herbicide may not kill mature plants. Re-apply the herbicide through mid-fall if the plant is still

actively growing and recovery from the initial herbicide application appears likely. Final results may not be apparent till the following spring. If the plants are still alive, retreatment may be necessary. If care is taken to minimize off target impacts, adjacent desirable vegetation may naturally re-vegetate the site. Because yellow flag iris sets seed, at least annual monitoring will be required to find any new plants and rapidly remove them from the site. Please refer to the following website for herbicide application techniques - <http://www.se-eppc.org/manual/herbapp.html>

2005 Herbicide Screen at Buena Creek, Yakima Co. (T. Miller, WSU Cooperative Extension). Yellow flag iris plants were in bud stage at the time of the spring treatment. Few open flowers were present in the infestation at that time, and no open flowers were in the plots. Yellow flag iris seedpods were present on iris plants at the time of the fall treatment, although none had yet shattered seed.

Spring treatments: In summary, yellow flag iris generally responded more quickly to glyphosate (Aquamaster®) than to imazapyr (Habitat®). After about five months yellow flag iris control with imazapyr at 1 or 1.5% was generally superior to that of glyphosate at 3 or 5%, as was control from combination treatments.

Comparisons between spring and fall treatments: At comparable times after treatment, it appears that fall herbicide applications were slightly more effective than spring treatments. This was particularly true at the 5 to 7 month evaluation, where the average yellow flag iris control provided by fall treatments was 8 percentage points greater than from spring applications (97 and 89%, respectively). By 12 months after treatment, fall treatments were still providing an average of 93% yellow flag iris control, compared to 87% from the average spring treatments. (Source: As cited in 2008 Update. IPM Yellow Flag Iris Plant Profile, WSDA).

Biological Control

No biological control agents have been researched or released for the control of yellow flag iris and we are not aware of any research activities into biocontrol agents. Yellow flag iris and other iris species are cultivated and prized for their flowers in many states, so bio-control research for this species is not likely.

LITERATURE, REFERENCES CITED

1. Washington State Department of Ecology – IPM Plan for Freshwater Emergent Noxious Weeds and Quarantine Listed Weeds.
http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/noxious/Noxious%20Emergent%20IPM.pdf
2. IPM Plant Profile, Yellow flag iris, Updated July 2008, WSDA.
3. Fio Rito Lakes and Mattoon Lake Management Plans, WDFW. Sept 2007.
4. WSDA Aquatic Weeds Management Fund Final Report to DOE, Yellow Flag Iris Control and Education, June 30, 2008

APPENDIX B

DRAFT MEMORANDUM OF UNDERSTANDING FOR THE YAKIMA RIVER COOPERATIVE WEED MANAGEMENT AREA

July 1, 2012

This Memorandum of Understanding (MOU) is between the Benton County Noxious Weed Control Board, the Kittitas County Noxious Weed Control Board, the Yakima County Noxious Weed Control Board, the Yakama Nation, the Washington State Department of Agriculture (WSDA), the Washington State Department of Ecology (WDOE), the Washington State Department of Fish and Wildlife (WDFW), the Washington State Department of Transportation (WSDOT), the Washington State Noxious Weed Control Board and Washington State University Integrated Weed Control Program.

WSDA, WDOE, WDFW and WSDOT are entering into this Agreement under authority of Chapter 39.34RCW of Washington State, Interlocal Cooperation Act, and specific RCW 77.12.10. The Benton, Kittitas and Yakima County Noxious Weed Control Boards enter into this agreement under authority of Chapter 17.10 RCW. The Yakima Tribe enters into this agreement under the authority of its Constitution and Bylaws, the ordinances, resolutions, and laws of the 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 Yakima River of Benton, Yakima and Kittitas Counties. Each of the Parties has a common interest in weed management within the Yakima 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

Yakima River CWMA – The Cooperative Weed Management Area is the geographic area contained within The Yakima River Basin, WRIA 37, 38 and 39. This agreement is specifically directed toward management of invasive weeds that infest or threaten the aquatic and riparian ecosystem of the Yakima River and its tributaries.

Department of Agriculture - an agency of the state of Washington.

Department of Ecology – an agency of the state of Washington

Department of Transportation – 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 Commission

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 Yakima 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 Yakima River is affected by a number of weed species listed in the 20012 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 Yakima 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 Aquatic Plant Management Plan (IAPMP) for the Yakima 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, riparian and upland weeds of the Yakima 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 Benton, Kittitas and Yakima County Noxious Weed Boards shall:

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

4.01 Terms and Conditions

- (1) Effective Dates. This MOU takes effect on July 1, 2012, until December 31, 2013, 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.
- (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.

5.01 Project Contacts for the Working Group

1) Benton County Noxious Weed Board	Marc Stairet	509-786-6988
2) Benton County Noxious Weed Board	Sharlene Vowels	509-786-6988
3) Kittitas County Noxious Weed Board	Todd Davis	509-962-7007
4) Kittitas County Noxious Weed Board	Marc Eylar	509-962-7007
5) Yakima County Noxious Weed Board	Dick Jacobson	509-574-2180
6) Yakama Nation	Jason Newquist	509-865-5121
7) Yakama Nation	Katrina Strathmann	509-865-5121
8) Washington State Dept. of Agriculture	Bridget Simon	509-834-0530
9) Washington State Dept. of Agriculture	Greg Haubrich	509-249-6973
10) Washington State Dept. of Ecology	Jenifer Parsons	509-457-7136
11) Washington State Dept. of Fish & Wildlife	Dave Heimer	253-759-7165
12) Washington State Dept. of Fish & Wildlife	Mike Keller	509-545-2012
13) Washington State Dept. of Transportation	James Morin	509-577-1912
14) Washington State Noxious Weed Board	Alison Halpern	360-902-2053
15) Washington State University, IWCP	Jennifer Andreas	253-798-3255

YAKIMA RIVER COOPERATIVE WEED MANAGEMENT AREA MOU
APPROVED

Agency/Partner: _____

Dated: _____, 2007.

By: _____

Title: _____

Address: _____

Phone: _____

Appendix C

Yakima River CWMA Contact List

Name	Agency	Phone	Email
Marc Stairet	Benton NWCB	509-786-6988	weeddude@clearwire.net
Sharlene Vowels	Benton NWCB	509-786-6988	bcweed1@charter.net
Jenifer Parsons	Dept. of Ecology	509-457-7136	jenp461@ecy.wa.gov
Todd Davis	Kittitas NWCB	509-962-7007	todd.davis@co.kittitas.wa.us
Marc Eylar	Kittitas NWCB	509-962-7007	marc.eylar@co.kittitas.wa.us
Dave Heimer	WDFW	253-759-7165	heimedmh@dfw.wa.gov
Mike Keller	WDFW	509-545-2012	Michael.Keller@dfw.wa.gov
Greg Haubrich	WSDA	509-249-6973	ghaubrich@agr.wa.gov
Bridget Simon	WSDA	509-834-0530	bsimon@agr.wa.gov
Alison Halpern	WSNWCB	360-902-2053	ahalpern@agr.wa.gov
Jennifer Andreas	WSU	253-798-3255	jandreas@wsu.edu
Jason Newquist	Yakama Nation	509-865-5121 ext. 6317	jason@yakama.com
Katrina Strathmann	Yakama Nation	509-865-5121 ext. 6377	kstrathmann@yakama.com
Dick Jacobson	Yakima NWCB	509-574-2180	effie.shinn@co.yakima.wa.us

APPENDIX D-1

2012 Washington State Noxious Weed List

Class A Weeds: Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. Eradication of all Class A plants is required by law.

Class A Weeds	
Scientific name	Common name(s)
<i>Abutilon theophrasti</i>	velvetleaf
<i>Alliaria petiolata</i>	garlic mustard
<i>Brachypodium sylvaticum</i>	false-brome
<i>Butomus umbellatus</i>	flowering rush
<i>Carduus pycnocephalus</i>	thistle, Italian
<i>Carduus tenuiflorus</i>	slenderflower thistle
<i>Centaurea calcitrapa</i>	purple starthistle
<i>Centaurea macrocephala</i>	bighead knapweed
<i>Centaurea nigrescens</i>	Vochin knapweed
<i>Clematis orientalis</i>	oriental clematis
<i>Crupina vulgaris</i>	common crupina
<i>Euphorbia oblongata</i>	eggleaf spurge
<i>Galega officinalis</i>	goatsrue
<i>Geranium lucidum</i>	shiny geranium
<i>Glyceria maxima</i>	reed sweetgrass
<i>Helianthus ciliaris</i>	Texas blueweed
<i>Heracleum mantegazzianum</i>	giant hogweed
<i>Hieracium floribundum</i>	yellowdevil hawkweed
<i>Hieracium sabaudum</i>	European hawkweed
<i>Hydrilla verticillata</i>	hydrilla
<i>Isatis tinctoria</i>	dyer's woad
<i>Ludwigia peploides</i>	floating primrose-willow
<i>Mirabilis nyctaginea</i>	wild four-o'clock
<i>Myriophyllum heterophyllum</i>	variable-leaf milfoil
<i>Pueraria montana</i> var. <i>lobata</i>	kudzu
<i>Salvia aethiopsis</i>	Mediterranean sage
<i>Salvia pratensis</i>	meadow clary
<i>Salvia sclarea</i>	clary sage
<i>Schoenoplectus mucronatus</i>	ricefield bulrush
<i>Silybum marianum</i>	milk thistle
<i>Solanum elaeagnifolium</i>	silverleaf nightshade
<i>Solanum rostratum</i>	buffalobur
<i>Sorghum halepense</i>	johnsongrass
<i>Spartina alterniflora</i>	smooth cordgrass
<i>Spartina anglica</i>	common cordgrass
<i>Spartina densiflora</i>	dense-flowered cordgrass
<i>Spartina patens</i>	saltmeadow cordgrass

<i>Spartium junceum</i>	Spanish broom
<i>Thymelaea passerina</i>	spurge flax
<i>Zygophyllum fabago</i>	Syrian beancaper

Class B Weeds: Non-native species presently limited to portions of the State. Species are designated for control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal. Please contact your County Noxious Weed Control Coordinator to learn which species are designated in your area.

Class B Weeds	
Scientific name	Common name(s)
<i>Acroptilon repens</i>	Russian knapweed
<i>Alhagi maurorum</i>	camelthorn
<i>Alopecurus myosuroides</i>	blackgrass
<i>Amorpha fruticosa</i>	indigobush
<i>Anchusa arvensis</i>	annual bugloss
<i>Anchusa officinalis</i>	common bugloss
<i>Anthriscus sylvestris</i>	wild chervil
<i>Berteroa incana</i>	hoary alyssum
<i>Bryonia alba</i>	white bryony
<i>Buddleja davidii</i>	butterflybush
<i>Cabomba caroliniana</i>	fanwort
<i>Carduus acanthoides</i>	plumeless thistle
<i>Carduus nutans</i>	musk thistle
<i>Cenchrus longispinus</i>	longspine sandbur
<i>Centaurea diffusa</i>	diffuse knapweed
<i>Centaurea jacea</i>	brown knapweed
<i>Centaurea jacea x nigra</i>	meadow knapweed
<i>Centaurea nigra</i>	black knapweed
<i>Centaurea solstitialis</i>	yellow starthistle
<i>Centaurea stoebe</i>	spotted knapweed
<i>Chondrilla juncea</i>	rush skeletonweed
<i>Conium maculatum</i>	poison-hemlock
<i>Cynoglossum officinale</i>	houndstongue
<i>Cyperus esculentus</i>	yellow nutsedge
<i>Cytisus scoparius</i>	Scotch broom
<i>Daphne laureola</i>	spurge laurel
<i>Daucus carota</i>	wild carrot
<i>Echium vulgare</i>	blueweed
<i>Egeria densa</i>	Brazilian elodea
<i>Epilobium hirsutum</i>	hairy willowherb
<i>Euphorbia esula</i>	leafy spurge
<i>Euphorbia myrsinites</i>	myrtle spurge
<i>Foeniculum vulgare</i>	common fennel

<i>Geranium robertianum</i>	herb-Robert
<i>Hieracium atratum</i>	polar hawkweed
<i>Hieracium aurantiacum</i>	orange hawkweed
<i>Hieracium caespitosum</i>	yellow hawkweed
<i>Hieracium glomeratum</i>	queen-devil hawkweed
<i>Hieracium laevigatum</i>	smooth hawkweed
<i>Hieracium pilosella</i>	mouseear hawkweed
<i>Hypochaeris radicata</i>	common catsear
<i>Impatiens glandulifera</i>	policeman's helmet
<i>Kochia scoparia</i>	kochia
<i>Lamiastrum galeobdolon</i>	yellow archangel
<i>Lepidium latifolium</i>	perennial pepperweed
<i>Lepyroclis holosteoides</i>	lepyroclis
<i>Leucanthemum vulgare</i>	oxeye daisy
<i>Linaria dalmatica</i> ssp. <i>dalmatica</i>	Dalmatian toadflax
<i>Ludwigia hexapetala</i>	water primrose
<i>Lysimachia vulgaris</i>	garden loosestrife
<i>Lythrum salicaria</i>	purple loosestrife
<i>Lythrum virgatum</i>	wand loosestrife
<i>Myriophyllum aquaticum</i>	parrotfeather
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil
<i>Nymphoides peltata</i>	yellow floatingheart
<i>Onopordum acanthium</i>	Scotch thistle
<i>Phragmites australis</i>	common reed (nonnative genotypes)
<i>Picris hieracioides</i>	hawkweed oxtongue
<i>Polygonum x bohemicum</i>	Bohemian knotweed
<i>Polygonum cuspidatum</i>	Japanese knotweed
<i>Polygonum polystachyum</i>	Himalayan knotweed
<i>Polygonum sachalinense</i>	giant knotweed
<i>Potentilla recta</i>	sulfur cinquefoil
<i>Rorippa austriaca</i>	Austrian fieldcress
<i>Sagittaria graminea</i>	grass-leaved arrowhead
<i>Senecio jacobaea</i>	tansy ragwort
<i>Soliva sessilis</i>	lawnweed
<i>Sonchus arvensis</i> ssp. <i>arvensis</i>	perennial sowthistle
<i>Sphaerophysa salsula</i>	swainsonpea
<i>Tamarix ramosissima</i>	saltcedar
<i>Tribulus terrestris</i>	puncturevine
<i>Ulex europaeus</i>	gorse

Class C Weeds: Noxious weeds which are already widespread in WA or are of special interest to the state's agricultural industry. The Class C status allows counties to enforce control if locally desired. Other counties may choose to provide education or technical consultation.

Class C Weeds	
Scientific name	Common name(s)
<i>Aegilops cylindrica</i>	jointed goatgrass
<i>Ailanthus altissima</i>	tree-of-heaven
<i>Artemisia absinthium</i>	absinth wormwood
<i>Cardaria draba</i>	hoary cress
<i>Cardaria pubescens</i>	hairy whitetop
<i>Cirsium arvense</i>	Canada thistle
<i>Cirsium vulgare</i>	bull thistle
<i>Clematis vitalba</i>	old-man's-beard
<i>Convolvulus arvensis</i>	field bindweed
<i>Cuscuta approximata</i>	smoothseed alfalfa dodder
<i>Gypsophila paniculata</i>	babysbreath
<i>Hedera helix</i> 'Baltica', 'Pittsburgh', and 'Star'; <i>H. hibernica</i> 'Hibernica'	English ivy - four cultivars only
<i>Hemizonia pungens</i>	spikeweed
<i>Hieracium lachenalii</i>	common hawkweed
<i>Hieracium</i> spp.	hawkweeds, nonnative and invasive species not listed elsewhere
<i>Hyoscyamus niger</i>	black henbane
<i>Hypericum perforatum</i>	common St. Johnswort
<i>Iris pseudacorus</i>	yellowflag iris
<i>Linaria vulgaris</i>	yellow toadflax
<i>Matricaria perforata</i>	scentless mayweed
<i>Nymphaea odorata</i>	fragrant waterlily
<i>Phalaris arundinacea</i>	reed canarygrass
<i>Potamogeton crispus</i>	curlyleaf pondweed
<i>Rubus armeniacus</i>	Himalayan blackberry
<i>Rubus laciniatus</i>	evergreen blackberry
<i>Secale cereale</i>	cereal rye
<i>Senecio vulgaris</i>	common groundsel
<i>Silene latifolia</i> ssp. <i>alba</i>	white cockle
<i>Tanacetum vulgare</i>	common tansy
<i>Xanthium spinosum</i>	spiny cocklebur
<i>Zostera japonica</i>	Japanese eelgrass (on commercially managed shellfish beds only)

APPENDIX D-2

2012 WSDA Quarantine Plant Lists

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.

Scientific name	Common name(s)
<i>Butomus umbellatus</i>	flowering rush
<i>Cabomba caroliniana</i>	fanwort
<i>Crassula Helmsii</i>	Australian swamp stonecrop
<i>Egeria densa</i>	Brazilian elodea
<i>Epilobium hirsutum</i>	hairy willow herb
<i>Glossostigma diandrum</i>	mud mat
<i>Glyceria maxima</i>	reed sweetgrass, tall manna grass
<i>Hydrilla verticillata</i>	hydrilla
<i>Hydrocharis morsus-rana</i>	European frog-bit
<i>Lagarosiphon major</i>	African elodea
<i>Ludwigi peploides</i>	floating primrose-willow
<i>Ludwigia hexapetala</i>	water primrose
<i>Lysimachia vulgaris</i>	garden loosestrife
<i>Murdannia keisak</i>	marsh dew flower; Asian spiderwort
<i>Myriophyllum aquaticum</i>	parrotfeather
<i>Myriophyllum hterophyllum</i>	variable-leaf milfoil
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil
<i>Najas minor</i>	slender-leaved naiad; brittle naiad
<i>Nymphoides peltata</i>	yellow floating heart
<i>Sagittaria graminea</i>	grass-leaved arrowhead
<i>Sagittaria platyphylla</i>	delta arrowhead
<i>Schoenoplectus mucronatus</i>	ricefield bulrush
<i>Spartina alterniflora</i>	smooth cordgrass
<i>Spartina anglica</i>	common cordgrass
<i>Spartina densiflora</i>	dense-flowering cordgrass
<i>Spartina patens</i>	salt meadow cordgrass
<i>Stratiotes aloides</i>	water soldier
<i>Trapa bicornus</i>	water caltrap; devil's pod; bat nut
<i>Trapa natans</i>	water chestnut; bull nut
<i>Utricularia inflata</i>	swollen bladderwort

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.

Scientific name	Common name(s)
<i>Abutilon theophrasti</i>	velvetleaf
<i>Alliaria petiolata</i>	garlic mustard
<i>Amorpha fruticosa</i>	Indigobush; lead plant
<i>Anchusa officinalis</i>	common bugloss
<i>Anthriscus sylvestris</i>	wild chervil
<i>Brachypodium sylvaticum</i>	false brome
<i>Carduus acanthoides</i>	plumeless thistle
<i>Carduus nutans</i>	musk thistle; nodding thistle
<i>Carduus pycnocephalus</i>	Italian thistle
<i>Carduus tenuiflorus</i>	slenderflower thistle
<i>Centaurea biebersteinii</i>	spotted knapweed
<i>Centaurea calcitrapa</i>	purple starthistle
<i>Centaurea diffusa</i>	diffuse knapweed
<i>Centaurea jacea</i>	brown knapweed; rayed knapweed; hard-heads; brown centaury; horse-knobs
<i>Centaurea jacea x nigra</i>	meadow knapweed
<i>Centaurea macrocephala</i>	bighead knapweed; lemon fluff; globe centaury
<i>Centaurea nigra</i>	black knapweed
<i>Centaurea nigrescens</i>	Vochin knapweed
<i>Chaenorrhinum minus</i>	dwarf snapdragon
<i>Crupina vulgaris</i>	common crupina
<i>Cytisus scoparius</i>	Scotch broom
<i>Daucus carota</i>	wild carrot; Queen Anne's lace
<i>Echium vulgare</i>	Blueweed; viper's bugloss; blue devil
<i>Euphorbia esula</i>	leafy spurge
<i>Euphorbia oblongata</i>	eggleaf spurge
<i>Galega officinalis</i>	goatsrue
<i>Geranium lucidum</i>	shiny geranium
<i>Helianthus ciliaris</i>	Texas blueweed
<i>Heracleum mantegazzianum</i>	giant hogweed
<i>Hibiscus trionum</i>	Venice mallow; flower-of-an-hour
<i>Hieracium aurantiacum</i>	orange hawkweed; red daisy; flameweed; devil's weed
<i>Hieracium caespitosum</i>	yellow hawkweed; devil's paintbrush; yellow paintbrush
<i>Hieracium floribundum</i>	yellow devil hawkweed
<i>Hieracium pilosella</i>	mouseear hawkweed
<i>Hieracium sabaudum</i>	European hawkweed
<i>Impatiens glandulifera</i>	policeman's helmet; Himalayan balsam;

	jewelweed
<i>Isatis tinctoria</i>	dyers woad
<i>Kochia scoparia</i>	Kochia; burning bush; summer-cyprus; Fireball; Mexican fireweed
<i>Lepidium latifolium</i>	perennial pepperweed
<i>Leucanthemum vulgare</i>	oxeye daisy; white daisy; field daisy
<i>Linaria dalmatica</i> ssp. <i>dalmatica</i>	Dalmatian toadflax
<i>Mirabilis nyctaginea</i>	wild four o'clock; umbrella-wort
<i>Onopordum acanthium</i>	Scotch thistle
<i>Polygonum cuspidatum</i>	Japanese knotweed
<i>Polygonum polystachyum</i>	Himalayan knotweed
<i>Polygonum sachalinense</i>	Giant knotweed
<i>Proboscidea louisianica</i>	unicorn plant
<i>Pueraria montana</i> var. <i>lobata</i>	kudzu
<i>Salvia aethiopsis</i>	Mediterranean sage
<i>Salvia pratensis</i>	meadow clary
<i>Salvia sclarea</i>	clary sage
<i>Senecio jacobaea</i>	tansy ragwort
<i>Silybum marianum</i>	milk thistle
<i>Solanum elaeagnifolium</i>	silverleaf nightshade
<i>Solanum rostratum</i>	buffalobur
<i>Soliva sessilis</i>	lawnweed
<i>Sorghum halepense</i>	Johnsongrass
<i>Spartium junceum</i>	Spanish broom
<i>Tamarix ramosissima</i>	saltcedar
<i>Thymelaea passerina</i>	spurge flax
<i>Torilis arvensis</i>	hedgearsley
<i>Ulex europaeus</i>	gorse; furze
<i>Zygophyllum fabago</i>	Syrian bean-caper

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.

Scientific name	Common name(s)
<i>Lythrum salicaria</i>	purple loosestrife
<i>Lythrum virgatum</i>	wand loosestrife

APPENDIX E

Project Maps

Noxious weed survey data was provided by the Benton, Kittitas and Yakima County Noxious Weed Control Boards, the Yakama Nation, Washington State University Integrated Weed Control Program and the Washington State Departments of Agriculture, Ecology and Fish and Wildlife.

Data for the Water Resource Inventory Areas (WRIA's) was provided by the Washington State Department of Ecology.

Data for the Rare Plant Species and Endangered Ecosystems map was provided by the Washington State Department of Natural Resources, Washington Natural Heritage Program.

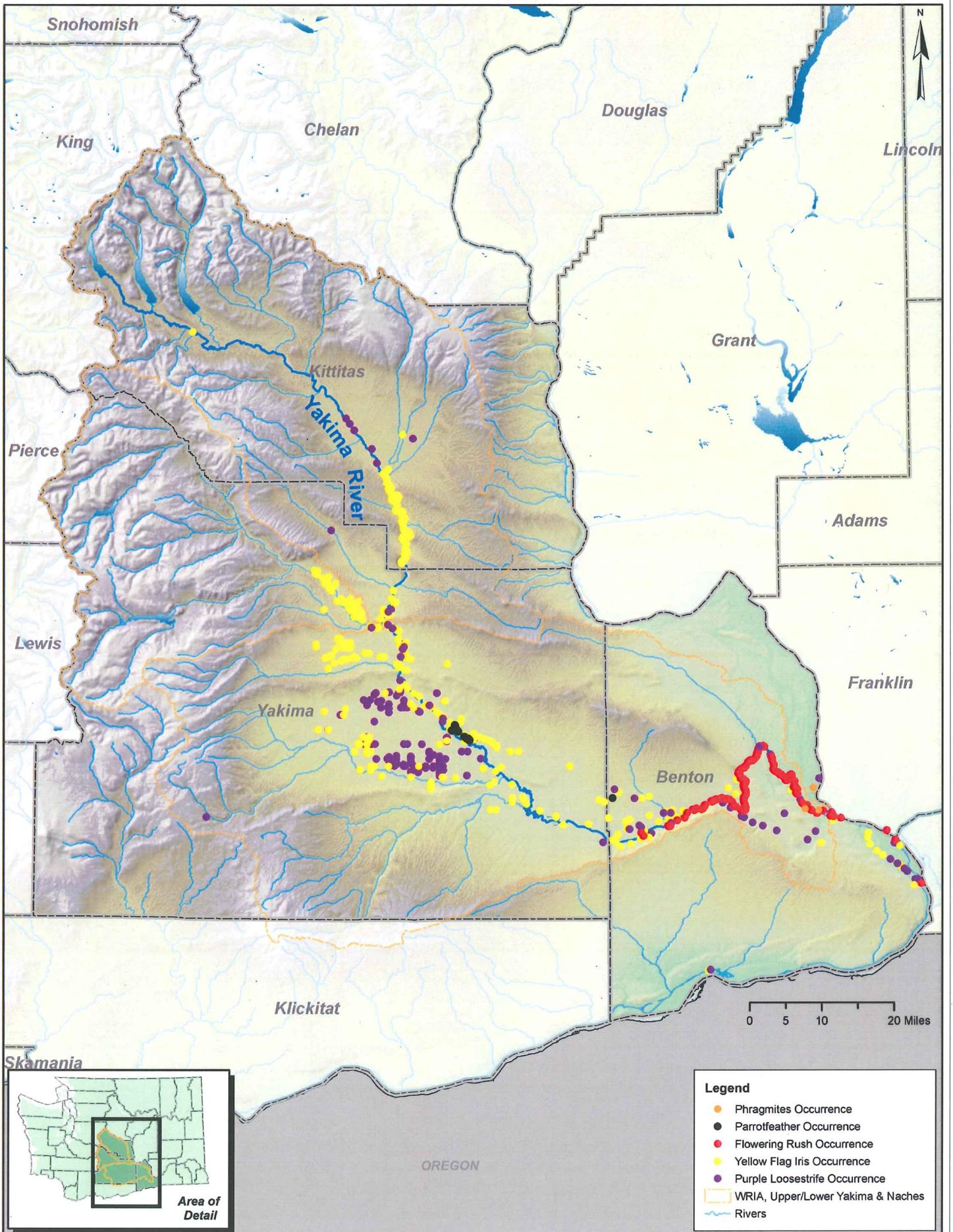
All of the maps were created by Landon Udo, GIS Specialist, Washington State Department of Agriculture.

No warranty is made by WSDA as to the accuracy, reliability, or completeness of this data for individual or aggregate use with other data.

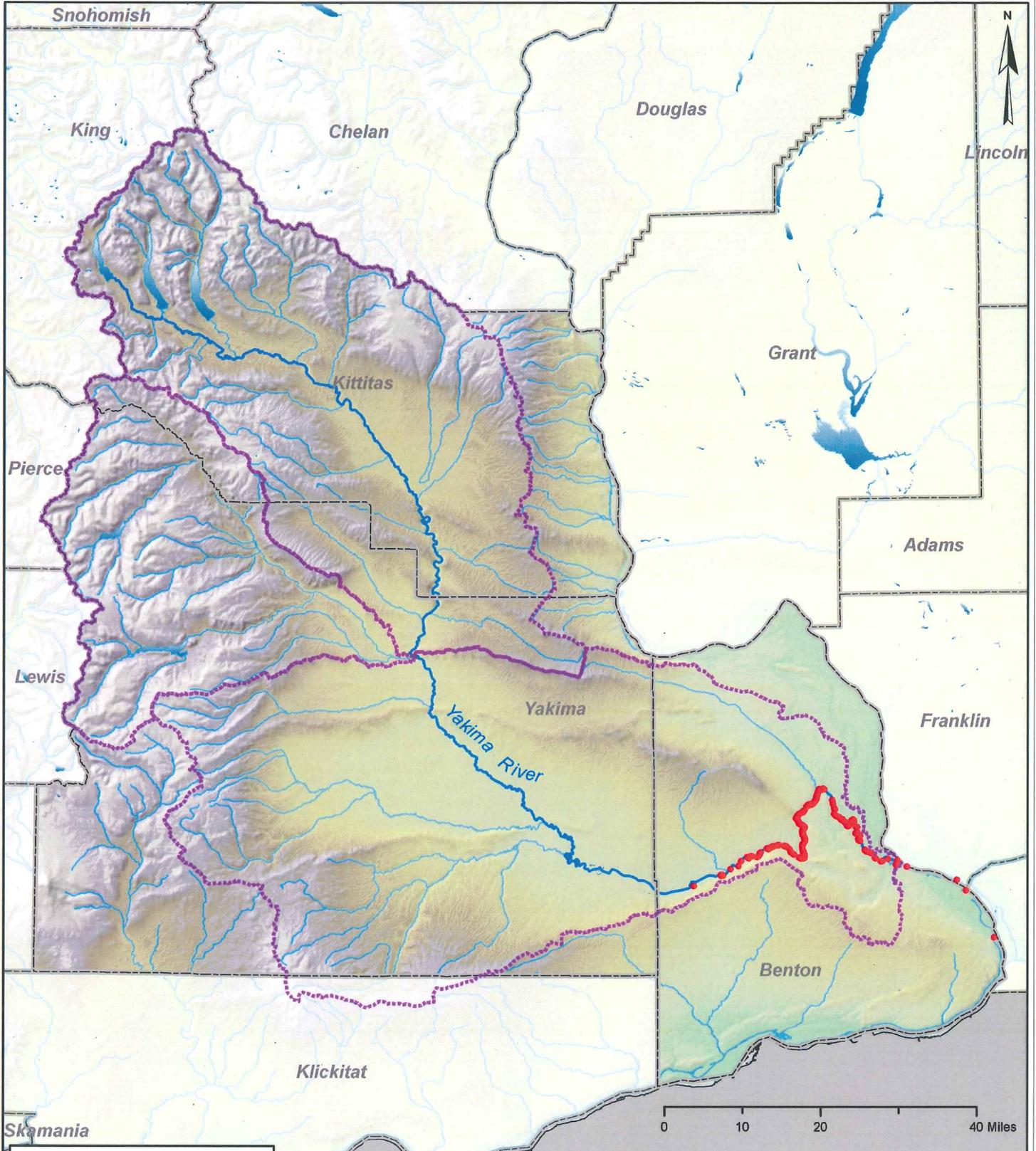
Project Maps

1. Yakima River Basin with 5 targeted weed species
2. Flowering rush distribution map
3. Parrotfeather distribution map
4. *Phragmites* distribution map
5. Purple loosestrife distribution map
6. Yellow-flag iris distribution map
7. Rare plant species and endangered ecosystems map

Yakima River Basin IAVMP Project Area, All Project Weed Occurrences 2011



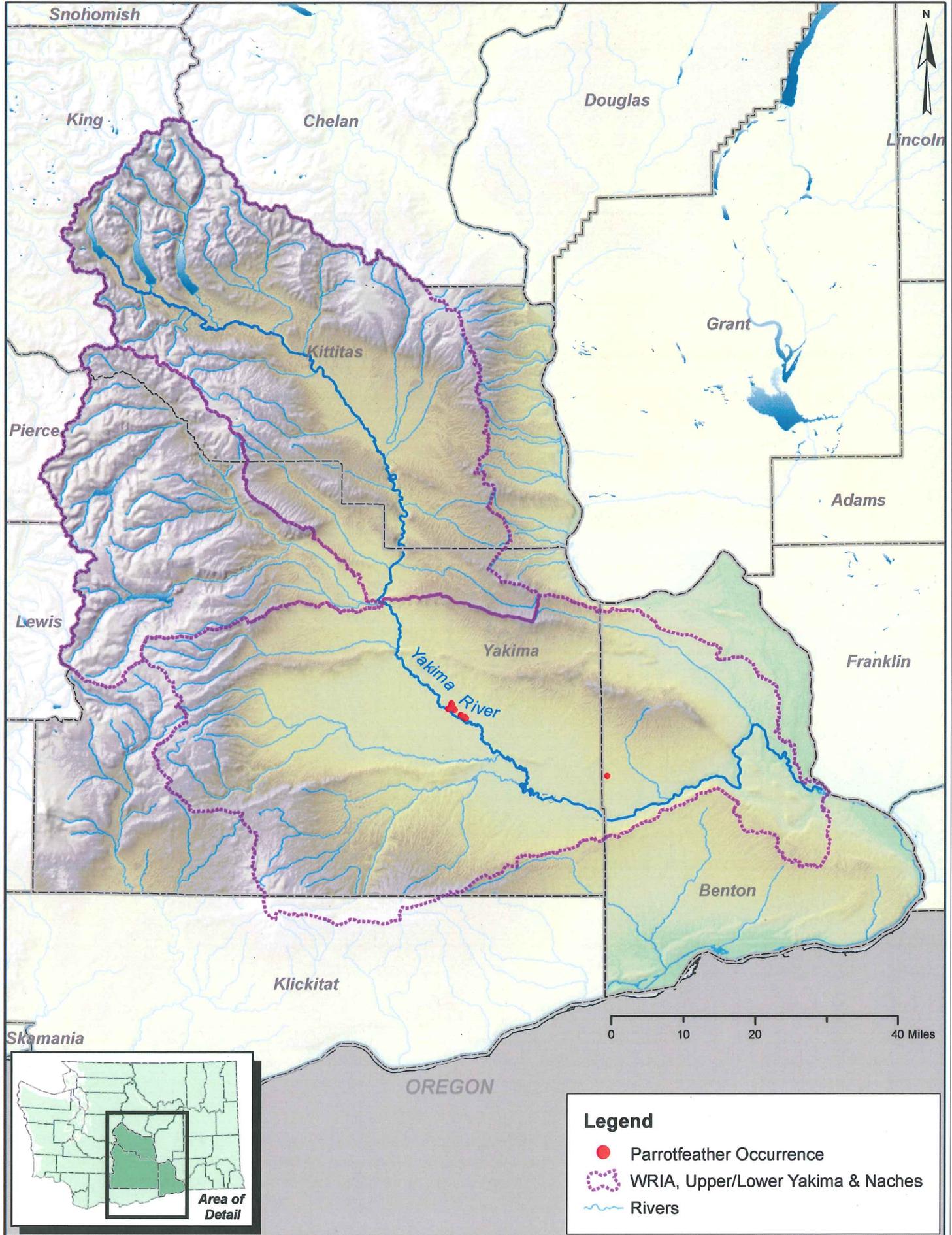
Yakima River Basin IAVMP Project Area, Flowering Rush Occurrences 2011



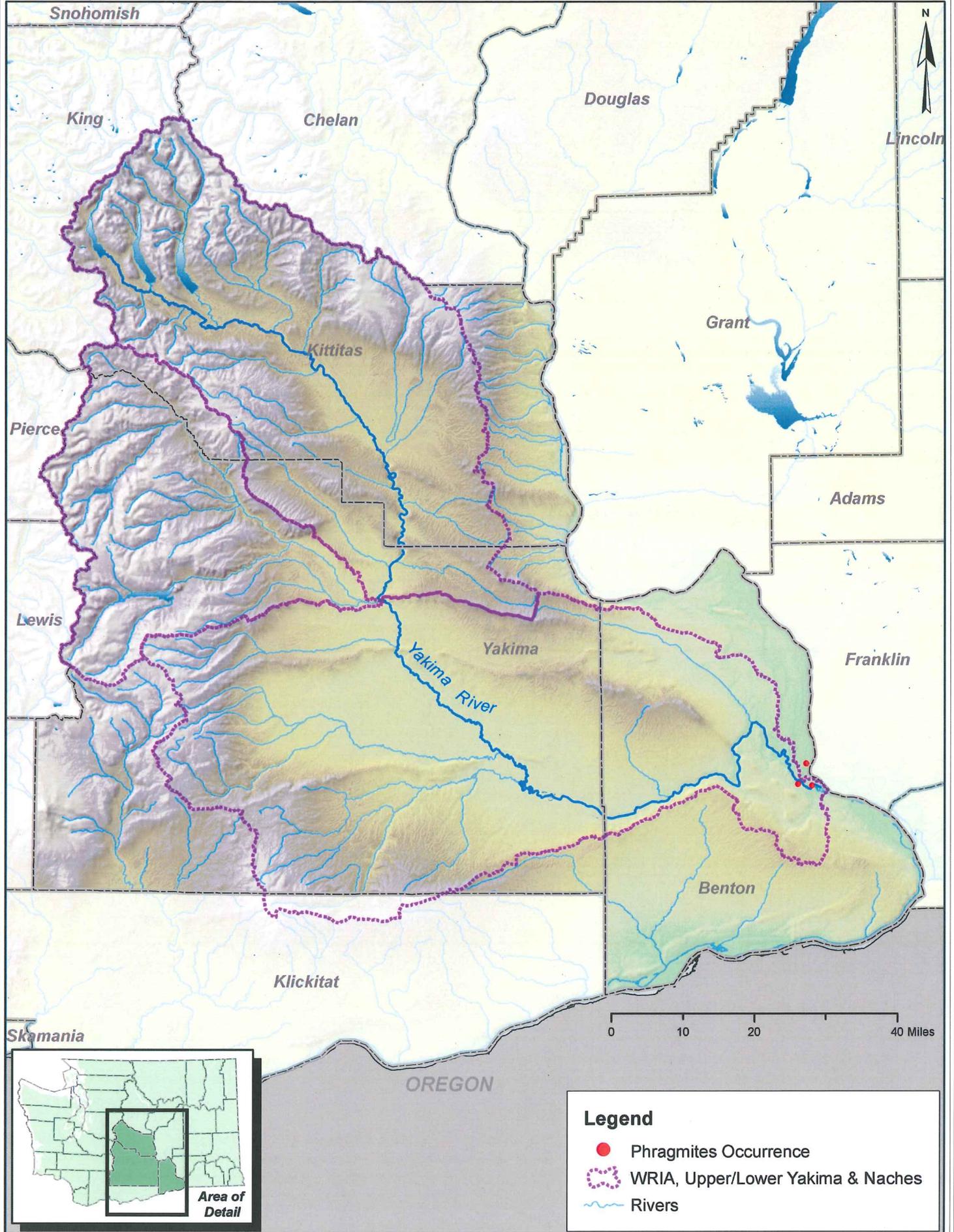
Legend

- Flowering Rush Occurrence
- WRIA, Upper/Lower Yakima & Naches
- ~ Rivers

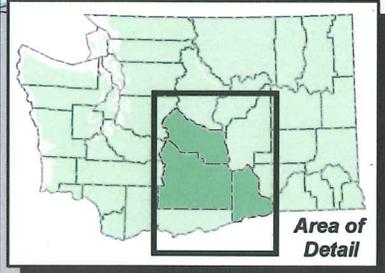
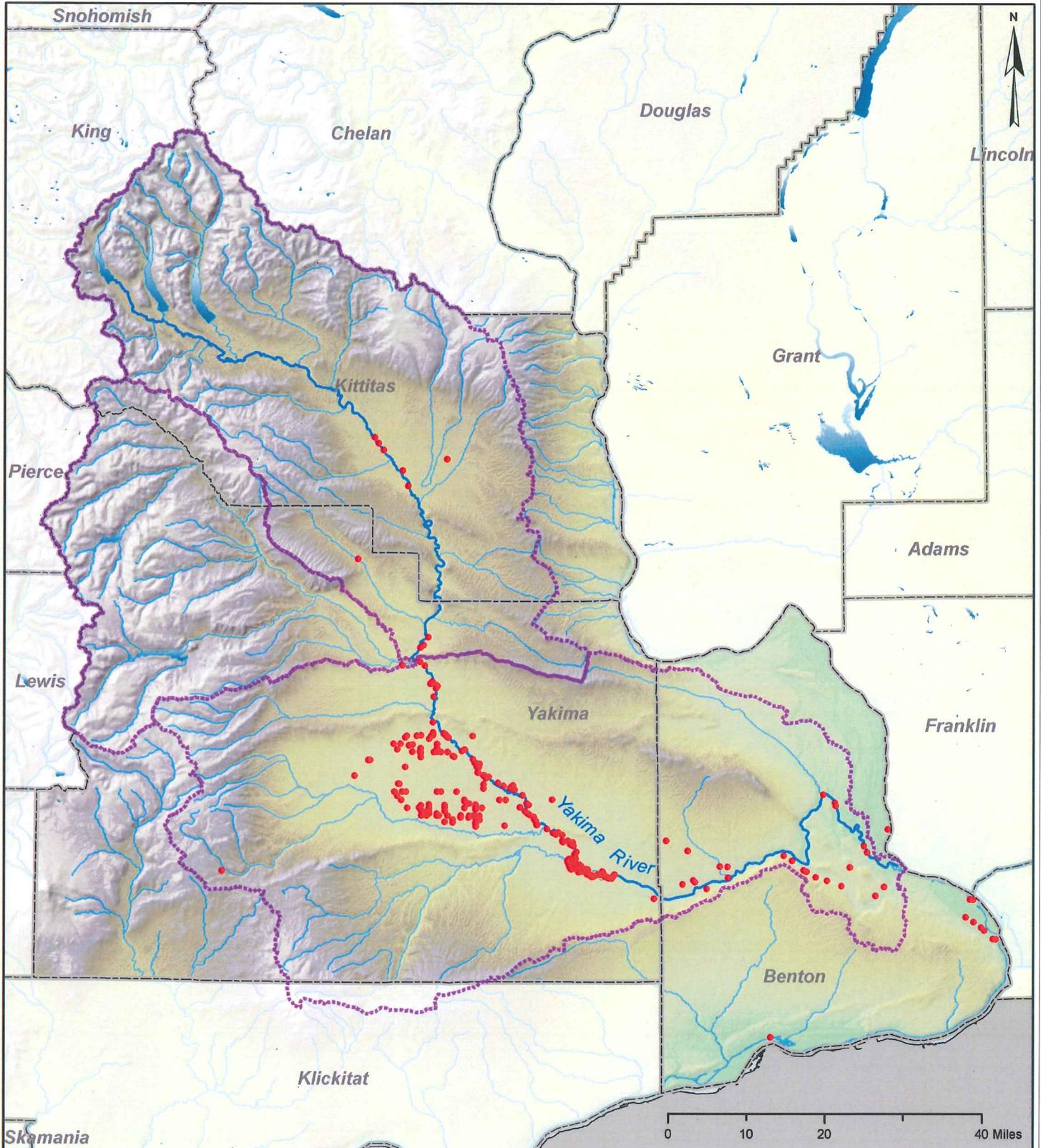
Yakima River Basin IAVMP Project Area, Parrotfeather Occurrences 2011



Yakima River Basin IAVMP Project Area, Phragmites Occurrences 2011



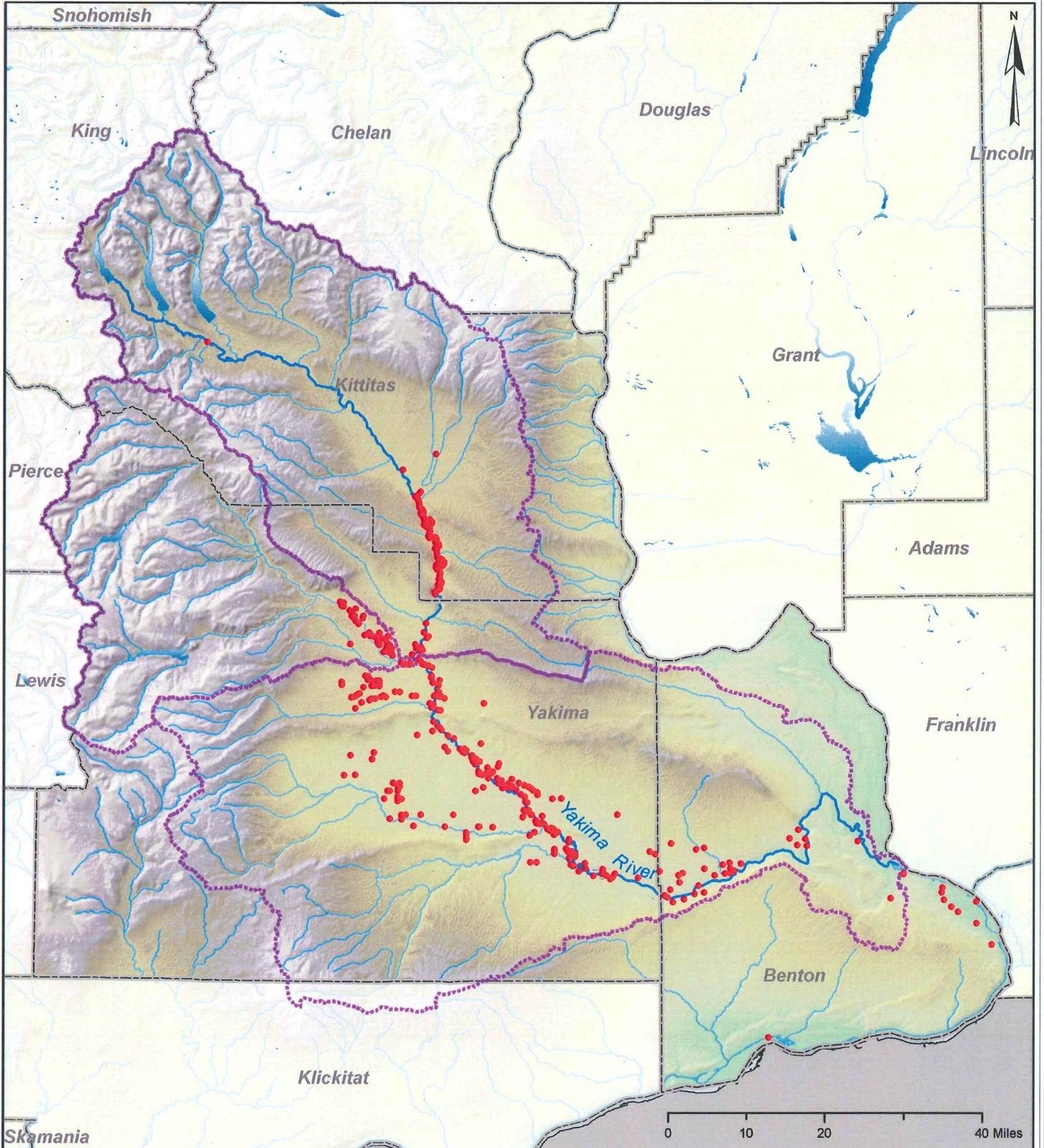
Yakima River Basin IAVMP Project Area, Purple Loostripe Occurrences 2011



Legend

- Purple Loostripe Occurrence
- WRIA, Upper/Lower Yakima & Naches
- ~ Rivers

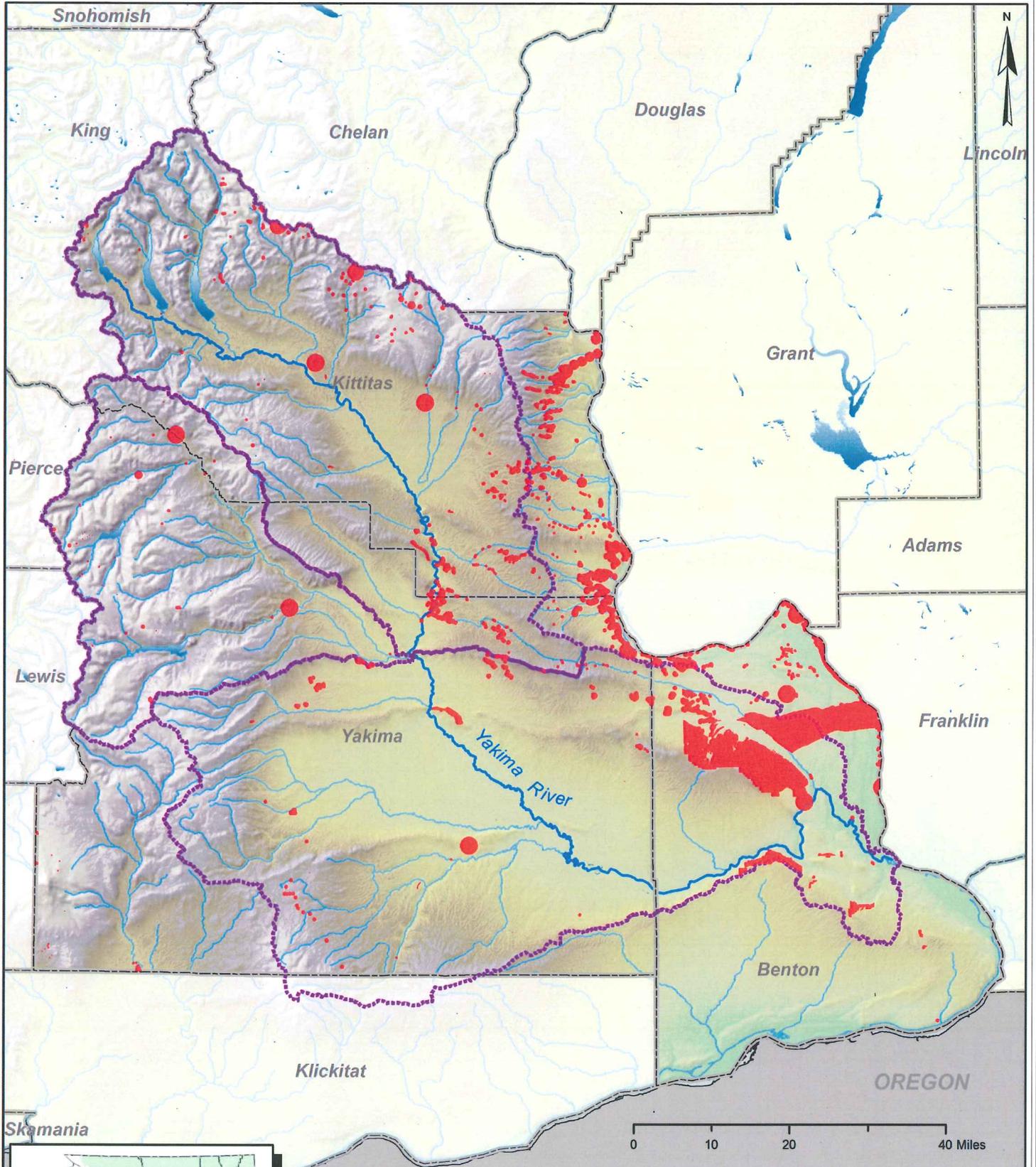
Yakima River Basin IAVMP Project Area, Yellow Flag Iris Occurrences 2011



Legend

- Yellow Flag Iris Occurrence
- WRIA, Upper/Lower Yakima & Naches
- ~ Rivers

Yakima River Basin IAVMP Project Area, Rare Plants and Endangered Ecosystems 2011



Legend

-  WNHP, Rare Plant Species and Endangered Ecosystems
-  WRIA, Upper/Lower Yakima & Naches
-  Rivers