

Integrated Aquatic Vegetation Management Plan

SAMMAMISH RIVER

King County, Washington



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EXECUTIVE SUMMARY

The Sammamish River is a 13.5-mile-long waterway that connects Lake Sammamish to Lake Washington. The basin drains a 240-square-mile watershed that is comprised of the Sammamish River, Bear Creek, Little Bear, Swamp Creek, and North Creek basins. The River is part of the Lake Washington watershed and is in Water Resource Inventory Area 8. Many municipalities are along the river, including Bothell, Woodinville, Kenmore, and Redmond. Land use along the river ranges from agricultural to industrial to public and private.

Once a series of wetlands and slow moving water connecting the two large lakes, the river was straightened and dredged for commerce from the early 1900's through the mid-1900's. It is no longer used for commerce and today there is public access to the river which is enjoyed for canoeing, kayaking, and fishing. Along most of the river there is a popular walking/biking trail that spans from Bothell to Marymoor Park. City and county parks along the river provide many public access points to the water which are used for birding, wildlife watching, fishing, dog recreating, and hand-launch boat access.

The river provides important habitat for many different types of wildlife. Birds and small mammals use the river banks for forage and shelter and many aquatic animals use the river for both the important habitat and access to other ecologically important areas. The river is used by several key salmonid species for spawning, rearing and passage. Chinook, Coho, Sockeye, Kokanee, Steelhead, and Coastal Cutthroat are salmonid species known to currently inhabit the Sammamish River system (Kerwin, 2001).

Invasive noxious weeds have been identified in the river system and pose threats to water quality and aquatic habitat. Four weeds: purple loosestrife (*Lythrum salicaria*), garden loosestrife (*Lysimachia vulgaris*), common reed (*Phragmites australis*) and Brazilian elodea (*Egeria densa*) are particularly critical for removal. These four target weed species are all classified as Class B weeds on the King County noxious weed list, being limited in distribution and a local priority for control. All are designated for control in King County except Brazilian elodea which is a non-regulated weed in the Sammamish River. Despite this classification, Brazilian elodea is part of the focus of this management plan and needs to be controlled in the river because dense mats of the submerged plant are already forming and there is risk of further habitat loss for endangered species act (ESA) listed salmonid species. While control of these Class B target weeds has been minimally addressed to date, there is a strong recommendation for these plants to be controlled within the river system.

Representatives from the municipalities along the river, non-profit groups, concerned citizens, state agencies, and King County Water and Land Resources Division worked together to apply for an Aquatic Weeds Management Fund grant through the Washington Department of Ecology (Ecology) to develop this Integrated Aquatic Vegetation Management Plan (IAVMP).

It is known that many other noxious weeds also occur along the river including, Himalayan blackberry, English ivy, reed canary grass, yellow-flag iris, invasive knotweed, curly leaf pondweed, and Eurasian watermilfoil. These noxious weeds are wide spread and not regulated in King County, but control of them is recommended to ensure the best outcome when restoring the river corridor. This IAVMP will not discuss these non-regulated weeds in detail, but King County Noxious Weed Control Program produced Best Management Practices (BMPs) documents for these weeds which are included as an appendix (Appendix A). These BMPs will help guide any groups or municipalities working on the river on how best to deal with the unregulated noxious weeds.

This IAVMP is a planning document developed to ensure that the applicant and stakeholders have considered the best available information about the waterbody and watershed prior to initiating control efforts. Members of King County Water and Land Resources staff, bordering municipalities, Washington State agencies, river front property owners, and non-profits worked in partnership to develop this IAVMP for the Sammamish River. A core group of stakeholders, along with several King County Staff, formed an IAVMP Steering Committee to address the task of generating community appreciation of and action towards this important ecological, aesthetic and recreational goal. The Committee was able to educate others about the problem, contribute feedback about different treatment options, and work together to decide how best to manage the Sammamish River noxious weed problem.

This IAVMP presents an overview of the aquatic weed problems, details about the planning process, watershed and river characteristics, a review of suitable control options, a management plan, budget and funding plans, and an implementation plan. There is also a large Appendix section that contains background and supporting documents.

LOCATION

The Sammamish River watershed is located in northwest King County (about 70% of total acreage) and southwest Snohomish County (about 30% of total acreage), Washington (Figure 1). Included in the watershed are all or portions of the incorporated cities of: Everett, Mill Creek, Lynnwood, Mountlake Terrace, Brier, Kenmore, Bothell, Woodinville, Redmond, Bellevue, Sammamish, and Issaquah as well as unincorporated portions of King and Snohomish County. The watershed is composed of approximately 153,600 acres that includes 62,080 acres in the Lake Sammamish basin, 32,000 acres in the Bear Creek basin, and 42,880 acres that are the combined Little Bear, Swamp, and North Creek basins. The remaining 16,640 acres comprise the Sammamish River subbasin. In addition to Lake Sammamish and its tributaries, major streams inputs in the river include Bear Creek, Little Bear Creek, North Creek, and Swamp Creek.



Figure 1. Sammamish River Watershed and IAVMP Project Area Regional Map (King County GIS Center, 2006).

State resource agencies frequently use a system of Water Resource Inventory Areas (WRIA) to refer to the state’s major watershed basins. The Sammamish River is located in WRIA 8, which refers to the Cedar-Sammamish combination watershed and includes Lake Washington, Lake Sammamish, and the Cedar River. From the termination of the Sammamish River, it is another 15 miles through the Lake Washington-Lake Union water body to the Puget Sound via the United States Army Corps of Engineers (USACE) Hiram M. Chittenden Locks. The Sammamish River contributes approximately 27 percent of the surface flow to Lake Washington (Kerwin, 2001).

The IAVMP Project Area, as outlined in Figure 1 and other subsequent maps, focuses on the Sammamish River corridor, including the valley floor and the lower extent of tributaries as they enter the River. This project area is 5,373 acres.

PROBLEM STATEMENT

Due to the presence of several species of invasive aquatic noxious weeds, the Sammamish River is in danger of losing aesthetic beauty, wildlife habitat, and recreational benefits which it provides. If left unmanaged, Brazilian elodea could blanket the river in a short time, limiting many recreational uses and eliminating important aquatic habitat. Invasive shoreline plants threaten to turn the shoreline habitat of the Sammamish River into monoculture stands, reducing the suitability of wildlife habitat that the native plants provide.

There are many types of invasive weeds present in the system but this plan will focus on the three Class B regulated aquatic shoreline weeds and the one highly invasive but Class B submerged weed. The goal will be to control and manage the weeds to decrease the threat to the river system. These four weeds are *Lysimachia vulgaris* (garden loosestrife), *Lythrum salicaria* (purple loosestrife), *Phragmites australis* (phragmites, common reed) and *Egeria densa* (Brazilian elodea).

These invasive plants:

- Pose a safety hazard to boaters by entanglement of boating equipment;
- Crowd out native plants, creating monocultures lacking in biodiversity;
- Decrease water quality by affecting temperatures and dissolved oxygen,
- Significantly reduce fish and wildlife habitat, which will potentially degrade fish and wildlife populations;
- Reduce wildlife viewing opportunities;
- Pose a threat to adjoining ecosystems.

Brazilian elodea is the most significant invasive threat to the waterway, but other noxious weeds have been identified in the Sammamish River. Purple and garden loosestrife and common reed have populations along the shoreline that will spread rapidly and out-compete native plants, damaging the ecological functions of the surrounding habitat.

At this point, it will be impossible to discuss the possibility of eradication for the four weeds because of the seed source found upstream in Lake Sammamish. All of the shoreline plants, except for phragmites, have extensive populations in Lake Sammamish, meaning there will be a constant source for reinfestation in the Sammamish River. The same is true for the Brazilian elodea. However, control of the noxious weeds on the river is important to halt and minimize the impacts they have on the river and in order to start the work, it is important to tackle these four weeds first and then through the experiences and successes of this effort, work with shoreline municipalities, non-profit organizations and citizens on continuing the effort of control by working on the non-regulated noxious weeds and restoring the native plant populations in and around the river.

MANAGEMENT GOALS

The goal for this IAVMP is to begin control efforts of the regulated aquatic noxious weeds in and along the Sammamish River in a manner that increases the ability for native plant and animal communities to thrive, maintains acceptable water quality conditions, and facilitates recreational enjoyment of the river.

The following objectives will be pursued to ensure success in meeting this goal:

- Control of the submerged aquatic noxious weed Brazilian elodea to reduce existing populations below the level of significant impact.
- Control of regulated shoreline noxious weeds to reduce existing populations below the level of significant impact and to prevent spread.
- Maintain safe conditions for native salmonids during weed control efforts.
- Involve the Sammamish River community in planning and implementation of the IAVMP.

Detailed treatment prescriptions for each of the noxious weeds that encompass these management goals are covered in subsequent sections of this plan.

COMMUNITY INVOLVEMENT

Steering Committee, outreach, and education process

The King County Department of Natural and Resources and Parks (DNRP) has taken the lead on the IAVMP process for the Sammamish River. In 2010, the King County Noxious Weed Program applied for and received a grant from the Department of Ecology to work with the Sammamish River Community and write the IAVMP for the three Class B regulated weeds and Brazilian elodea which are invasive weed threats in the system.

In spring of 2011, the first steering committee meeting was held at King County where the IAVMP document and process was discussed at length. Thirteen people attended this meeting as a kick off to the project. Attendees included shoreline property owners, local municipal representatives, King County representatives, and WA State agency personnel.

During the remainder of 2011 and the first half of 2012 very little community involvement was done due to project administrative changes. In mid-June 2012 the project was assigned a new project manager and the project has been on track since.

June 2012: Steering Committee Meeting

A meeting was held with 5 attendees that discussed the new project administration and the next steps. A timeline and outline of the IAVMP was discussed

January 2013: Steering Committee Meeting

A third steering committee meeting was held at the end of January 2013. At this meeting, stakeholders discussed the first part of the IAVMP for feedback. The upcoming meeting schedule and the summer surveying/field work schedule were presented.

April 2013: Steering Committee Meeting

At this meeting the second part of the IAVMP, Management Options, was discussed at length

Continuing Community Education

To ensure that the efforts are consistent with best available science and water quality standards, information will be disseminated through bordering jurisdictions, non-profits that work in and on the

river as well as the WRIA 8 Ecological Forum. Watershed mailings can be used when applicable. The steering committee will be able to act as a liaison between community members and groups, jurisdictions and King County DNRP.

WATERSHED AND WATERBODY CHARACTERISTICS

The Sammamish River connects Lake Sammamish to Lake Washington. The basin drains a 240 square mile watershed comprised of the Sammamish River, Bear Creek, Little Bear, Swamp Creek, and North Creek basins (Figures 1, 4).

History of the River

Historically, the Sammamish River was somewhat longer than it is today with abundant “swampy” areas that were filled with peat and diatomaceous earth. Before development the river was approximately 30 miles long and had an even gentler gradient than today (Chrastowski, 1983). The river corridor was heavily logged from the 1870s through the early 20th century. Throughout the 20th century, the river went through dramatic changes that reduced the complexity of the floodplain including the lowering of the Lake Washington, the channelization of the river, and the construction of drainage ditches in the river valley. The elevation of Lake Washington was lowered about nine feet with the opening of the Chittenden Locks in 1916, and this elevation change drained much of the swampy Sammamish River corridor. In 1911, farmers in the Sammamish River Valley formed a drainage district that began to straighten, widen, and deepen the upper reach of the river from about NE Redmond Way north. In 1962, The Corps of Engineers began to systematically dredge the river, primarily as a flood control project, thus deepening the river 5 feet throughout most of its length, dramatically decreasing its remaining connection with the floodplain. Through this work the Corps hardened much of the upper part of the river’s banks. This action resulted in most of the smaller tributaries being cut off from the river. The Corps’ project also included the construction of a weir at the Lake Sammamish outlet to help with flood control and maintain water levels. Overall, this project practically eliminated flooding in the Sammamish River valley and reduced the maximum flood elevations and seasonal water surface elevations in Lake Sammamish (King County WLRD, 2012a).

A new weir was installed on the Sammamish River (at river mile 13.24 on the King County river mile designation system) at the outlet of the Lake Sammamish in Marymoor Park in 1998 (Figure 2) (Armburst *et al.*, 2008). The intent of the new weir was, in addition to regulating the level of Lake Sammamish, to “improve fish passage and create a riparian corridor of native vegetation” (2008). No obvious barriers to fish passage were found during a 2002 survey (2008). However, a seasonal thermal barrier (water temperatures potentially uncomfortably warm for some fish) exists between Lake Sammamish and Bear Creek. This is due to the relatively warm water coming from the sun-warmed surface water of Lake Sammamish. At Bear Creek, approximately 1.5 miles downstream of Lake Sammamish, the river receives an input of cooler water (USAC & KC, 2002).

The Sammamish River is now about 13.5 miles long and varies in width from 50-75 feet wide (in the Redmond and Woodinville areas) to about 100 feet wide (in Bothell and Kenmore) to over 200 feet wide near Lake Washington. The upper river corridor extends from Lake Sammamish (about 3,000 feet upstream of the weir) to the city of Woodinville through a floodplain valley that is more than a mile wide in places. Land use in this upper reach includes open space and recreational areas at Marymoor Park, urban commercial and residential development in the city of Redmond, the Willows Run Golf

Course, the Sammamish Valley Agricultural Production District and urban development again in the city of Woodinville. The lower reach extends from Woodinville to the mouth of the river at Lake Washington. This reach has a much narrower drainage area, which includes the downtown cores of Bothell and Kenmore but also open space areas, including the Wayne and Inglemoor Country Club golf courses, Bothell parkland along the Sammamish River Trail, and King County-owned parcels at the mouth of Swamp Creek and the mouth of the river. The WDFW Kenmore Boat Launch facilitates trailer motor boat access to the Sammamish River (Figure 2). From the boat launch, motor boats can navigate upstream as far as the shallow riffle in the waterway just downstream of the junction with Little Bear Creek (at the border between Bothell and Woodinville).

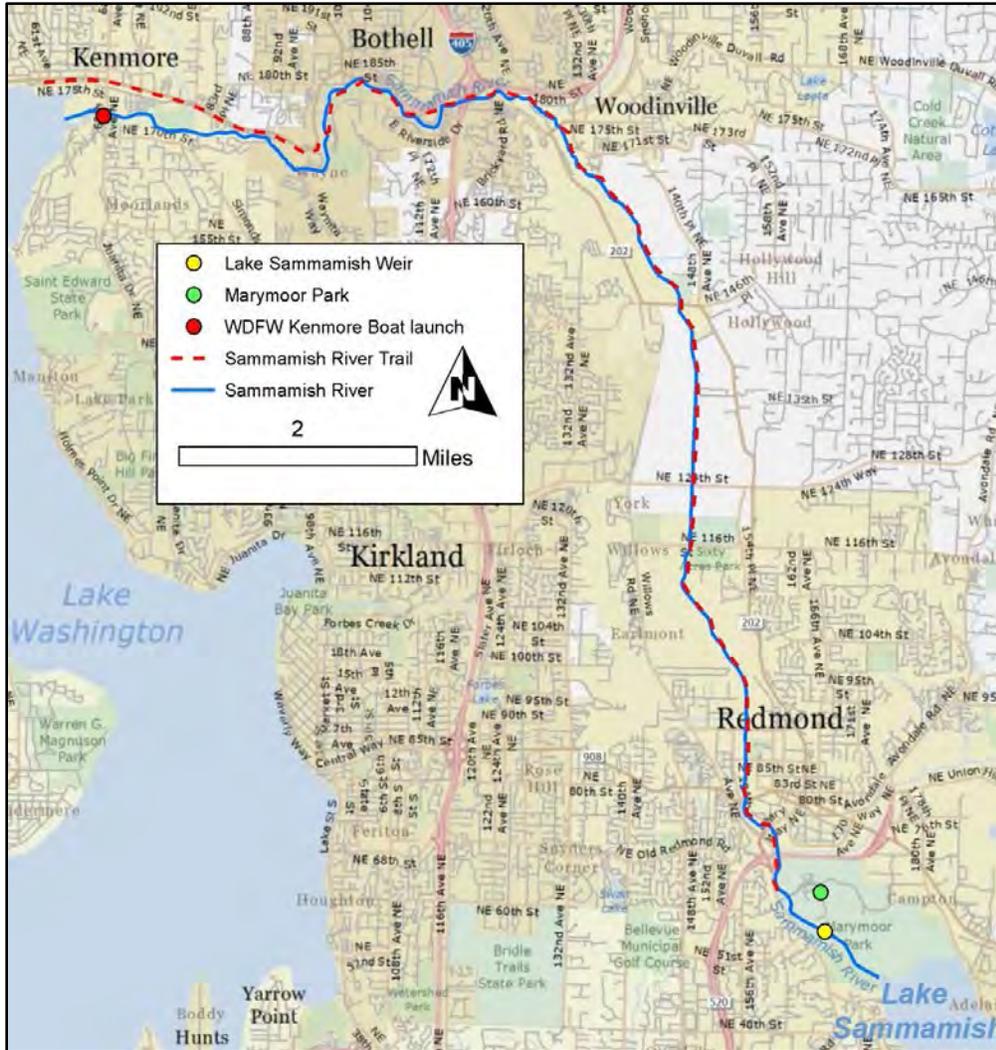


Figure 2. Sammamish River detail.

Land Use Activities in the Watershed and Potential Nonpoint Nutrient Source Locations

The major use within the Sammamish River IAVMP Project Area is residential (Table 1) (Figure 3). The 62% portion of the watershed that is used for residential developments vary from high density multi-family units to 2.5-acre rural lots. The majority of the agriculture in the watershed, approximately 1,450 acres, is concentrated in the Sammamish River 100-year floodplain.

Table 1. Land Use Within the Sammamish River IAVMP Project Area (King County GIS Center, 2007).

Land cover type	acres	% area
cultivated	823	15
mix forest/trees	761	14
grass/herbaceous	1076	20
shrub	109	2
high density development	1608	30
medium density development	722	13
low density development	82	2
water	191	4
total	5372	100

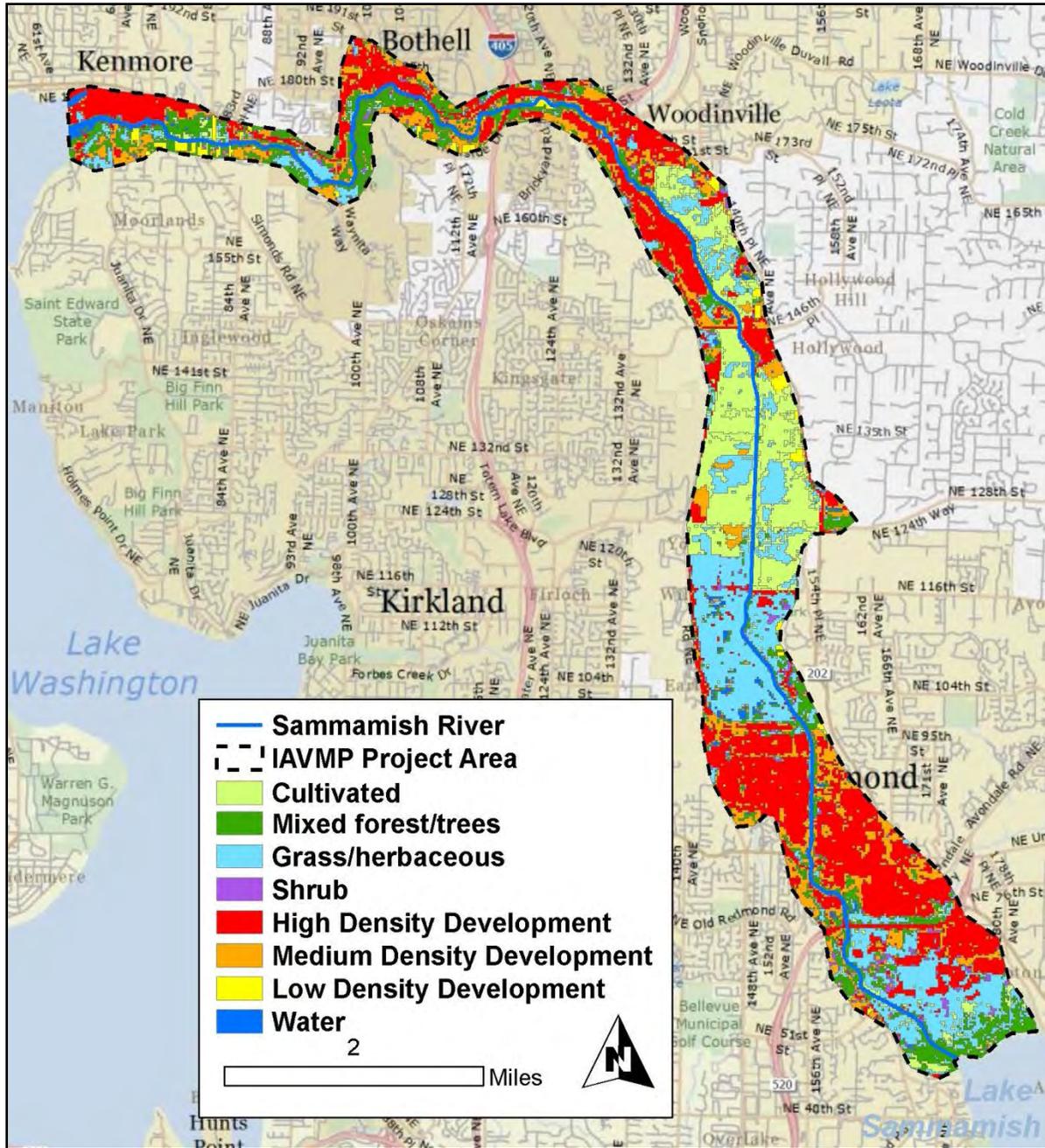


Figure 3. Land use in the Sammamish River IAIVMP Project Area (King County GIS Center, 2007).

Stream and Wetland Locations

There are 144 miles of level 1 streams in the Sammamish River watershed (King County GIS Center 2012) (Figure 4). These are streams and rivers that are designated “shorelines of the state” as defined in 90.58.030 RCW. Within the Sammamish River watershed there are 1135 acres of wetlands (King County GIS Center 2005). Most of this wetland area is scattered throughout the watershed, well away from the river’s influence. However, 81 acres of wetland are at the origin of the Sammamish River near Lake

Sammamish and 13.5 acres of wetland are at the river’s termination at Lake Washington (2005). The remainder of the river is channelized and has no wetlands associated with it.

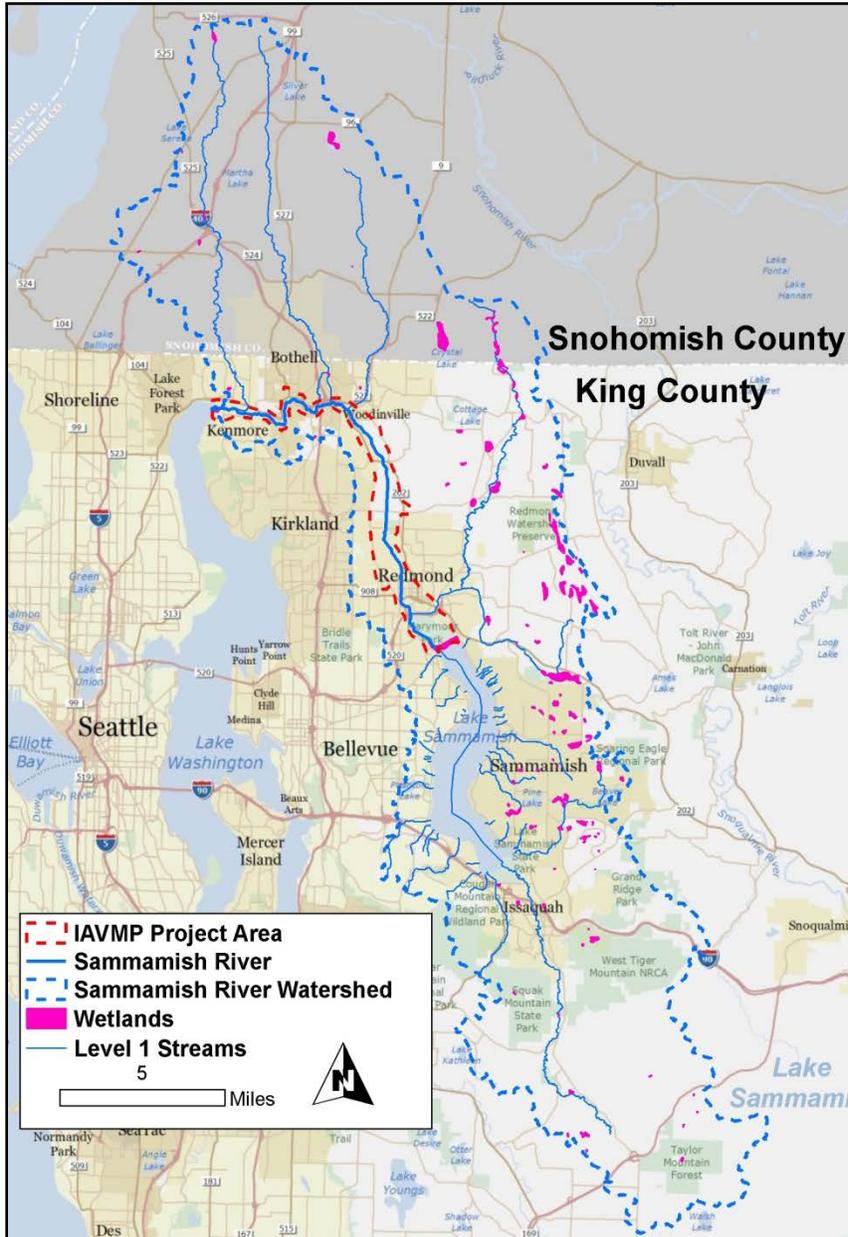


Figure 4. Sammamish River Watershed, Level 1 Stream, and Wetland Map(King County GIS Center, 2005, 2012).

River Flows

The annual average flow rate of the Sammamish River (as measured at the Woodinville USGS gauge # 12125200 from 1965-2000) is 311 cubic feet per second (cfs) (Carey, 2003). The lowest regular flows of 70-75 cfs usually occur in August. Common high flows in the winter range from 500 to 1,550 cfs (values

from stream gauge 51T located at the 116th St NE bridge in Redmond for water years 2005-2013)(King County WLRD, 2013).

Extreme flows on the river (100- year highs and lows) range from about 10 cfs to over 4,000 cfs (USAC & KC, 2002). Most of the river's water flow comes from the surface waters of Lake Sammamish, Bear Creek, Little Bear Creek, Swamp Creek, and North Creek (Figure 4). Additionally, ground water inputs into the river provide a cooling influence to the River's water temperature, especially during the warm summer months (Carey, 2003).

Starting at an elevation of 29 feet at the Lake Sammamish weir (NGVD 29), the Sammamish River drops 14 to 16 feet of elevation over its 13.5-mile-length (King County, 2012b). The elevation of Lake Washington, controlled by the USAC Locks in Ballard, varies from a low of 13 feet (NGVD 29) in the winter months (November-March) to a high of 15 feet (NGVD 29) in the summer (USAC & KC, 2002). Most of this drop occurs within the transition zone as the river begins at Lake Sammamish. In this corridor (including the weir) the river drops 7 feet in about 1450 feet of length (0.47%) (King County, 2012b). The remaining stretch of the river, from the north end of Marymoor Park to Lake Washington, has a very low gradient (0.0195), dropping 7-9 feet in 13 miles (2012b).

Water Quality of the Water Body

Water quality samples are analyzed monthly for temperature, dissolved oxygen, pH, conductivity, turbidity, total suspended solids, ortho-phosphate, total phosphorus, ammonia, nitrate-nitrogen, total nitrogen, and fecal coliform bacteria. Results are compared to State water quality standards. Water quality standards are designed to protect public health and aquatic life. Comparing monitoring results to water quality standards allows an understanding of how safe the river is for recreational contact as well as for aquatic life (King County WLRD, 2012a).

The Sammamish River is categorized as "Core Salmon Migration and Rearing Habitat" for aquatic life use and "Primary Contact" for recreational use. The river is on the 2004 Washington Department of Ecology's (Ecology) 303(d) list for violation of fecal coliform, dissolved oxygen and water temperature standards. Noxious weeds, in particular the Brazilian elodea can exacerbate the temperature and dissolved oxygen issues in the river. It can do this by first inhibiting the water mixing in areas where it grows, and then directly as oxygen is consumed by bacteria during decomposition of dead plant material. Further, dense mats of the elodea can increase water temperature by absorbing sunlight, raise the pH of the water, and exacerbate mosquito breeding areas due to pool creation (KCNWCP, 2010a). Shade producing vegetation along the shoreline can also affect river water temperatures by lessening further warming of the already warm water coming from Lake Sammamish in the summer. The combination of Brazilian elodea and lack of shade producing vegetation along stretches of the river potentially result in a further increase in water temperature.

Status on the 303 (d) list

When assessing water quality the Washington Department of Ecology (Ecology) categorizes waterbody impairments into five categories, ranging from "Category 1" (meets test standards for clean waters) to "Category 5" (polluted waters that require a TMDL). During the 2008 Ecology water quality assessment for the 303(d) list several parameters were found to be "Category 5" in locations throughout the length of the Sammamish River (see Appendix C for table) (WADOE, 2008). "Category 5" water quality test results occur when data shows that water quality standards have been violated for one or more

pollutant and there is no pollution (TMDL) control plan. Parameters for which a “Category 5” rating was recorded on the Sammamish River were: temperature, dissolved oxygen, and fecal coliform. The 2008 assessment of the Sammamish River also found several “Category 2” water quality test results for temperature, which indicate “waters of concern.”

Long-term Trends

A 28-year (1979 – 2007) trend analysis was conducted with water quality data from both Sammamish River stations. Results indicated that water quality might have declined over this 28-year period with significant increases in water temperatures and conductivity, and decreasing dissolved oxygen concentrations (King County WLRD, 2012a). High conductivity can suggest the presence of unidentified dissolved charged substances in the water. Water at the mouth of the river is becoming less acidic as indicated by the significant increase in pH (the pH remains within acceptable range relative to the state standards). Decreased total suspended solids (TSS), turbidity, nutrients (ortho-phosphate and total phosphorus, ammonia and total nitrogen), and bacteria levels indicate some improvements in water quality in the same 28-year period.

Problem Algae

The nutrient, light, temperature, and flow characteristics of the Sammamish River support the growth of filamentous green algae in several locations. Filamentous green algae is not toxic, but is considered to be a nuisance when it builds up. (Sally Abella, personal communication: 12-4-12).

Soils

The Sammamish River IAVMP Project Area consists of several dozen soil types, as it covers such a large area. Soil texture can influence the susceptibility of the river bank to erode. Soil texture also influence land managers’ choices about what and where vegetation is planted in restoration areas While the historic (before channelization) orientation and elevation of the river may have included more wetland soil types (muck soils), currently the majority of the river corridor’s soil types are variations of silty or sandy loam (Table 2, Figure 5) (USDA, 1973).

Table 2. Soil types of the Sammamish River IAVMP Project Area

Soil Type	acres	% of total
clay loam	170	3.2
loamy sand	906	16.9
muck	907	16.9
sandy loam	879	16.4
silt loam	2209	41.1
urban land	168	3.1
water	134	2.5
total	5373	100

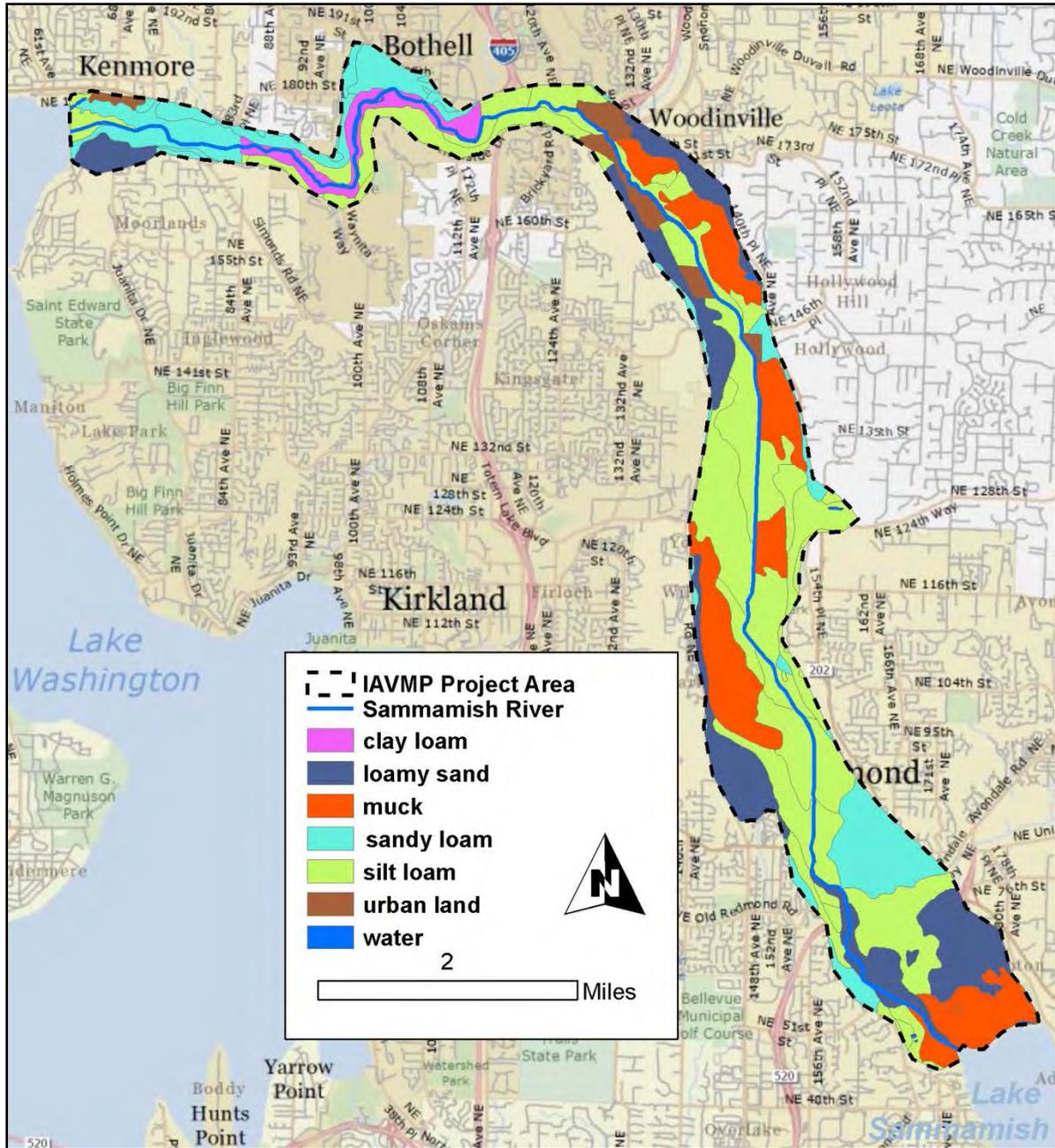


Figure 5. Soil Type of the Sammamish River IAIVMP Project Area (USDA NRCS, 1973).

River Sediment and LWD

The very low gradient of the Sammamish River has resulted in slow water flow and a heavily sedimented bottom (WADOE, 1979). Submersed aquatic plants, such as Brazilian elodea which is very well established in large parts of the Sammamish River channel, can exacerbate this by trapping sediment (Madsen *et al.*, 2001). Sediments within the Sammamish River channel are primarily silty through the length of the waterbody. Sandy river channel sediments occur at the junctions with Swamp Creek, North Creek, Little Bear Creek, and Bear Creek. The small riffle located just downstream of the junction with Little Bear Creek (about river mile 5.5) also contains a rocky stream bottom for several yards. There is

very little large woody debris in the river channel. This is largely due to removal of trees during channel dredging and straightening as well as a current lack of trees for recruitment along the main or tributary channels (USACE and KC, 2002).

Water Withdrawals

Currently there are 23 certified, active water right withdrawals on the Sammamish River, dating from 1945 to 1977 (WADOE, 2012). Additionally, there are eleven active claims, one active water right application, and ten inactive water rights on the River. Most of the water withdrawal is for irrigation purposes. Combined, the certified, active water rights would allow about ten cubic feet-per-second to be pumped out of the River. The water right withdrawal locations span the length of the River. Municipal wells near the river that affect the aquifer are a further impact to the ground water and, indirectly, the river level.

SHORELINE USE OF THE WATER

The paved Sammamish River regional trail parallels the Sammamish River for about 11 miles, from Marymoor Park in Redmond to Blyth Park in Bothell (Figure 2). From that point, the paved Burke-Gillman regional trail continues west to the outlet of the Sammamish River into Lake Washington. Major parks along the river that have public river access points include Marymoor Park, Wilmont Gateway Park, Bothell Landing Park, Blyth Park, and the WDFW Kenmore Boat Launch (Figure 2), which is popular for shoreline fishing. Marymoor Park also contains a large, 40-acre dog park that includes about 250 feet of free dog access to the river in four locations. The Kenmore Boat Launch provides access to the river just upstream of the mouth to Lake Washington (Figure 2). There are also three golf courses adjacent to river: Willows Run Golf Club, Wayne Public Golf Course, and the Inglewood Golf Club. There are about 1.95 miles of river shore that have at least one side with residential use extending clear to the water's edge.

BENEFICIAL AND RECREATIONAL USES

Recreation on the river is mainly limited to boating, both for general recreation and fishing. Fishing is popular in the backwater part of the river near Lake Washington as accessed by the Kenmore WDFW boat launch (Figure 2). Canoeing, rowing, and kayaking are popular the length of the river. Other kayaking activities on the river include past hosting of the 12-mile kayak leg of the Mountains to Sound Relay and a Kayak Rental outfitter in Bothell.

Through 1976 a motor boat race called the Sammamish Slough Race was held on the River (Redmond Historical Society, 2012). However, nowadays motor boats are usually only found downstream of the riffle near Little Bear Creek to Lake Washington. Some of the residential properties that abut the River in that stretch even have boat docks. The entire Sammamish is a "No Wake" zone for motor boats.

There are no public swimming access points along the river; however there are places where the public can easily access the water at numerous parks along its length. No portion of the river has lifeguards present at any time during the year.

In addition to the Sammamish River Trail and recreation directly in or on the water, other beneficial uses of the river include bird and other wildlife watching. There are several birding organizations that frequent the shores of the Sammamish River including Friends of Marymoor Park and Eastside Audubon.

Fish and Wildlife Communities

The Sammamish River and the surrounding terrestrial habitat in the river corridor support a variety of fish, birds, and animals by providing nesting, forage, and cover.

Fish

Chinook, coho, sockeye, kokanee, steelhead, and coastal cutthroat are known salmonid species to currently inhabit the Sammamish River system (Table 3) (Kerwin 2001). The United States Fish and Wildlife Service have identified the river and its tributaries as potential foraging habitat for bull trout on the assumption that they are found in the watershed. Volunteers with the Salmon Watcher Program have been making observations at various locations within the Sammamish River basin since 1997. In addition to the native salmonid species and the native bull trout, 24 species of introduced have been reported to occur in the Lake Washington Basin (WRIA 8), (Table 3),(Kerwin, 2001).

Two salmon-bearing tributary systems are located in the upper reach: Bear Creek and Little Bear Creek. The lower reach includes two large salmon-bearing tributaries: Swamp Creek and North Creek (Kerwin, 2001).

Table 3. Fish of the Sammamish River (Kerwin, 2001)

American shad*	Cherry salmon*	Lake whitefish*
Atlantic salmon*	Chinook salmon	Largemouth bass*
Black bullhead*	Coho salmon	Pumpkinseed sunfish*
Black crappie*	Common carp*	Smallmouth bass*
Bluegill*	Cutthroat trout	Steelhead trout
Brook trout*	Fathead minnow*	Tench*
Brown bullhead*	Goldfish*	Warmouth*
Brown trout*	Grass carp*	Weather loach*
Bull trout	Kolanee salmon	White crappie*
Channel catfish*	Lake trout*	Yellow perch*
bold = native fish, * = non-native fish (occurring in WRIA 8)		

Birds

Birds are attracted to the Sammamish River and its surrounding riparian habitat due to the mix of forest, wetland, and open water habitats. Birding enthusiasts along the river and at the origin of the river (Marymoor Park) have been compiling bird occurrence and activity data for several decades. At the river and adjacent wetlands of Marymoor Park, 232 different species of birds have been observed over the past 23 years (Appendix C) (FOMP, 2012). Of these species, 27 are on the Washington State Department of Fish and Wildlife Species of Concern list (Table 4). A separate list of bird sightings has been recorded along the Sammamish River at multiple locations within the Redmond city limits (Roger Dane, personal communication: 11-27-12). From 2008-2012 this survey found a total of 89 species of birds.

Table 4. WDFW Species of Concern bird list seen at Marymoor Park (FOMP, 2012).

WDFW species of concern status: <i>State, Federal</i>	Common Name	if seen only in one year (sole year noted)
SM, none	Ash-throated Flycatcher	2010
SS, Fco	Bald Eagle	multiple years
SM, FCo	Black Swift	multiple years
SM, none	Black Tern	2004
SE, FCo	Brown Pelican	2008
SC, FCo	Burrowing Owl	2008
SM, none	Caspian Tern	multiple years
SS, none	Common Loon	multiple years
SC, none	Golden Eagle	2008 ?
SM, none	Great Blue Heron	multiple years
SM, none	Great Egret	2005
SM, none	Green Heron	multiple years
SC, none	Lewis's Woodpecker	2011
SC, FCo	Loggerhead Shrike	2011
SC, FCo	Northern Goshawk	2000 ?
SM, none	Osprey	multiple years
SS, Fco	Peregrine Falcon	multiple years
SC, none	Pileated Woodpecker	multiple years
SC, none	Purple Martin	multiple years
SM, none	Red-necked Grebe	multiple years
SC, none	Sage Sparrow	2007
SC, none	Sage Thrasher	2007
SE, none	Sandhill Crane	2010
SM, none	Swainson's Hawk	2008
SM, none	Turkey Vulture	multiple years
SC, none	Vaux's Swift	multiple years
SC, none	Western Grebe	multiple years
Status code Key: State- (SE: State Endangered), (SC: State Candidate), (SS: State Sensitive), (SM: State Monitored). Federal- (Fco: Federal Species of Concern)		

Mammals, Reptiles, and Amphibians

A variety of mammals, reptiles, and amphibians utilize the Sammamish River during various times in their live cycle. A list compiled by Michael Hobbs and the Friends of Marymoor Park at Marymoor Park over the past several years demonstrates the range of sightings (Table 5) (FOMP, 2012).

Table 5. Mammals, Reptiles, and Amphibians seen at Marymoor Park (Sammamish River environs) (FOMP, 2012).

Mammals		
Beaver	Black Rat	Black-tailed Jackrabbit
Common Opossum (I)	Coyote	Eastern Cottontail (I)
Eastern Gray Squirrel (I)	Long-tailed Vole	Long-tailed Weasel
Mink	Mountain Beaver	Mule Deer
Muskrat	Northern Flying Squirrel	Raccoon
River Otter	Townsend’s Chipmunk	Townsend’s Mole

Reptiles and Amphibians		
Bull Frog (I)	Northwestern Garter Snake	Pacific Tree Frog
Painted Turtle (I)	Red-eared Slider (I)	

CHARACTERIZATION OF THE AQUATIC PLANTS AND SHORELINE VEGETATION OF THE SAMMAMISH RIVER

Pre-European settlement the floodplain of the Sammamish River was primarily heavily vegetated wetland (USACE & KC, 2002). Native plant communities included emergent wetland, shrub wetland, forested wetland, riparian forest, and upland forest (2002).

The vegetation along and in the Sammamish River has been highly altered since European settlement, and further since being channelized in the 1960s. The existing steep banks that line most of the River and the historic dredged channel both influence what type of plants grow. Now no longer forested, the riparian area of the river only contains scattered mature tree.

There are no known vegetation surveys done specifically of the Sammamish River. However, a detailed plant survey was conducted in Marymoor Park in 2000-2002 (Appendix C). The location of this survey includes both the river corridor and the adjacent wetland and upland habitats. The survey, conducted by Washington Native Plant Society, found a total of 158 species; of which, 71 are native and 87 are introduced. Of the introduced plants, 18 species are on the 2012 King County Noxious Weed List.

Rare Plants

A data search with the Washington State Department of Natural Resources’ (DNR) Washington Natural Heritage Program (WNHP) found no know rare plants in the Sammamish River corridor. A letter from DNR stating this is the case is included in Appendix C.

General Shoreline Vegetation

Upland riverbank vegetation along the Sammamish varies from maintained native plant restoration sites to landscaped residential properties to 100% invasive species cover (Table 6, Figure 6). For purposes of this report, “upland” riverbank or shoreline vegetation is considered to be the plants that do not require that “their feet are wet”; i.e., usually Facultative Upland or drier. This swath of vegetation extends from the river’s edge up to the top of the hardened banks of the channel. Most of the steep-sloped river bank is covered in vegetation. In November of 2012 a cursory survey of the river’s upland shoreline

vegetation was done by the King County Noxious Weed Control Program (KCNWCP). Approximately eleven percent of the shoreline was found to be landscaped and 89% of the shoreline vegetation was “wild”, ranging from maintained native plant restoration sites to 100% Himalayan blackberry or reed canarygrass.

Restoration areas seen during this survey ranged from “recently installed” to mature. Sections of the river that had just been restored consisted of dense plantings of young native trees and shrubs with noxious weeds cleared away. Mature restoration areas may consist of a dense thicket of alder or willow or widely spaced cottonwood or conifer. The “*restoration of riparian vegetation*” is one emphasized action to improve migratory and rearing conditions for salmon as proposed in the WRIA 8 Chinook Salmon Conservation Plan (WRIA 8 Steering Committee and Forum, 2005).

Table 6. Noxious Weed Cover along the Sammamish River Shoreline.(KCNWCP 2012)

% noxious weed cover*	Miles of shoreline
0%-20%	2.1
20%-40%	4.6
40%-60%	2.5
60%-80%	0.7
80%-100%	15.5
Total (both banks)	25.4

*the vast majority of this noxious weed cover is comprised of Himalayan blackberry and reed canarygrass

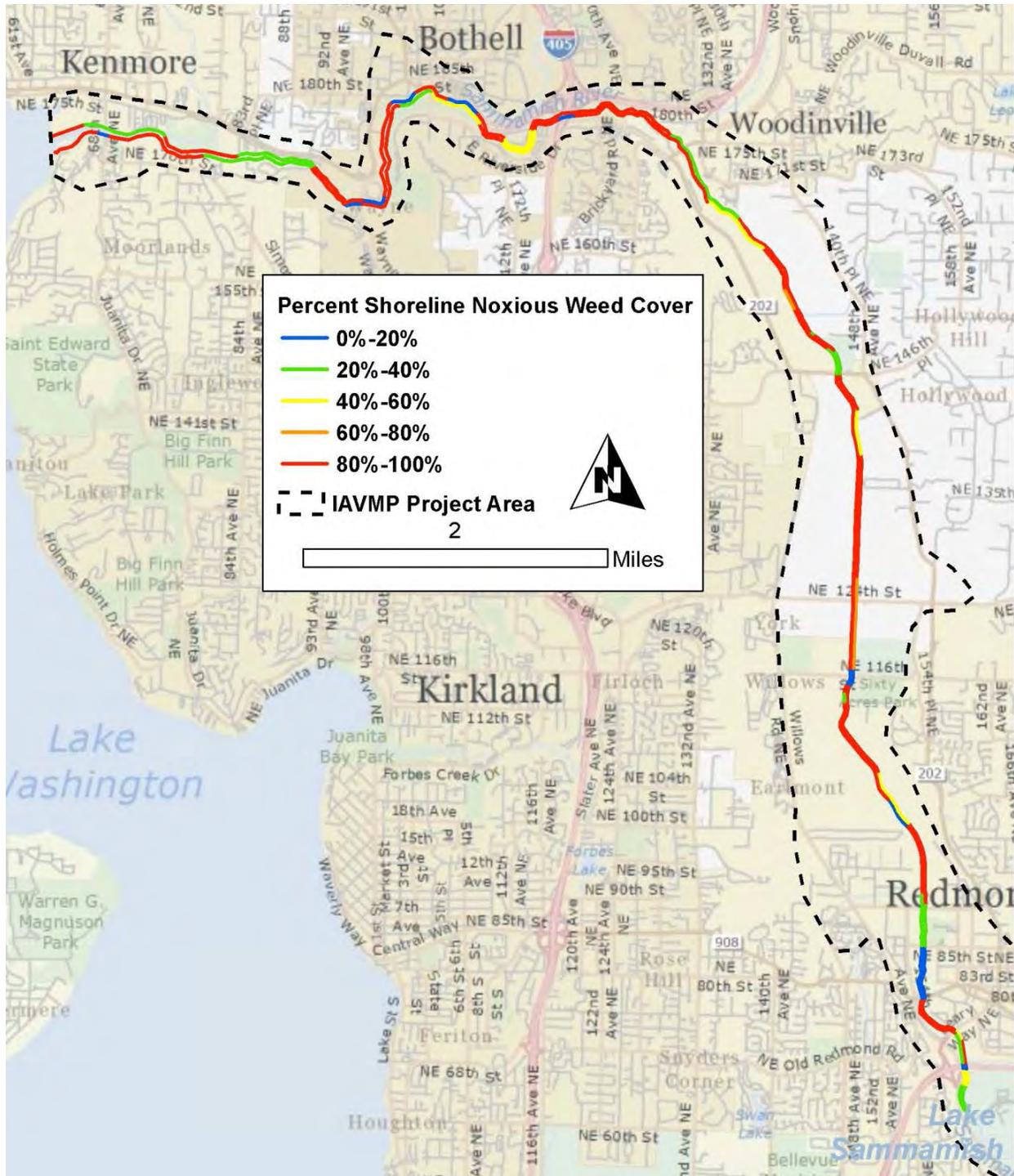


Figure 6. Percent Noxious Weed Cover of the Sammamish River Shoreline Vegetation (KCNWCP, 2012)

During the November 2012 survey, the percent noxious weed cover was estimated for each section of river bank; right and left river banks were surveyed separately (Figure 8).

The vast majority of non-regulated noxious weed present along the Sammamish River are either Himalayan blackberry or reed canarygrass. These two plants are wide spread throughout western

Washington and prevent the natural establishment of woody shoreline vegetation. In addition to blackberry and reed canarygrass, other regulated and non-regulated noxious weeds were found scattered along the upland part of the river bank (Table 7). These sparse to scattered upland weeds include tansy ragwort, English holly, Scotch broom, butterfly bush, common tansy, and poison hemlock. Upland noxious weeds such as these exclude native upland vegetation, alter the activity of native pollinators, and can be poisonous to animals.

Control of all of these unregulated noxious weed species will not be discussed in detail as part of the IAVMP. The Best Management Practices documents produced by the King County Noxious Weed Control Program for these weeds are included as an appendix to this document (Appendix A). These documents will help guide any groups or municipalities working on the river on how best to deal with unregulated noxious weeds.

Table 7. Noxious Weeds on the Sammamish River (KCNWCP, 2013)

Common Name	Scientific Name	Class	Regulated on the Sammamish River	Location	Distribution Along the River	
Brazilian elodea	<i>Egeria densa</i>	B	no*	Submersed/ floating	Very wide spread	Regulated in King County
Common reed/phragmites	<i>Phragmites australis</i>	B	yes	Shoreline	Sparse	
garden loosestrife	<i>Lysimachia vulgaris</i>	B	yes	Shoreline	Very wide spread	
purple loosestrife	<i>Lythrum salicaria</i>	B	yes	Shoreline	Very wide spread	
tansy ragwort	<i>Senecio jacobaea</i>	B	yes	Upland	Scattered	
butterfly bush	<i>Buddleia davidii</i>	B	no	Upland	Scattered	Non-Regulated in King County
common tansy	<i>Tanacetum vulgare</i>	C	no	Upland	Sparse	
curly-leaf pondweed	<i>Potamogeton crispus</i>	C	no	Submersed/ floating	Sparse	
English holly	<i>Illex aquifolium</i>	w.o.c.*	no	Upland	Sparse	
English ivy	<i>Hedera helix</i>	C	No	Upland	Scattered	
Eurasian watermilfoil	<i>Myriophyllum spicatum</i>	B	no	Submersed/ floating	Scattered	
fragrant water lily	<i>Nymphaeae odorata</i>	C	no	Submersed/ floating	Sparse	
Himalayan blackberry	<i>Rubus armeniacus</i>	C	no	Upland	Very wide spread	
invasive knotweed	<i>Polygonum Sp.</i>	B	no	Upland	Very sparse	
poison-hemlock	<i>Conium maculatum</i>	B	no	Upland	Sparse	
reed canarygrass	<i>Phalaris arundinaceae</i>	C	no	Upland/ Shoreline	Very wide spread	
Scotch broom	<i>Cytisus scoparius</i>	B	no	Upland	Scattered	
yellow flag iris	<i>Iris pseudacorus</i>	C	no	Shoreline	Sparse	

*w.o.c. = Weed of Concern in King County- an invasive, non-native plant for which control is recommended.

*Brazilian elodea is regulated in most of King County except for Lake Doloff, Fenwick, Sammamish, Washington, Union, and the Sammamish River due to large established populations in these waterbodies.

FOCUS ON NOXIOUS WEEDS FOR THIS MANAGEMENT PLAN

The term “noxious weed” refers to those non-native plants that are legally defined by Washington State’s Noxious Weed Control Law (RCW 17.10) as “highly destructive, competitive, or difficult to control once established.” Noxious weeds have usually been introduced accidentally as a contaminant, or as ornamentals. Non-native plants often do not have natural predators (i.e., herbivores, pathogens) or strong competitors to control their numbers as they may have had in their home range. The Washington State Noxious Weed Board has designated purple loosestrife (*Lythrum salicaria*), garden loosestrife (*Lysimachia vulgaris*), and phragmites/common reed (*Phragmites australis*) as regulated noxious weeds on the Sammamish River, meaning their control and/or eradication is required (Table 7) (WSNWCB, 2013). Brazilian elodea (*Egeria densa*), Eurasian watermilfoil (*Myriophyllum spicatum*), fragrant water lily (*Nymphaea odorata*), invasive knotweeds (*Polygonum* spp.), reed canarygrass (*Phalaris arundinacea*), Himalayan blackberry (*Rubus armeniacus*), English ivy (*Hedera helix*), and Yellow flag iris (*Iris pseudacorus*) are listed noxious weeds (Table 7), but their control is not required by the King County Noxious Weed Board because they are already widespread in this part of the county (KCNWCP, 2013). However, Brazilian elodea is addressed in this document as it is the dominant submersed weed in the river system and can negatively impact the salmonid species and associated rearing and spawning habitat. For that reason, control plans will be explored for Brazilian elodea.

Another reason these four plants (purple loosestrife, garden loosestrife, common reed, and Brazilian elodea) are the focus of the management plan to better position the project to receive grant funding from Ecology should it be pursued. Ecology funds Aquatic Weed Management Fund grants which focus on the control of regulated noxious weeds in waterways that have public boat access.

NOXIOUS WEED CONTROL HISTORY ON THE SAMMAMISH RIVER

While noxious weeds have been an issue on the Sammamish River for many years, a coordinated control effort has been slow to form. No whole-river efforts have targeted submersed or shoreline noxious weeds on the Sammamish River.

However, many local municipalities along the river have done shoreline restorations and have plans to continue the efforts. The focus of many of these projects is often to improve fish and wildlife habitat as well as aesthetics for the public. For example, the city of Bothell has future restoration planned for areas where two creeks empty into the Sammamish River. These plans include day lighting creeks, channel restoration and riparian plantings. This effort will likely include approximately 5,000 feet of Sammamish River shoreline. Another example is the city of Redmond, which has approximately 15,000 feet of river shoreline restoration planned. These projects include bank regrades, adding habitat features and riparian plantings. These actions will directly benefit the goals of the WRIA 8 Chinook Salmon Conservation Plan which proposes the “restoration of riparian vegetation” as one focus of action to improve migratory and rearing conditions for the fish (WRIA 8 Steering Committee and Forum, 2005).

Restoration efforts along the banks of the Sammamish River should be coordinated to ensure work is not duplicated and progresses in a methodical manner. It is important that as restoration projects (including noxious weed removal and planting) are planned, regulations and guidelines are looked into such as Critical Area Ordinances (CAO’s), Shoreline Master Programs, and planned levee setbacks. The

King County Noxious Weed Control program has monitored and worked to achieve control of purple and garden loosestrife along the river for many years (Figures 8 and 10). However, while the plants persist year to year, control enforcement has been variable. This is due to the extremely large amount of the plants, the many agencies (local, county, and state) involved, the lack of a strategy for the whole infestation and that populations continue to exist in Lake Sammamish, which contributes to the Sammamish River infestation.

EMERGENT AQUATIC NOXIOUS WEEDS

Many regulated and non-regulated noxious weeds grow right at the water's edge or in an emergent manner. These plants often crowd out native vegetation by forming dense stands at the water's edge. They dramatically reduce habitat value of shorelines and access to the river. Shoreline aquatic noxious weeds that have been found along the Sammamish River are: yellow flag iris, invasive knotweed species, reed canarygrass, phragmites/common reed, garden loosestrife, and purple loosestrife (Table 7). Some of these are regulated (required to be controlled) and some are not, but they all have an impact on the river.

Regulated emergent aquatic noxious weeds are a higher priority for control and a focus of this Management Plan. The three regulated emergent noxious weeds that occur on the Sammamish River are the Class B noxious weeds purple loosestrife, garden loosestrife, and phragmites/common reed. While phragmites is only found in a few locations along the river, purple loosestrife and garden loosestrife are both wide spread emergent aquatic noxious weeds on the river. A detailed discussion of each of these plants follows.

***Lythrum salicaria* (purple loosestrife)**

Purple loosestrife, a regulated Class B Noxious Weed in King County, was introduced to the United States in the early 1800s at northeastern port cities, in ship ballast obtained from European tidal flats (KCNWCP, 2011). It arrived in marine estuaries in the Pacific Northwest in the early 1900s, suggesting that it was spread by maritime commerce. Deliberate planting and escapes from cultivation likely aided in the spread of infestations across the country. Purple loosestrife was first reported found in Washington in 1929 along the Lake Washington shoreline. Currently purple loosestrife is found around the perimeter of Lake Sammamish and is found on about 80% of the shoreline of the Sammamish River (Figure 8). It is the most common regulated aquatic noxious weed in King County. Control of the plant along the river has been inconsistent over the years.

Purple loosestrife is an invasive and competitive noxious weed that alters wetland ecosystems by replacing native and beneficial plants (KCNWCP, 2011). Water-dependent mammals and waterfowl and other birds leave wetlands when their food source, nesting material and shelter are displaced by the plant. Purple loosestrife occurs in freshwater and brackish wetlands, lake and river shorelines, streams, ditches and wet pastures. It requires partial to full sunlight and moist soil to standing water.



Figure 7. Purple loosestrife.

Purple Loosestrife is a perennial emergent aquatic plant that can reach over 9 feet tall and 5 feet wide (Figure 7) (KCNWCP, 2011). As many as 30 herbaceous stems emerge from the persistent taproot and spreading roots. The plant is noted for its square (sometimes six-sided) stem and opposite leaves. Purple loosestrife's showy magenta flowers appear from July into October. Reproduction is mainly by seed but also by stem and root fragment. A mature plant can produce over two million pepper-sized seeds per year. The seeds, which can remain viable for about three years, are dispersed mainly by water but also by animals, boots, tires, boats, and pets. Mature plants can live for 20 years.

The original mechanism for purple loosestrife infestation on the Sammamish River is not known but likely occurred through a combination of several sources (upstream waterways, unintentional plant part or seed transfer by humans, intentional ornamental plantings, transfer by animal feathers or fur, and possibly wind). Most notably, immediately upstream of the Sammamish River, the shoreline of Lake Sammamish is ringed by uncontrolled purple loosestrife plants growing largely in residential waterfronts.

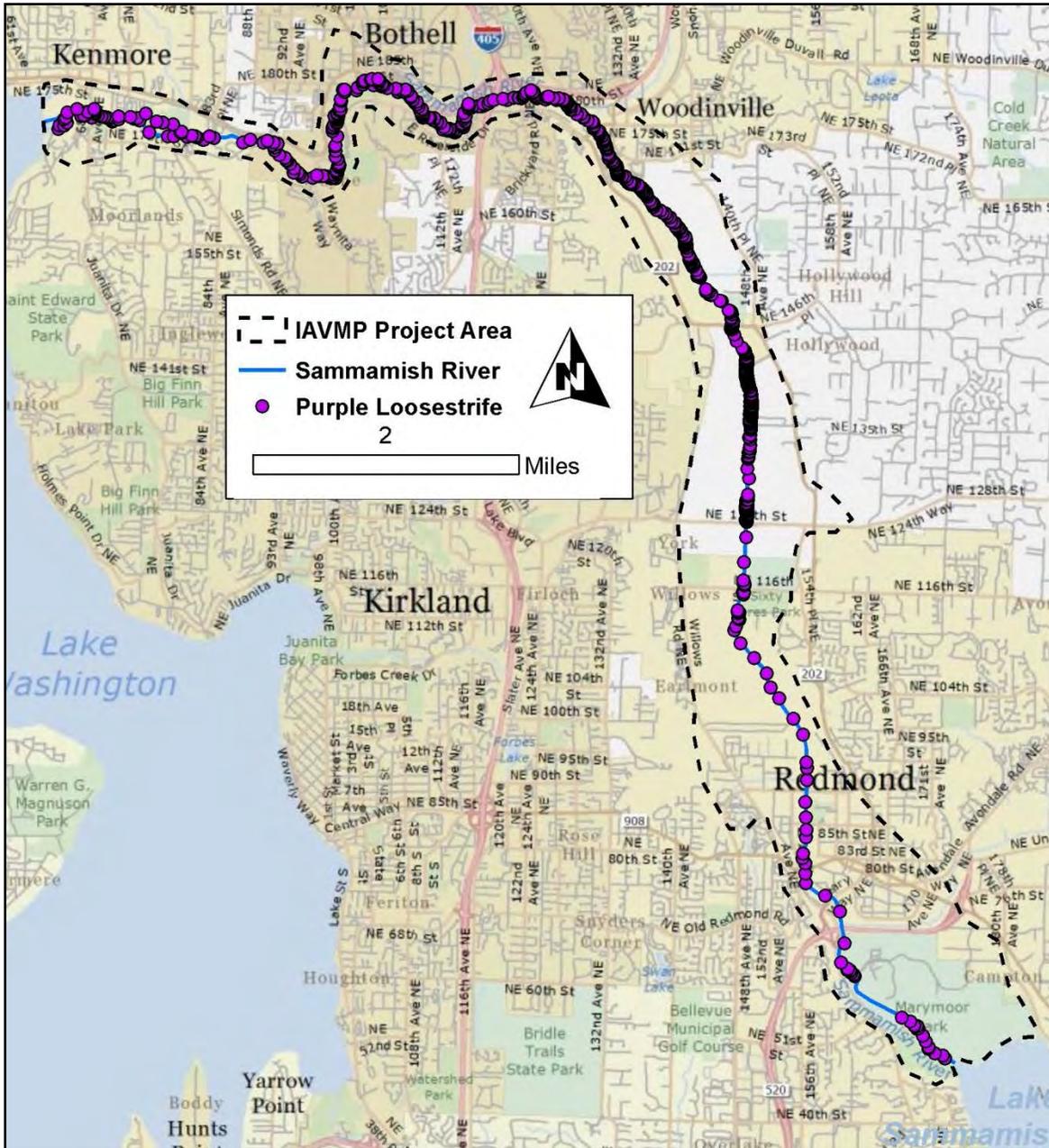


Figure 8. Purple loosestrife locations in the IAVMP Project Area.

***Lysimachia vulgaris* (garden loosestrife)**

Garden loosestrife, a regulated Class B Noxious Weed in King County, is native to Europe and Asia and was introduced to North America as an escaped garden ornamental (KCNWCP, 2010b). In Washington, the earliest record is a herbarium specimen from Juanita Bay in Lake Washington dated 1978. However, the extent of the infestation on the shoreline of Lake Sammamish suggests that the actual introduction was considerably earlier. Uncontrolled garden loosestrife plants are commonly found in residential waterfronts all around the lake.



Figure 9. Garden loosestrife.

Garden loosestrife is a perennial that can reach 10 feet tall in the shade (generally 4-7 feet tall in full sun) (Figure 9) (KCNWCP, 2010b). Yellow 5-petaled flowers with orange centers are borne in terminal panicles with smaller clusters on stalks from the upper leaf nodes. Stems and leaves are slightly fuzzy, and leaves are opposite or in whorls of three (sometimes four). Garden loosestrife is considered a facultative wetland species, usually occurring in wetlands but occasionally found in uplands. These plants produce seed in dry capsules, and a large plant can produce 100 or more seeds. A recent study at the University of Washington found nearly 90% germination success. Seed longevity is not precisely known, but seeds can remain viable for at least several years. Seeds ripen in late fall or early winter (usually November in King County). Garden loosestrife also reproduced through vegetative means, either by rooting at nodes on the stem or by fragmentation of stolons and rhizomes. Vegetative reproduction seems to be common in King County. Red stolons can reach 15 feet long and branch in the fall before fragmenting. Garden loosestrife can tolerate fairly deep shade.

Similar to the unrelated but more widespread purple loosestrife, garden loosestrife disrupts wetland ecosystems by displacing native or beneficial plants (KCNWCP, 2010b). Loss of native vegetation results in decreased sources of food, nesting material, and shelter. Economic impacts could be high in agricultural communities when irrigation systems are clogged or when wet pastures are turned into a monoculture and are unavailable for grazing.

Garden loosestrife is aggressive and competitive, taking full advantage of disturbance to natural wetland vegetation caused by anthropogenic alterations of the landscape. It has been observed to out-compete and displace other aggressive species, including purple loosestrife and cattails (KCNWCP, 2010b).

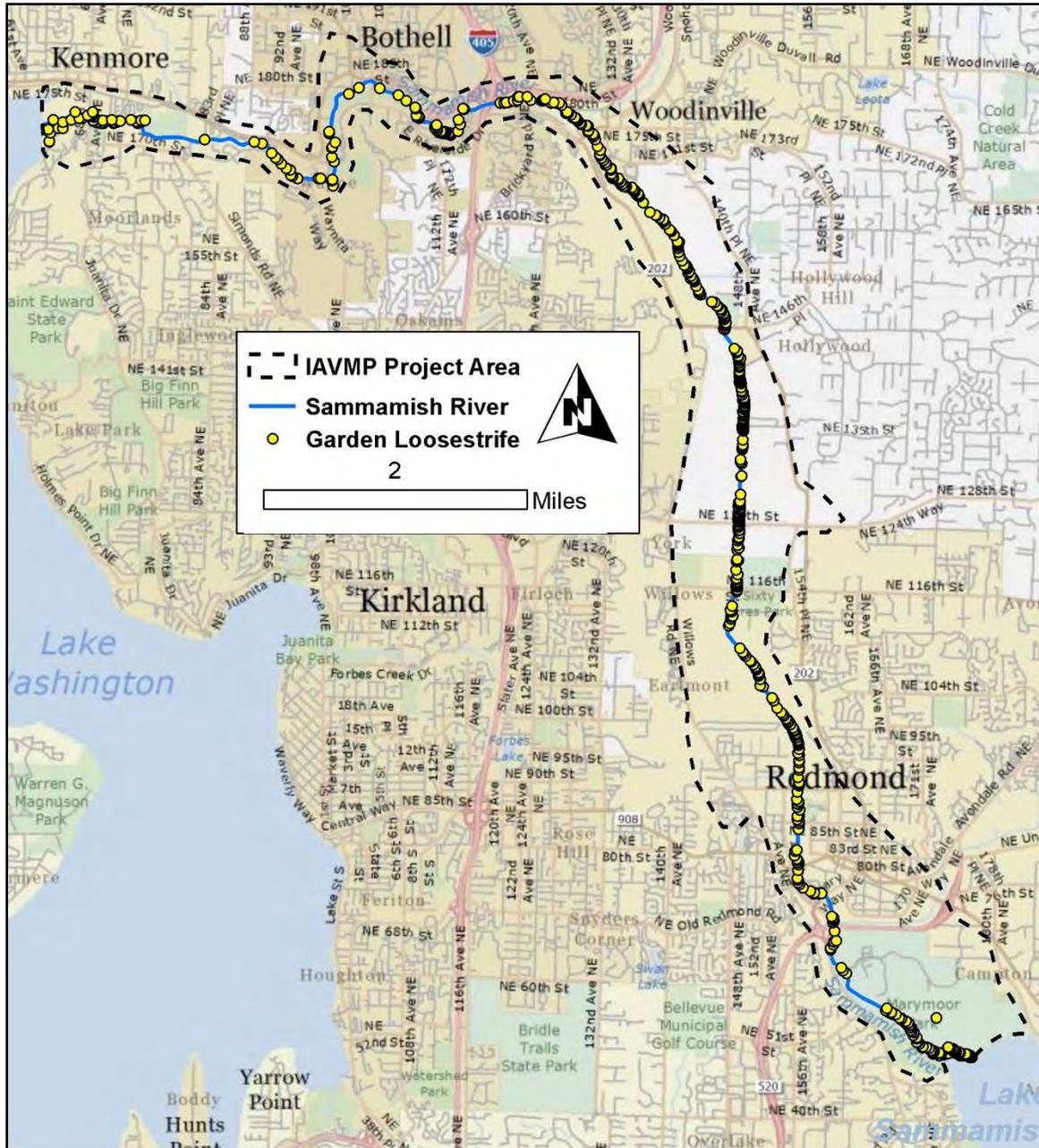


Figure 10. Garden loosestrife locations in the IAVMP Project Area.

Garden loosestrife is found growing on the lower parts of both banks of the Sammamish River all the way from Lake Sammamish to Lake Washington (Figure 10). It covers 40% of the shoreline of Lake Sammamish and is established in most of the wetlands on Lake Washington and along the shoreline wherever there is available habitat (primarily public parks). Currently there are aggressive grant-funded efforts to control garden loosestrife in Lake Sammamish State Park, Marymoor Park and Union Bay. In addition, the cities of Issaquah, Bellevue, Redmond, Kenmore, Kirkland, Seattle, Mercer Island and Renton have an ongoing commitment to maintain control of this plant on public shorelines on Lakes Sammamish and Washington. There has not yet been a coordinated effort to gain control of the garden loosestrife along the Sammamish River. Seeds and plant fragments from uncontrolled populations on

the Sammamish River migrate downstream and can re-infest areas in Lake Washington where the weed has been controlled or not yet established.

***Phragmites australis* (phragmites, common reed)**

The species *Phragmites australis*, a regulated Class B Noxious Weed in King County, has inhabited wetlands in North America for over 3,000 years. However, recent research has shown that in the late 19th century, several European strains (haplotypes or genotypes) were introduced and had a competitive advantage over native strains as well as other native species (KCNWCP, 2010c). The introduced strains now have a widespread distribution in the United States and can be found in every state. The invasive strains of phragmites create tall dense stands that degrade wetlands and coastal areas by competing with native vegetation (including the native phragmites) for space and resources, creating a monoculture. Both the native and non-native strains are present in Washington State, although no populations of the native strain have been recorded in King County (KCNWCP, 2010c). However, positive identification should be sought prior to controlling any phragmites population. Identification can be difficult. Any previously unknown phragmites should be reported to the KCNWCP for identification assistance.



Figure 11. Phragmites, common reed.

Phragmites is a tall, clonal, long-lived grass which lives in wetlands, and lake and stream margins (Figure 11). It can tolerate brackish water and is often found in estuaries and tidal wetlands. It is considered a facultative wetland species, usually occurring in wetlands but occasionally found in uplands. It has tan woody stems to 12 feet tall and feathery, plume-like flower heads that are purplish at first and turn tan as they mature. Stiff, gray-green leaves are up to 16 inches long and 1.5 inches wide. Phragmites can spread by seed, but most commonly it spreads laterally on rhizomes (underground stems) or from root fragments. Rhizomes can exceed 60 feet in length, grow more than six feet per year,

and readily grow into new plants when fragmented. The roots form a dense mat that can reach a depth of up to six feet. Stands of the native strain have lower stem density, less dense flower heads, slightly different coloration and more flexible stems. See Appendix A – Phragmites Best Management Practices document for a chart describing the differences.

There are currently about 30 known sites of invasive phragmites throughout King County and two locations are along the Sammamish River (Figure 12). One of these, in Bothell, has been controlled, with no plants seen in this location for at least four years (KCNWP 2012). The other, on the south bank in Kenmore across from the Swamp Creek Natural Area, is about 1,500 square feet in area. It has been treated yearly for several years and is in decline, but requires ongoing monitoring and treatment to move toward eradication. This site is on private land and is being managed by the property owner with the assistance of the KCNWCP.

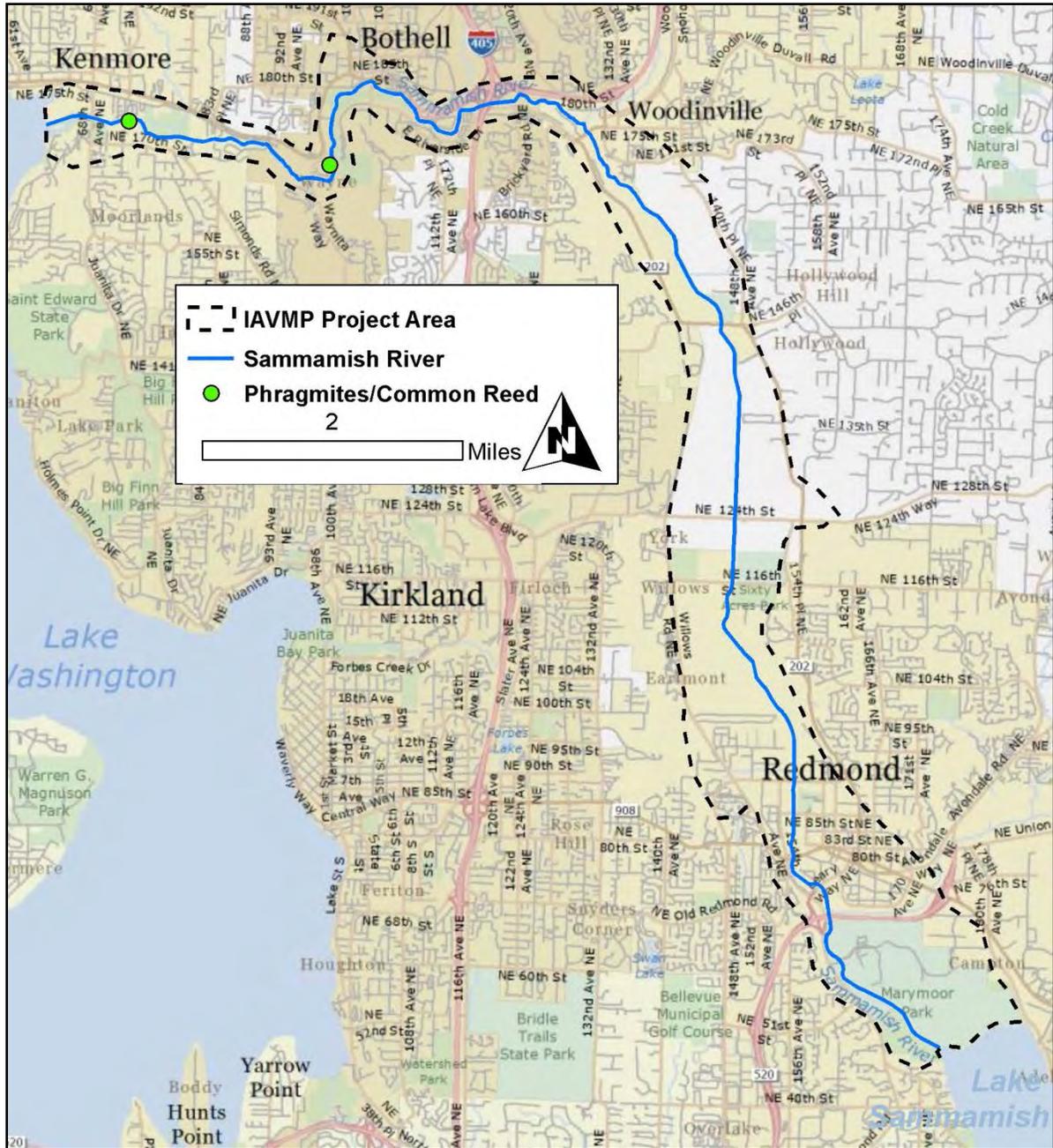


Figure 12. Phragmites/common reed locations in the IAVMP Project Area.

Since seeds of phragmites are wind-borne, new populations could become established elsewhere along the river from the existing Kenmore site as well as from other small sites in the region. The greatest immediate threat phragmites poses is to Squire’s Landing Park Natural Area in Kenmore (just upstream of the Kenmore phragmites site river bank right), but other wetlands and river bank could become infested as well. While these plants may occur in other yet-to-be-found locations on the river, phragmites species has not become wide spread. The relative small area infested by this species presents a good opportunity to achieve eradication along the river if control efforts continue and any new infections are promptly reported and dealt with.

SUBMERSED AND FLOATING AQUATIC VEGETATION AND WEEDS

While the waterbody is technically a river, because of its depth and slow current, the submersed plants that inhabit it are generally more commonly found in lakes. The most common submersed plant in the river is aquatic noxious weed Brazilian elodea. Except for the very center of the channel, this plant occupies most of the river channel from the weir at Marymoor Park downstream for about seven miles (Figure 14). From about river mile 5.5 downstream to Lake Washington, there have been only scattered and small patches of Brazilian elodea found. The plant has been surveyed for many years by the King County Noxious Weed Control Program. Brazilian elodea is not designated for control in Lake Sammamish, Lake Washington, or the Sammamish River because it is already widespread in these waterbodies.

The other submersed aquatic noxious weeds are Eurasian watermilfoil and curly-leaf pondweed. While not mapped, the plant is known to grow in small patches throughout the length of the river. Eurasian watermilfoil is a common problem in the littoral zone of small and large lakes (including Lake Sammamish and Lake Washington) (KCNWCP, 2012). Both submerged weeds are not regulated in King County because they are already wide spread.

There are also a few patches of floating aquatic noxious weeds, primarily at the origin and terminus of the river. This floating plant is the Class C noxious weed fragrant water lily and is non-regulated in King County.

The Sammamish River does contain some native submersed vegetation, including coontail, narrow leaf bur-reed, common waterweed, and pondweed species. These plants are relatively uncommon, especially in the first five miles or so of the river because of crowding by Brazilian elodea.

***Egeria densa* (Brazilian elodea)**

This noxious weed is a submersed, freshwater perennial plant found in both still and flowing waters including lakes, ponds and quiet streams (KCNWCP, 2010a). Brazilian elodea tends to form dense monospecific stands that can cover hundreds of acres.

Native to Brazil and Argentina, Brazilian elodea is a popular aquarium plant often sold in pet stores and available in school science kits under the name *Anacharis*. When it is introduced into freshwater, it forms dense beds that reduce water quality and impede recreational activities. It is illegal to buy or sell this plant in Washington State. It was first reported in the United States in Millneck, Long Island where it was collected in 1893. It has long been sold as an aquarium plant in the United States and thought to have infested many lakes through aquarium “dumps.”

Brazilian elodea is a very aggressive submerged aquatic plant that can out-compete native aquatic plants, forming dense monotypic stands (KCNWCP, 2010a). It can reduce biodiversity, change the predator/prey relationship in the waterbody, and adversely impact the food web. Dense stands, where the plant “tops out,” can prevent wind mixing and lead to extensive areas of low water oxygen level. Stagnant mats create mosquito breeding habitat and increase the water temperature underneath by absorbing sunlight. When stands of Brazilian elodea die back in the fall the resulting decay uses up dissolved oxygen and adds nutrients to the water, conditions that can increase algae growth.

Additionally, dense stands of the plant impact recreation by eliminating swimming opportunities, fouling boat motors, and snagging fishing lines.

Identifying [Brazilian elodea](#) can be difficult it is important to get an expert to confirm the species before planning any control measures. The plant grows mostly underwater but can form dense mats along the surface. A perennial that grows in up to 20 feet of water, Brazilian elodea spreads by fragmentation, but is not known to seed in North America (Figure 13). The plant is generally submersed (rooted) but sometimes forms floating mats. Three-petalled white flowers with a yellow center appear floating on the surface of the water from late spring to early fall. Leaves of Brazilian elodea are bright to dark green, 2-4 cm wide by 3-5 cm long, and grow in whorls of 4-8 and the stems are very leafy compared to the native elodea, [common waterweed \(*Elodea canadensis*\)](#). The leaf edges appear smooth to the naked eye (native elodea has 3 leaves in a whorl) (KCNWCP, 2010a).



Figure 13. Brazilian elodea.

In the King County area, *Egeria densa* has been observed to overwinter in a dormant-like, evergreen condition. Seeds and/or female flowers have never been reported from Brazilian elodea populations established in the United States. The absence of sexual reproduction in introduced populations of Brazilian elodea emphasizes the importance of the vegetative growth phase of the plant.

This weed is so proficient that it can out-compete the common aquatic noxious weed, Eurasian watermilfoil. The Brazilian elodea infestation in the Sammamish River likely originated from the upstream population that exists in Lake Sammamish. That infestation, which occurs in the relatively shallow north end of the lake, provides a source of viable plant fragments that can re-infest the River.

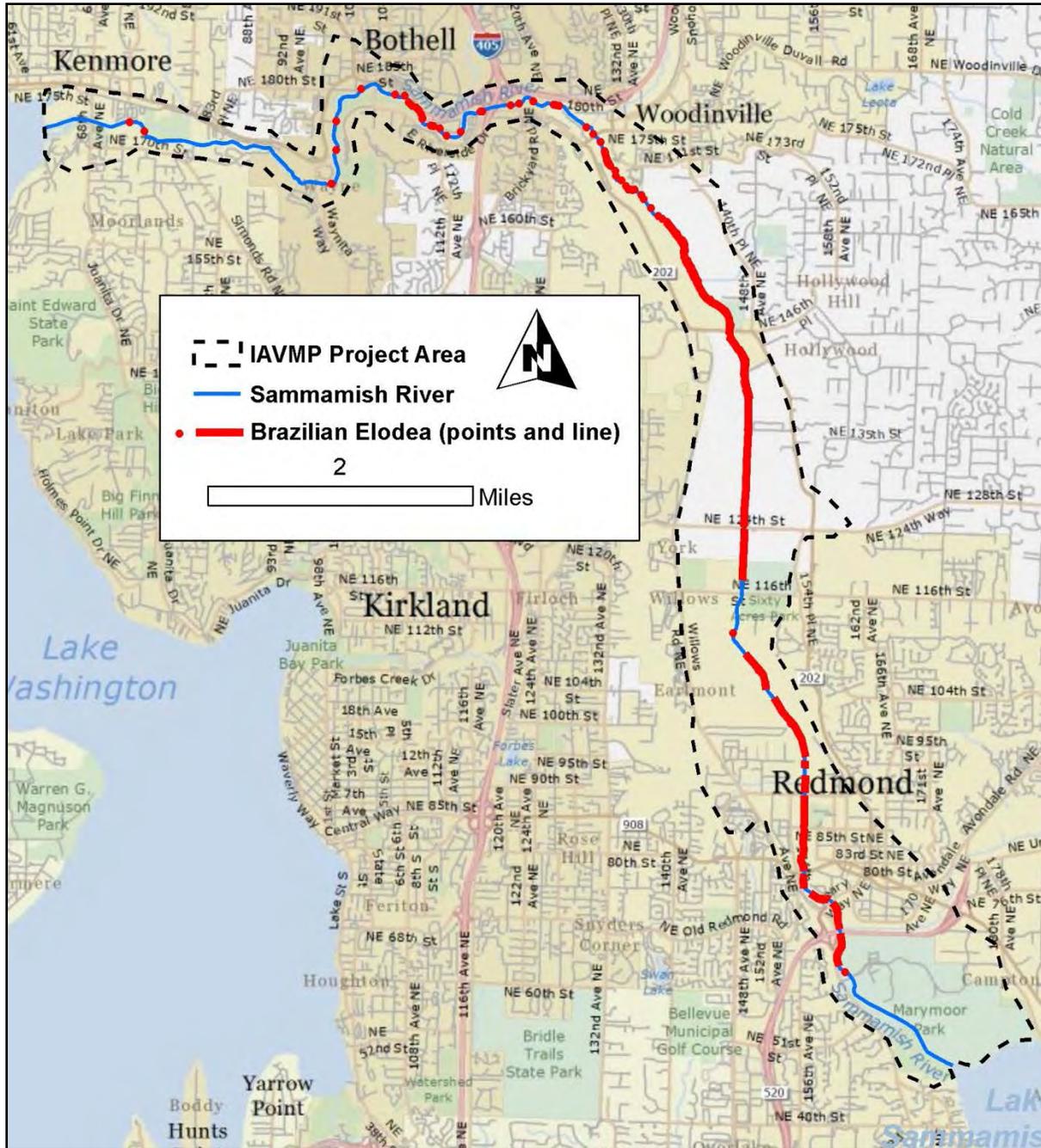


Figure 14. Map of Brazilian Elodea in the Sammamish River, 2009 – 2012 survey data

While still available for sale elsewhere in the U.S., the plant is illegal to sell in Washington and is a non-regulated Class B Noxious Weed on the Sammamish River. In King County, it is established in Lakes Washington, Sammamish, Union, Fenwick, and Dolloff as well as the Sammamish River. The plant has recently been discovered at Fisherman’s Terminal on the Lake Washington Ship Canal. Except for the very center of the channel, this plant occupies most of the river channel from the weir at Marymoor Park downstream for about seven miles (Figure 14). From about river mile 5.5 downstream to Lake Washington, there have been only scattered and small infestation of Brazilian elodea found.

SECTION 6 - MANAGEMENT ALTERNATIVES

A wide variety of control methods have been developed to address the general problem of aquatic noxious weeds. The suitability of control methods for specific plants such as purple loosestrife or Brazilian elodea varies widely. All known control options (aquatic herbicide, manual control methods, mechanical control methods, environmental manipulation, biological control) have been considered and evaluated for each noxious weed species as it relates to the conditions on the Sammamish River (Table 8). This matrix separates potential control methods into those that warrant further investigation (either for whole waterbody treatment or for small-scale temporary control) and those methods that are not applicable on the Sammamish River.

Table 8. Control Option Matrix for Regulated Noxious Weeds on the Sammamish River.

broad control method category	Specific method	compatible with Sammamish River water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for garden loosestrife	further consideration?	effectiveness for phragmites/ common reed	further consideration?	effectiveness for Brazilian elodea	further consideration?
Manual Control Methods	Hand pulling	yes, small areas, follow-up work	effective in some situations (where soil is very wet and not rocky), can be part of an IPM solution	yes ¹	not possible, breaks off from long rhizomes leaving root fragments behind	no	not possible, breaks off from rhizomes leaving root fragments behind	no	A useful method in shallow water, must remove leafy part of plant along with root crown to prevent re-growth. Labor intensive.	YES
Manual Control Methods	Digging	yes, small areas, follow-up work	Suitable for small plants or pioneering stands. Carefully dig out as much root and rhizome as possible.	yes ¹	Suitable for small plants or pioneering stands. Carefully dig out as much root and rhizome as possible.	yes ¹	Suitable for small plants or pioneering stands. Carefully dig out as much root and rhizome as possible.	yes ¹	only successful for very small areas, all fragments must be removed, increases turbidity.	no ¹
Manual Control Methods	diver hand pulling	yes	not relevant	no	not relevant	no	not relevant	no	A useful method in deeper water, must remove leafy part of plant along with root crown to prevent re-growth. Labor intensive. Snorkel divers in shallower water, SCUBA divers in deeper water. Stringent safety protocols should be employed ² .	YES

Table 8 (continued). Control Option Matrix for Regulated Noxious Weeds on the Sammamish River.

broad control method category	Specific method	compatible with Sammamish River water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for garden loosestrife	further consideration?	effectiveness for phragmites/ common reed	further consideration?	effectiveness for Brazilian elodea	further consideration?
Manual Control Methods	raking	no	not relevant	no	not relevant	no	not relevant	no	not practical, causes fragmentation	no
Environmental Manipulation Control Methods	bottom barriers/ tarp staking	area of infestation too large	tarping can suppress growth in some situations, but will not eradicate.	no ¹	tarping can suppress growth in some situations/small areas but will not eradicate; covering must extend several feet beyond the edges of the infestation; follow-up work required	no ¹	tarping can suppress growth in some situations, but will not eradicate.	no ¹	Need to be very securely anchored in moving water impractical for large infestations	no ¹
Environmental Manipulation Control Methods	Shading	yes, shading of noxious weeds, via growth of taller vegetation, to reduce or control infestations may be an option along the Sammamish River	While purple loosestrife plants grow well in conditions ranging from full sun to %50 shade, plants do exist, but not thrive in shady areas. Deep shade may reduce the density and vigor of plants.	yes ³	garden loosestrife is known to thrive in full sun but also be shade tolerant.	no	Seedlings are susceptible to shading and shading by trees & shrubs can decrease plant vigor.	yes ³	May not be able to tolerate shaded water. Very little information about effect of shading on Brazilian elodea control.	yes ³
Environmental Manipulation Control Methods	burning	not practice because not usually effective and danger of burning near urban areas; air quality concerns.	not relevant	no	not relevant	no	Generally, prescribed burning does not reduce the growing ability of phragmites unless root burn occurs which seldom happens because the rhizomes are usually covered by a layer of soil, mud and/or water.	no	not relevant	no

Table 8 (continued). Control Option Matrix for Regulated Noxious Weeds on the Sammamish River.

broad control method category	Specific method	compatible with Sammamish River water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for garden loosestrife	further consideration?	effectiveness for phragmites/ common reed	further consideration?	effectiveness for Brazilian elodea	further consideration?
Environmental Manipulation Control Methods	water level drawdown	not possible on the Sammamish River, no water control structures.	not relevant	no	not relevant	no	not relevant	no	not relevant	no
Mechanical Control Methods	Cutting	yes	when cut at the base at flower-drop, will control the plant for the year. Remove and bag all plant parts. Will not eradicate. Can be part of an IPM solution	yes ¹	Cutting alone is not a control option for garden loosestrife, new plants will grow from rhizomes.	no	Cutting/mowing without use of herbicide should be done in late July (before tassel set) when most of the energy is in the stalk and not the roots. Cutting during other times may stimulate growth.	yes ¹	Will not control and <u>has actually resulted in increased vigor of cut plants.</u> Cut fragments may spread infestation.	no
Mechanical Control Methods	Harvesting machine	can't be done around docks, logs and other in-water obstructions, may be impossible in the moving water	not relevant	no	not relevant	no	not relevant	no	will cause extensive fragmentation and spread infestation, impractical in the river	no
Mechanical Control Methods	Rotovation machine	can't be done around docks, logs and other in-water obstructions, may be impossible in the moving water	not relevant	no	not relevant	no	not relevant	no	will cause extensive fragmentation and spread infestation, turbidity, impractical in the river	no
Mechanical Control Methods	Diver dredging	yes	not relevant	no	not relevant	no	not relevant	no	uses a suction dredge to remove plants from soil. Expensive. Has proved effective in flowing water.	yes

Table 8 (continued). Control Option Matrix for Regulated Noxious Weeds on the Sammamish River.

broad control method category	Specific method	compatible with Sammamish River water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for garden loosestrife	further consideration?	effectiveness for phragmites/ common reed	further consideration?	effectiveness for Brazilian elodea	further consideration?
Mechanical Control Methods	Sediment agitation (weed rollers)	yes	not relevant	no	not relevant	no	not relevant	no	not practical in moving water or large infestations	no
Biological Control Methods	grass carp	Grass carp are not allowed in flowing water	not relevant	no	not relevant	no	not relevant	no	Grass carp are not allowed in flowing water	no
Biological Control Methods	<i>Galerucella</i> beetles for purple loosestrife	yes	already on site, scattered. Not effectively reducing population. Must be combined with manual control of seeds.	yes					not relevant	no
Biological Control Methods	other biocontrol agents for specific plants	possibly, difficult to acquire if agents are known	<u>seed and root feeding weevils</u> : Not currently on site, difficult to obtain. Would take several years for populations to build to controlling levels & require with manual control of seeds.	yes	No biological control agents are presently known. No research is currently being	no	There are no effective biocontrol agents for phragmites at this time.	no	research is being done but there are currently no accepted biocontrol agents for Brazilian elodea in moving water	no
Chemical Control Methods	Diaquat	legal formulation not effective, also chemical control in flowing water is very difficult and risky to non-target plants and animals.	not relevant	no	conducted	no	not relevant	no	Effective formulations are illegal in WA state waters ⁴ . Chemical control in flowing water is very difficult and risky to non-target plants and animals.	no

Table 8 (continued). Control Option Matrix for Regulated Noxious Weeds on the Sammamish River.

broad control method category	Specific method	compatible with Sammamish River water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for garden loosestrife	further consideration?	effectiveness for phragmites/ common reed	further consideration?	effectiveness for Brazilian elodea	further consideration?
Chemical Control Methods	Endothall	not effective, also chemical control in flowing water is very difficult and risky to non-target plants and animals.	not relevant	no	not relevant	no	not relevant	no	Not effective for Brazilian elodea control ^{4,5} . Chemical control in flowing water is very difficult and risky to non-target plants and animals.	no
Chemical Control Methods	Fluridone	requires whole-waterbody treatment, also chemical control in flowing water is very difficult and risky to non-target plants and animals.	not relevant	no	not relevant	no	not relevant	no	only WA state permitted herbicide shown to be effective on Brazilian elodea. Chemical control in flowing water is very difficult and risky to non-target plants and animals.	yes
Chemical Control Methods	Glyphosate	may be effective tool for phragmites control	not desirable for purple loosestrife control; it is non-selective and monocots (cattails, grasses, and sedges) may be unintentionally damaged in during spraying	no	not desirable for garden loosestrife control; it is non-selective and monocots (cattails, grasses, and sedges) may be un-intentionally damaged in during spraying	no	Effective, if properly applied. Non-selective, will control both grasses and broadleaf plants, apply carefully	yes	not relevant	no
Chemical Control Methods	Imasapyr	may be most effective tool for phragmites and garden loosestrife control	effective for purple loosestrife control, slow acting chemistry; it is non-selective and monocots (cattails, grasses, and sedges) may be unintentionally damaged in during spraying	yes	tests suggest a low concentration of imasapyr (0.75%) applied in early summer (June) can be very effective; Non-selective, will control both grasses and broadleaf plants, apply carefully	YES	Very effective, if properly applied. Non-selective, will control both grasses and broadleaf plants, apply carefully	YES	not relevant	no

Table 8 (continued). Control Option Matrix for Regulated Noxious Weeds on the Sammamish River.

broad control method category	Specific method	compatible with Sammamish River water body characteristics	effectiveness for purple loosestrife	further consideration?	effectiveness for garden loosestrife	further consideration?	effectiveness for phragmites/ common reed	further consideration?	effectiveness for Brazilian elodea	further consideration?
Chemical Control Methods	Triclopyr TEA	aquatic formulations are compatible for use	effective, if properly applied. Selective: won't harm monocots (cattails, grasses, and sedges)	yes	<u>moderately effective</u> , re-growth often occurs with treated plants. Selective: won't harm monocots (cattails, grasses, and sedges)	yes	not effective on monocots (grasses)	no	not relevant	no
Chemical Control Methods	2,4-D Amine	Some formulations are compatible	Potentially effective but not recommended for control. Toxic to fish and aquatic invertebrates.	no	Potentially effective but not recommended for control. Toxic to fish and aquatic invertebrates.	no	not effective on monocots (grasses)	no	not relevant	no
No Action	No Action	With many existing and planned shoreline habitat restoration projects along the River, some weed control is already happening.	no action towards control would result in continued seed and propogue spread down stream into uninfested habitat areas of the Sammamish River and Lake Washington	no	no action towards control would result in continued seed and propogue spread down stream into uninfested habitat areas of the Sammamish River and Lake Washington	no	no action towards control would result in continued seed and propogue spread down stream into uninfested habitat areas of the Sammamish River and Lake Washington	no	no action towards control would result in continued seed and propogue spread down stream into uninfested habitat areas of the Sammamish River and Lake Washington	no

¹method can be employed by individual property owners for small-scale temporary control or potentially for follow-up control after good initial control has been achieved.

²Safety protocols, such as those developed by the Thurston County Noxious Weed Board specifically address the unique job hazard concerns that come with SCUBA diving work. <http://www.co.thurston.wa.us/tcweeds/special-projects.htm>

³shading, while not effective as a method for initial control of the plants, may be part of a long-term IPM strategy for control, particularly when combined with restoration plantings.

⁴Diquat and endothall have only suggested successful results in combination with copper compounds, but the use of copper is illegal in most Washington State waters (including the Sammamish River) due to its demonstrated toxicity to juvenile Salmonids.

⁵WA Department of Ecology states that Endothall is "not effective in controlling ... Brazilian elodea." : <http://www.ecy.wa.gov/programs/wq/plants/management/aqua028.html>

A Word about Integrated Pest Management

The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts. IPM uses a multifaceted and adaptive approach. Control methods are selected that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management of noxious weeds will require dedication over a number of years, and should allow for flexibility in method as appropriate.

THE “NO ACTION” ALTERNATIVE

Among all the considered control options, one management alternative that should be considered is the option of “no action.” In this situation the “no action” option would not necessarily mean that no work gets done on the aquatic invasive plants, however it means there is no unified effort to address all the invasive weeds together. Work may be done in pockets up and down the river but there is no guarantee for success of management of all regulated noxious weeds. The effects of “no action” on each of the species varies; generally, the plants would be able to continue sending propogules downstream into further reaches of the Sammamish River corridor, Lake Washington, and beyond. Other effects of the “no action” alternative are that the weeds continue to spread along the shoreline and within the river, creating monocultures and altering habitat for the wildlife that uses the river.

The potentially negative side effects of all the considered control options are considered against the “no action” alternative. For example the option of controlling purple loosestrife with herbicide considers the negative effect of herbicide spray on non-target plants compared to not controlling purple loosestrife in the first place.

Purple loosestrife (*Lythrum salicaria*)

For more information on the following purple loosestrife control methods reference Appendix A – Purple Loosestrife Best Management Practices document. A large, scattered infestation of purple loosestrife exists upstream on the shores of Lake Sammamish, making eradication of the plant on the shore of the river impossible until the Lake Sammamish infestation is addressed. Still, focusing control of the plant in targeted areas or targeted reaches of the river can facilitate habitat restoration, and encourage plant diversity.

Hand Pulling and digging (only suitable for small areas or used in combination with other methods)

Hand pulling or digging of purple loosestrife plants is possible in areas where plants are growing out of soft substrate and the root mass of the plants are reachable. The entire root mass must be removed, bagged, and disposed of. Plants that are growing in rock or riprap, in amongst large downed wood, or amongst woody vegetation may not be able to be completely removed using this method. Additionally, while hand pulling may be feasible on a small scale, using hand pulling and digging for the entirety of the river shoreline would be prohibitively expensive. Using hand pulling and digging methods to control purple loosestrife may work on the Sammamish River only if it is part of an IPM solution that incorporates several control tactics such as biological control, long-term persistent cutting, weed fabric and selective herbicide use.

Weed Fabric/Tarps (only suitable for small areas)

The use of thick cardboard or plastic, staked down, and covered by six inches of mulch to cover closely cut purple loosestrife plants can prevent seed spread but will not eradicate the plant. Weed fabric is only an option where the terrain is flat soil and not interrupted by logs, other vegetation, or rock. Weed fabric also needs to be checked often because it can become damaged and will need to be repaired or re-installed. Using weed fabric to control purple loosestrife may work on the Sammamish River only if it is part of an IPM solution that incorporates several control tactics such as hand pulling, biological control, long-term persistent cutting, and selective herbicide use.

Cutting (used in combination with other methods)

Cutting plants at the base when in flower may prevent seeding, but cut plants may continue to produce flowers. Sites should be consistently and regularly monitored from the beginning of flowering (early July) until first frost to cut and remove any subsequent flowers. Cutting will not kill the plants, and they will need to be controlled every year. Care must also be taken to properly dispose of root and stem fragments to prevent the growing of new plants. Cut plant parts must not be left on site, because root and stem fragments can form new plants. Using cutting to control purple loosestrife may work on the Sammamish River only if it is part of an IPM solution that incorporates several control tactics such as hand pulling, biological control, weed fabric, and selective herbicide use.

Biological Control (used in combination with other methods)

Purple loosestrife population density and the number of flowering plants can be reduced using this method, but there will always be some plants remaining. Releases of the biological agents should be made only at sites where loosestrife infestations are large and immediate eradication of the weed is not the primary objective. Biological control can take up to six years to have a significant impact on the infestation.

Galerucella beetles have been released in the southeast part of Marymoor Park by (or for) the King County Noxious Weed Control Program (KCNWP) in 1997, 1998, 1999, 2000, 2001, 2002, 2004, 2005, 2006, and 2007. They were also released along the Sammamish River in Marymoor Park in 2003 and 2007. *Galerucella* beetles are already on site but have not been able to effectively reduce the purple loosestrife infestation. The use of *Galerucella* beetles needs to be combined with the removal and bagging of plant flowers.

Other biocontrol methods that target purple loosestrife, such as use of seed feeding weevils and root feeding weevils, are more difficult to obtain than *Galerucella* beetles. They have not yet been tried on the Sammamish River. If released they would take several years to build up populations to levels that would result in a significant impact on the population. The use of seed feeding weevils and root feeding weevils for purple loosestrife control needs to be combined with the removal and bagging of plant flowers. By its nature, biocontrol methods will, at best, result in reduced infestation of the target plant but not result in eradication.

Chemical Control – most effective initial control method

For large and widespread infestations of purple loosestrife, herbicide use may be necessary for effective control. The application of herbicide to the emergent purple loosestrife is best conducted by manual spot applications. Control of purple loosestrife is most effectively achieved using a selective herbicide such as an aquatic approved version of triclopyr (TEA) or 2,4-D (Amine)(see Appendix B for herbicide

label). Triclopyr-TEA in particular has been very effective in killing purple loosestrife plants and has the lowest human and ecological side effects. Selective herbicides also have the advantage of not harming monocot plants (native cattails, grasses, sedges, etc.).

While non-selective, an aquatic approved version of imazapyr is also effective at controlling purple loosestrife plants. Experienced herbicide applicators can spot spray target only purple loosestrife plants and avoid damage to adjacent monocot plants. Imazapyr is relatively slow acting so application should occur early – mid way through the summer (before late August/September) – to ensure that the chemical will have time to affect plant growth before seed production.

These aquatic herbicides must be used with a Washington State Department of Ecology approved aquatic surfactant. An experienced and licensed aquatic herbicide applicator can selectively target individual emergent weed species and limit collateral damage to other species to a minimum. This is especially true when infestations are small so that large areas with a diverse plant distribution don't have to be treated. Since the emergent noxious weed infestations at the Sammamish River are still confined largely to the shoreline, it should be relatively simple for the applicator to avoid significant collateral damage and preserve the native plant community.

Treatment of purple loosestrife will likely occur twice during the growing season in order to ensure that no plants were missed as the vegetative part of the plants can be hard to spot among other vegetation. In sensitive areas or areas prone to erosion, careful spot-spraying will create fewer disturbances than manual or mechanical control. Areas should be monitored for new plants germinating from the seed bank for several years following treatment. In some cases several years of treatment may be necessary.

Garden loosestrife (*Lysimachia vulgaris*)

For more information on the following garden loosestrife control methods reference Appendix A – Garden Loosestrife Best Management Practices (BMP) document. . A large, scattered infestation of garden loosestrife exists upstream on the shores of Lake Sammamish, making eradication of the plant on the shore of the river impossible until the Lake Sammamish infestation is addressed. Additionally, actual eradication of garden loosestrife is very difficult. Still, focusing control of the plant in targeted areas or targeted reaches of the river can facilitate habitat restoration, and encourage plant diversity.

Hand Pulling and Digging (only suitable for small areas or used in combination with other methods)

Hand pulling of garden loosestrife is not possible; the plant breaks off from long rhizomes leaving root fragments behind. Digging of garden loosestrife plants is possible in areas where plants are growing out of soft substrate and the root mass of the plants are reachable. The entire root mass must be removed, bagged and disposed of. Plants that are growing in rock or riprap, in amongst large downed wood, or amongst woody vegetation may not be able to be completely removed using this method. Additionally, while digging may be feasible in the small scale, using this technique on the whole river scale would be prohibitively expensive and potentially cause erosion problems. Using digging methods to control garden loosestrife may work on the Sammamish River only if it is part of an IPM solution that incorporates several control tactics such as biological control, long-term persistent cutting, weed fabric, and selective herbicide use.

Weed Fabric/Tarps (only suitable for small areas)

The use staked down tarps to cover closely cut garden loosestrife plants can slow down growth and prevent seed spread, but will not eradicate the plant. Tarps are only an option where the terrain is flat and not interrupted by logs, other vegetation, or rock. The covering must extend several feet beyond the edge of the infestation and be weighted so the plants cannot push it up. The edges of the covered area must be monitored for plants coming up from rhizomes extending beyond the sheet. Weed fabric will need to be checked often for damage or gaps and repaired or re-installed as needed, especially in areas that are prone to seasonal flooding.

Using weed fabric to control garden loosestrife may work on the Sammamish River only if it is part of an IPM solution that incorporates several control tactics such as digging, long-term persistent cutting, and selective herbicide use.

Cutting (used in combination with other methods)

Cutting alone is not a control option for garden loosestrife; new plants will grow from rhizomes. Cutting plants at the base when in flower may prevent seeding, but cut plants may continue to produce flowers and root mass. Cutting will not kill the plants, and they may continue to expand despite of it. Cut plant parts must not be left on site, because root and stem fragments can take root and form new plants. Using cutting to control garden loosestrife may work on the Sammamish River only if it is the first step of an IPM solution that incorporates several control tactics such as digging, tarping, and selective herbicide use.

Chemical Control --- most effective initial control method

For large and widespread infestations of garden loosestrife, herbicide use may be necessary for effective control. The application of herbicide to the emergent and upland garden loosestrife is best conducted by manual spot applications. Informal trials done by the KCNWP in 2011 suggest a low concentration of imazapyr (0.75%) applied in early summer (June) can be very effective in controlling garden loosestrife. Less complete control has been achieved by using higher concentrations of imazapyr later in the summer (August). While producing the most effective control results to date, imazapyr has the drawback of being non-selective, meaning it will control both grasses and broadleaf plants. When applying non-selective herbicides amongst native plants, great care must be taken to prevent unintended control.

The selective herbicide triclopyr is also commonly used to treat garden loosestrife, although has been found to be less effective than imazapyr. Apply triclopyr when plants are in the mid- to full-bloom stage. Application to preflowering plants or seedlings may also be effective, but unless the extent of the infestation is well known, plants can be difficult to locate when not in flower. Triclopyr is a selective herbicide and will kill only dicots. It will not harm monocots such as grasses, sedges, cattails and many native aquatic plants.

Glyphosate herbicide is occasionally used to treat garden loosestrife, although it has been found to be less effective than imazapyr. Additionally, like imazapyr, glyphosate is nonselective and it will injure or kill other vegetation contacted by the spray including grasses, cattails and other monocots.

These aquatic herbicides must be used with a Washington State Department of Ecology approved aquatic surfactant.

An experienced and licensed aquatic herbicide applicator can selectively target individual emergent weed species and limit collateral damage to other species to a minimum. Since the emergent noxious weed infestations at the Sammamish River are still confined largely to the shoreline, it should be relatively simple for the applicator to avoid significant collateral damage and preserve the native plant community.

Treatment of garden loosestrife will likely occur twice during the growing season in order to ensure that no plants were missed as the vegetative part of the plants can be hard to spot among other vegetation. In sensitive areas or areas prone to erosion, careful spot-spraying will create fewer disturbances than manual or mechanical control. For several years following treatment, areas should be monitored for new plants germinating from the seed bank. It is common that several years of treatment are necessary.

Phragmites/Common Reed (*Phragmites australis*)

For more information on the following phragmites/common reed control methods reference Appendix A – Common Reed-Phragmites Best Management Practices document. Since there are only a few patches of phragmites along the River (figure 14) eradication may be the goal for these invasive plants.

Hand Pulling and Digging (only suitable for small areas or used in combination with other methods)

Hand pulling of phragmites is not possible; the plant breaks off from rhizomes leaving root fragments behind. Digging of phragmites plants is possible in areas where plants are growing out of soft substrate and the root mass of the plants are reachable. Young infestations may have shallow roots, however mature infestations may have rhizomes up to six feet deep and the entire root mass must be removed, bagged, and disposed of. Plants that are growing in rock or riprap, in amongst large downed wood, or amongst woody vegetation may not be able to be completely removed using this method. Additionally, while digging may be feasible on a small scale, using this technique for the whole river would be prohibitively expensive and potentially cause erosion problems. Using digging methods to control phragmites may work on the Sammamish River only if it is part of an IPM solution that incorporates several control tactics such as biological control, long-term persistent cutting, weed fabric, and selective herbicide use.

Weed Fabric/Tarps (only suitable for small areas)

The use of thick cardboard or plastic, staked down, and covered by six inches of mulch to cover closely cut phragmites plants can prevent seed spread but will not eradicate the plant. Weed fabric is only an option where the terrain is flat and not interrupted by logs, other vegetation, or rock. Weed fabric also need to be checked often because it can become damaged and will need to be repaired or re-installed. Using weed fabric to control phragmites may work on the Sammamish River only if it is part of an IPM solution that incorporates several control tactics such as hand digging, long-term persistent cutting, and selective herbicide use.

Cutting (used in combination with other methods)

Cutting or mowing phragmites is most effective after herbicide application (see Chemical Control section below), however, repeated annual cuttings without herbicide can reduce spread. Depending on site wetness, mowing or cutting treated plants once after an herbicide treatment is recommended during late summer to fall (August to first hard frost) or in winter when the ground is frozen. Cutting/mowing without use of herbicide should be done in late July (before tassel set) when most of the energy is in the stalk and not the roots. Cutting during other times may stimulate growth.

Cutting can be done using brush cutters (weed whackers), hedge trimmers, or loppers. Stems should be cut 4 inches above ground to minimize impact to wildlife and native plants. Cut stems should be collected immediately, bagged and removed from site to prevent possible seed spread and allow sunlight to reach the soil surface to promote germination of native plants. An annual regime of cutting and removing stems at the end of July for several years may result in successful control. Using cutting to control phragmites may work on the Sammamish River only if it is part of an IPM solution that incorporates several control tactics such as hand pulling, weed fabric, and selective herbicide use.

Chemical Control – most effective initial control method

For large and widespread infestations of phragmites, herbicide use may be necessary for effective control. The application of herbicide to phragmites is best conducted by manual spot applications. Control of phragmites is most effectively achieved using a broad spectrum (effective on both monocots and dicots) herbicide such as an aquatic approved version of imazapyr or glyphosate applied to actively growing plants (full flower) (see Appendix B for herbicide label). Imazapyr in particular has been very effective in killing phragmites plants but does stay active in the soil longer than glyphosate. Triclopyr TEA or 2,4-D amine are not effective on grasses such as phragmites because they are intentionally formulated to avoid damage to monocots such as grass.

Herbicide application in mid-summer (full flower stage) followed by cutting (several weeks later once the stems and leaves have died) will encourage native plant growth and allows for identification of phragmites re-growth for herbicide spot treatment in the future. These aquatic herbicides must be used with a Washington State Department of Ecology approved aquatic surfactant.

An experienced and licensed aquatic herbicide applicator can selectively target individual emergent weed species and limit collateral damage to other species to a minimum. This is especially true when infestations are small so that large areas with a diverse plant distribution don't have to be treated. Since the emergent noxious weed infestations at the Sammamish River are still confined largely to the shoreline, it should be relatively simple for the applicator to avoid significant collateral damage and preserve the native plant community.

In sensitive areas or areas prone to erosion, careful spot-spraying will create fewer disturbances than manual or mechanical control. For several years following treatment, areas should be monitored for new plants germinating from the seed bank. In some cases several years of treatment may be necessary.

Brazilian elodea (*Egeria densa*)

For more information on the following Brazilian elodea control methods reference Appendix A – Brazilian Elodea Best Management Practices document. An infestation of Brazilian elodea exists upstream in the north end of Lake Sammamish, making eradication of the elodea in the river impossible until the Sammamish Lake infestation is addressed. Still, small areas or targeted reaches of the river can be cleared of the plant to facilitate water flow, habitat restoration, and encourage plant diversity.

Hand Pulling and Cutting (only suitable for small areas)

Hand pulling can be used to temporarily control Brazilian elodea in a small area if repeated on a regular basis. Hand pulling from the shoreline or a boat will not eradicate the plant from a water body and *is impractical for large infestations*. All pulled plant parts must be removed from the water, and an HPA pamphlet permit required. Several years of monitoring are needed for signs of plants growing from root

fragments and from the seed bank. Brazilian elodea can be composted on dry land or placed in yard waste bins. Cutting of Brazilian elodea is not recommended as it will likely increase the infestation through fragmentation.

Snorkel Hand Pulling (suitable for small areas or follow-up control)

Snorkel hand pulling involves the use of snorkelers to carefully pull and bag entire Brazilian elodea plants. Snorkelers are used instead of divers because the river water levels are low enough that it makes diver hand pulling impractical and snorkelers would be able to navigate the 5 feet or so water depth much easier. Snorkelers are able to target just Brazilian elodea plants and carefully search the area for missed plants. This method can be used to target critical areas of habitat and water flow. Diver hand pulling is also an excellent way to continue control efforts after the infestation has reached a level where only maintenance is required.

Snorkel Dredging (most effective initial control method)

The use of a suction dredge to remove Brazilian elodea plants and roots from waterbody sediment has proved effective in flowing water. The technique involves one snorkeler dislodging the Brazilian elodea and another uses a vacuum hose to remove the plants (Simpson & Peoples, 2006). The dredge is mounted on a floating raft that is moved around the waterbody as work progresses. The plant and root material are collected in a basket for disposal off site. While whole river eradication of Brazilian elodea may be time and cost prohibitively expensive, the diver dredging technique, in combination with diver hand pulling may be appropriate for targeted reaches of the river.

Since 2004 Thurston County Noxious Weed Control Agency and other agencies have used SCUBA diver dredging and SCUBA diver pulling techniques to clear Brazilian elodea from 34 miles of the Chehalis River. From 2005 to 2011 a 90% reduction in Brazilian elodea cover was achieved through the diver dredging technique, with diver hand pulling follow-up (TCNWCB, 2011). They were able to clear up to nearly 10 acres of Brazilian elodea from the river per year; a total of 300,000 pounds of plant material were removed over the eight years of the project (2011).

The Sammamish River is a much smaller and shallower river system than the Chehalis River and it is believe snorkelers would be appropriate to do the hand-pulling and snorkel dredging of Brazilian elodea within its channel. However, it could be possible that if deeper pools exist in the river a SCUBA diver team may need to be hired to clear those deeper areas out.

Any work done involving divers will need to carefully follow safety guidelines as outlined by Occupational Safety and Health Administration (OSHA), State, County, and local jurisdiction guidelines.

Bottom Barriers (only suitable for small areas)

An opaque bottom barrier can be used to suppress Brazilian elodea growth in small, discrete areas like at a boat launch or water intake. Barriers need to be very securely anchored and regularly cleaned because plants will root in the sediment that accumulates on top of them. Bottom barriers are not practical for large-scale infestations such as the entire infestation at the river and are not permanent.

Chemical Control

Chemical control of submersed plants, such as Brazilian elodea, in flowing water is difficult and requires careful consideration. While chemical control of the plant in small lakes has been successful in eradicating the plant, moving water and the presence of salmonid fish, makes the prospect very unlikely,

if not impossible in the Sammamish River. Also, as long as there is a source of plants (Lake Sammamish) using herbicides only as a control method, not an eradication method, does not make sense.

For large infestations of Brazilian elodea (in lakes) a round or two of herbicide treatment is often the most reasonable option for eradication. The only herbicide allowed in Washington waters that has been shown to be successful against Brazilian elodea is fluridone. Endothall and diquat have proven successful in combination with copper compounds, but the use of copper is illegal in most Washington State waters due to its demonstrated toxicity to juvenile salmonid (smolts). So, while the use of herbicide to treat Brazilian elodea in the Sammamish River may be theoretically possible, it is not practical.

SECTION 7 – INTEGRATED TREATMENT PLAN

The Sammamish River and its associated shoreline contain four listed noxious weed species whose presence has diminished the quality of the river as an ecological and human resource. The goal of the treatment plan is to halt and reverse the degradation caused by the targeted plants. The primary shoreline weeds include garden loosestrife (*Lysimachia vulgaris*), purple loosestrife (*Lythrum salicaria*) and phragmites/common reed (*Phragmites australis*). All three of the shoreline plants are regulated through the King County Noxious Weed Council. The most wide spread aquatic invasive weed is Brazilian elodea (*Egeria densa*), and while Brazilian elodea is not a regulated weed in the Sammamish River, it does pose the greatest threat to the endangered species act listed salmon, Chinook.

All four species are highly aggressive and are difficult to control. The management goal for purple and garden loosestrife plant will be control rather than eradication as a large source of reinfestation seeds and propagules for these plants exist upstream on the shores of Lake Sammamish. Until the upstream purple and garden loosestrife plants are eradicated, control of the plants in targeted areas, such as restoration sites or adjacent to uninfested habitat, is the goal. The common reed/phragmites infestations along the river are relatively small and have been reducing in size over time as a result of herbicide treatments. A reasonable management goal for the phragmites population is eradication within a few years. Eradication of Brazilian elodea is not the goal because Lake Sammamish, which feeds the Sammamish River, has a heavy uncontrolled infestation of Brazilian elodea and as long as the infestation remains in the lake, it will be a source of infestation for the river.

It is recognized that there are other noxious weeds present within the Sammamish River system but these weeds are not regulated and therefore not the focus of this IAVMP. However, in the effort to create an integrated treatment plan, it is encouraged for any municipality, non-profit, local government or citizen group to approach every restoration project on the River with all the invasive weeds in mind. To help facilitate comprehensive restoration planning, BMPs for the non-regulated weeds are included in Appendix A.

All methods suggested for the regulated weeds combine to form an Integrated Pest Management (IPM) strategy that is a balance between target weed control and environmental protection.

Permits

Most aquatic weed control activities require permits. Many manual and mechanical control methods are covered under the “Aquatic Plants and Fish” pamphlet, a Hydraulic Project Approval (HPA) from the Washington Department of Fish and Wildlife that is free of charge and expedites the removal aquatic of noxious weeds. This HPA pamphlet permit is for individual land owners and cannot be applied to entire

waterbody. It is intended to allow shoreline property owners to control aquatic noxious weeds without having to go through expensive and complicated permitting. The HPA is not intended to be used to control “beneficial plants” or native plants that may be seen as weeds.

A National Pollutant Discharge Elimination System (NPDES) permit must be obtained before aquatic herbicides can be applied to natural water bodies in Washington State (including the Sammamish River). The Washington Department of Agriculture holds an NPDES permit for the management of noxious weeds growing in wet areas such as lake shores, freshwater wetlands, river banks, and estuaries. Licensed applicators can obtain coverage under this permit free of charge. For herbicide treatment of submerged plants (floating or submersed weeds) the project will need an Aquatic Plant and Algae Management NPDES permit from the Washington Department of Ecology. This permit must be held by the herbicide applicator or the legal entity hiring the applicator, it must be applied for at least sixty days before the herbicide application, and a permit fee applies. For the Sammamish River project, it is not recommended to do in river herbicide work so and NPDES permit from Washington State Department of Ecology will not be necessary.

General Control Strategy- Shoreline Plants

The primary problem the loosestrifes and phragmites pose to the river system is reducing the wildlife habitat quality and reducing plant diversity. Therefore, shoreline aquatic weed control work will initially focused in areas of existing good habitat such as restoration areas that are the most vulnerable to the continued presence of the plants. Other priority areas of shoreline weed removal work are areas that have restoration activities scheduled in the future and existing parklands. This targeted site management approach focus the first priority for control work on these three areas:

- existing restoration areas
- pending restoration areas
- managed parks

These key asset areas already (or soon will) have many resources (such as time, labor, and restoration plantings) invested in them and work done controlling regulated noxious shoreline weeds will continue those efforts. Furthermore, these sites are more likely to have follow-up work on the noxious weed control done by their owners and managers as compared to weed control done in unmanaged stretches of the river.

After these priority areas have been addressed, shoreline weed control should be targeted in areas adjacent to and particularly up stream of current control areas and uninvaded areas. This work will build a buffer around the initial target areas, resulting in less maintenance needed in the future to keep them from coming back because there will be less seed and plant propogules coming in from off site.

The final step in shoreline weed control strategy along the Sammamish River will focus on the unmanaged stretched of river bank. These are the lowest priority because long-term stewardship of weed removal is less likely to occur in these areas. In order for the removal process to be successful, long-term stewardship/maintenance is critical because a large seed and propogule source for both new purple and garden loosestrife plants exists upstream in Lake Sammamish.

1. Phase I – priority treatment areas
 - a. existing restoration areas
 - b. pending restoration areas

- c. managed parks
2. Phase II – secondary treatment areas
 - a. Adjacent to primary treatment areas
 - b. Upstream of primary treatment areas
3. Phase III – unmanaged river bank areas

Prioritizing treatment areas in this manner, rather than moving down stream along sequential river miles from Lake Sammamish to Lake Washington, will ensure that the most valuable shoreline habitat is addressed first. This strategy will also ensure that, if work on the project were to be halted before the five-year initial control time line is complete, an impact will have been made in the most important areas.

Identifying the best priority treatment area sites may take some time, but a place to start may be the November 2012 River Shoreline Vegetation survey conducted by the King County Noxious Weed Control program (Figure 6). This map, and the associated data table, can help the project managers find riverbank areas that currently have restoration plantings and an estimate of the existing noxious weed cover¹. It is also important to seek out information from the agencies that installed and maintained these restoration areas. Direct communication with local cities (Kenmore, Bothell, Woodinville, and Redmond) and King County (Water and Land Resources Division) will be the most effective way to identify these “priority treatment areas.” Some of the restoration planting areas may no longer be receiving any weed removal maintenance.

The schedule above is a proposed schedule and will need to be reassessed prior to the beginning of the project and each year during the project, depending on the density and distribution of plants found during surveys. Adaptive management is key when working on noxious weed control projects.

Since the management techniques and timing for Brazilian elodea control are quite different from the shoreline noxious weeds the submersed plant will be dealt with separately.

Surveys of Shoreline Plants

At the beginning of the project, a pretreatment survey of the Sammamish River shoreline will be conducted to map the regulated noxious weeds on GPS. A survey of purple loosestrife, garden loosestrife and common reed will occur in mid-summer prior to treatment. It is recommended that the survey be conducted from a small boat in the river, as this approach affords the best views of emergent aquatic vegetation such as purple loosestrife and garden loosestrife. All plants will be mapped using a GPS to create GIS files. King County staff and local municipalities will work together to gather survey information that may have been performed independently of this project.

Based on the initial surveys, the river shoreline will be broken into zones and prioritized by infestation density, area and, when appropriate, helping with restoration efforts along the shoreline. This method allows for thorough treatment on a prioritized schedule.

¹ The % noxious weed cover presented in the survey and associated data table represents an estimate of all listed noxious weeds, including the unregulated noxious weeds Hymalian blackberry and reed canarygrass. Often, the majority of the area of all the “listed noxious weeds” is occupied by the unregulated weeds. The % cover noxious weeds value may best serve as a general measure of the condition of the site and a tool to help prioritize control efforts of the regulated shoreline noxious weeds.

After each control event the zone will be resurveyed to assess the need for further follow-up using appropriate control methods. Each zone will be surveyed prior to initial control and after. As zones are treated they will be surveyed each subsequent year in order to help inform treatment decisions and allow for adaptive management. It is anticipated that every zone will receive one year of dedicated control work and then at least one year of follow-up survey and control work.

CONTROL OF SHORELINE PLANTS

Initial Control

Initial control of all three regulated noxious shoreline weeds be accomplished using a selective aquatic herbicide formulations of triclopyr (e.g.: Renovate3™) for purple loosestrife and imazapyr (e.g., Habitat™) for both garden loosestrife and common reed (*see Appendix B for herbicide label*). The herbicides will be applied by a licensed aquatic herbicide contractor using boat mounted spot spraying equipment or a backpack sprayer. Treatment of these plants will occur in late summer, once most of the plants have flowered. It is also possible to access the plants from the Sammamish River trail with a backpack sprayer. A licensed herbicide applicator will be able to accurately spot spray plants on shore, avoiding non-target plants. Based off of post treatment surveys, a second spot treatment of plants using herbicide will be scheduled for mid-fall if deemed necessary.

Hand removal of any remaining loosestrife flowers or seed heads can be conducted in September. This flower and seed head removal will not prevent that specific plant from returning the following year, but will prevent further spread of the overall infestation by removing the seed source. It is also important to take care in cutting during the appropriate times (such as late summer/fall) as to not actually encourage growth. Removed plant material for the Class B shoreline weeds (purple loosestrife, garden loosestrife, and phragmites) will be securely bagged and disposed of in the garbage (not composted or green-wasted).

In areas of large infestation where native planting activities may occur after treatment, the use of weed tarps could be useful in lowering the risk of re-infestation. These sites need to be monitored to make sure new plants are not growing underneath the weed fabric or along the edges and that the tarps continue to be securely staked down.

Follow-up Control

The years following the initial control will continue to use a combination of herbicide treatment, cutting and hand pulling follow-up.

Schedule

Year 1

Survey the entire shoreline for the three regulated weeds. Following the survey, combine just acquired weed location data, historical weed location data, and the locations of Phase I treatment areas (existing restoration areas, pending restoration areas, and managed parks). Weed control work in year 1 will focus on these Phase I priority areas, ideally working downstream from site to site. Areas treated in year 1 will be surveyed at least two weeks following treatment to determine herbicide efficacy or effectiveness. During this survey re-treat any missed plants in the initial treatment area.

Year 2

Work in year 2 will entail surveying the entire river shoreline again, focusing on areas that were treated in year 1. This survey data will be compared to year 1 survey data to determine the control success of the year 1 treatment. Based on the control success of year 1 and what was accomplished control work will continue in Phase 1 priority areas and begin in Phase II locations, the areas just upstream of the previously treated priority areas. Also, any plants re-appearing in previously treated areas (Phase I areas) will be re-treated. In late summer/fall (at least two weeks after initial treatment) assess effectiveness of control methods and retreat, employ other strategies, such as seedhead removal as necessary.

Year 3

Survey work in year 3 will once again entail a survey of the shoreline regulated weeds on the entire river. Assuming good control in Phase I and Phase II locations, control work will now focus on the unmanaged Phase III riverbank areas. Control work in these areas should begin at the most up-stream uncontrolled areas of river bank and proceed downstream. Also, any plants re-appearing in previously treated areas (Phase I or II areas) will be re-treated. In late summer/fall (at least two weeks after initial treatment) assess effectiveness of control methods and retreat, employ other strategies, such as seedhead removal as necessary.

Year 4

Continue initial treatment of the remaining untreated Phase III areas, working in a downstream direction. Also, any plant re-appearing in previously treated areas (Phase I, II, or III areas) will be re-treated. In late summer/fall assess effectiveness of control methods and retreat, employ other strategies, such as seedhead removal as necessary.

Year 5

Continue initial treatment of the remaining untreated Phase III areas, working in a downstream direction. Also, any plants re-appearing in previously treated areas (Phase I, II, or III areas) will be re-treated. In late summer/fall (at least two weeks after initial treatment) assess effectiveness of control methods and retreat, employ other strategies, such as seedhead removal as necessary.

Year 6 and Year 7

Resurvey entire river and employ treatment strategies as necessary. Two years of post-surveys and adaptive treatment will account for any new infestations or hard to control areas to be controlled, insuring the success of the work.

A Treatment Chronology for Land Managers

In summary, a chronology of how to control the shoreline aquatic noxious weeds would proceed as follows:

1. Year 1
 - a. Survey (mid-July)
 - b. Individual spot spray with aquatic herbicide (end of July/early August)
 - c. Re-survey (mid-August, two weeks after initially herbicide treatment)
 - d. Follow-up spot spray (end of August)
2. Year 2
 - a. Survey (mid-July)

- b. Individual spot spray with aquatic herbicide (end of July/early August)
 - c. Re-survey (mid-August, two weeks after initially herbicide treatment)
 - d. Follow-up spot spray with aquatic herbicide or hand digging of remaining weeds (end of August)
3. Year 3
- a. Plant willow stakes and other native plants (winter) in effort to shade river and shade out the growth of invasive aquatic noxious weeds
 - b. Survey (mid-July)
 - c. Individual spot spray with aquatic herbicide or hand digging of remaining weeds (end of July/early August)

Brazilian elodea (*Egeria densa*)

Initial control (year 1)

Pretreatment survey of Brazilian elodea will occur in early to mid-July. The survey will be conducted from a small boat using a view tube to survey submerged plants. Plant locations will be recorded using a combination of GPS and sketched marks on detailed aerial photos and later transferred to a GIS file.

Areas of elodea infestation will be prioritized based on density, proximity to important ESA listed salmon habitat features and area that could affect the flow of water through the system. After identification of these areas the use of snorkel dredgers/hand pulling will be used. Dredging and hand-pulling will have to occur during the appropriate work window for salmon. It will be important to follow dredging protocol to insure that the effects of dredging by snorkelers (such as the disruption of sediment) are minimized and do not harm the sensitive species that use the river.

Snorkelers will target the top priority areas first and as the project continues work through the prioritization sites as possible. Surveys will be conducted each year to determine the extent of the infestation and assess how well the control methods are working.

The goal of this effort will be to see if dredging can keep critically important habitat for salmon open for passage as well minimize any hindrance to water flow between Lake Sammamish and Lake Washington. It is hoped that a routine schedule of dredging could become an effective way to control elodea in the Sammamish River until eradication is a possibility.

SECTION 8 - PLAN ELEMENTS, COSTS, AND FUNDING

Implementation of the Sammamish River IAVMP is scheduled to span five years, at a total estimated cost of \$155,000. Table 9 outlines the tasks and estimated costs of implementation on an annual basis. The majority of the costs accrue in the first five years, the period of most aggressive treatment. As the project progresses, more funds are dedicated at detecting and controlling reintroduction of aquatic noxious weed species.

Total Cost of the Plan

Planning Costs

Many of the planning costs have already been incurred through the creation of this IAVMP. Approximately 75% of the cost of researching, planning for and writing this management plan came in

the form of a grant from the Washington State Department of Ecology's Aquatic Weeds Management Fund. The remaining costs came in form of salary match from King County Water and Land Resources Division staff. Additionally several stakeholders contributed their time reviewing the written document. Total planning costs are estimated at around \$40,000.00.

Capital Costs

There are no capital costs associated with this IAVMP. It is not anticipated that any equipment will needed to be purchased.

Operational and Maintenance Costs

The majority of expenses associated with implementation of the Sammamish River IAVMP are operational and maintenance costs. These costs include hiring of herbicide contractors, mapping and surveying, follow-up weed removal, community outreach, and project administration & management (Table 9).

Table 9. Sammamish River IAVMP Budget.

Task		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
Noxious Weed Control	Diver and snorkel hand pulling/Dredging of Brazilian elodea (two days/year) in targeted location in the river only		\$6,000	\$6,150		\$6,300		\$6,500	\$24,950
	Purple and Garden loosestrife control (1/5 of the shoreline per year initial treatment(herbicide application)) + (follow-up treatment using an I.P.M. strategy (herbicide, hand pulling, biocontrol, ...))	\$4,000	\$7,000	\$8,500	\$10,000	\$11,500	\$7,500	\$5,000	\$53,500
	Phragmites control/eradication(herbicide treatment)	\$500	\$300	\$300	\$150	\$150	\$150	\$150	\$1,700
Weed Surveys	purple loosestrife and garden loosestrife survey (canoe)	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$10,500
	Brazilian elodea survey (canoe)	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$10,500
Education & Outreach		\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$10,500
Project Administration and Report Writing		\$4,760	\$4,410	\$4,760	\$4,760	\$4,760	\$4,760	\$4,760	\$32,970
sub totals		\$13,760	\$22,210	\$24,210	\$19,410	\$27,210	\$16,910	\$20,910	\$144,620
Project Total									\$144,620

Sources of Funding

Funding for implementation of the Sammamish River IAVMP may come from a combination of sources that will change as the project progresses. Potential sources of funding such as grants, self-funding by river-side municipalities, and non-profits in-kind time were all considered by the Steering Committee. Funding of this project will likely include a blend of different funds, grants, matching cash funds and matching in kind volunteer hours.

Grants

The program has applied for a grant from Washington State Department of Ecology's Aquatic Weeds Management Fund (AWMF) for the writing of this IAVMP. This IAVMP has been developed to be consistent with all AWMF guidelines and requirements so a local jurisdiction could apply for this funding source again and fund the implementation of the project. Given the waterbody-wide extent of the infestations, potential and actual harm that the plant infestations are causing salmonid species, and the support of interested parties along the River, the awarding of an AWMF grant is a possibility.

The Cooperative Watershed Management grant program exists within the WRIA 8 grant programs. The project plan will need to be in line with the goals and objectives of the WRIA 8 Salmon Recovery Plan. Given that this IAVMP project would have a direct impact on improving the Sammamish River habitat for ESA listed Chinook salmon, this project may be a good fit for this grant program.

Matching Funds

Awarding of the Ecology's AWMF grant requires matching funds. Requiring matching funds distributes the responsibility of funding between the state agency (Ecology) and the local stakeholders (municipalities along the River, WIRA 8, and the King County Noxious Weed Control Program). Both cash match and in-kind and/or interlocal match are potential sources of matching funds that could be used to fulfill this requirement.

Long-term Sustainability

The long term sustainability of this project is dependent on the municipalities along the river and the commitment of Sammamish River residents to follow-up weed control and the ability of the staff of the King County Noxious Weed Control Program to communicate weed control techniques, strategies and priorities. In the absence of the AWMF grant funding options will be re-evaluated by the Steering Committee.

SECTION 9 – MONITORING, EVALUATION, AND IMPLEMENTATION

Monitoring

Yearly surveying and monitoring of emergent and submerged aquatic noxious weeds will be conducted along the Sammamish River. These surveys will help guide noxious weed control efforts and provide a year-to-year baseline for progress towards weed control. During the surveys, mapping of the aquatic noxious weeds will be done using aerial photos and/or GPS data loggers. Collected data will then be transferred to GIS.

Evaluation of the Plan

The effectiveness of the plan will be evaluated yearly by the Project team/Implementation Committee (see below). Adaptive changes will be made as needed. Year-to-year comparisons of the monitoring data will be used to evaluate trends in specific target species abundance and distribution. The results of these comparisons will guide control efforts and may result in a change in future control strategies. Success of the plan will be measured by the reduction of the target noxious weed species.

Implementation

The implementation of the plan will follow the process outlined below:

Convene a project Implementation Committee. This group will consist of King County staff and interested parties who are invested in the health of the Sammamish River, likely members of the IAVMP Steering Committee. They will control how the plan is implemented.

Identify Funding Sources. The most likely source for funds to support the implementation of the IAVMP is the Washington State Department of Ecology Aquatic Weeds Management Fund (AWMF). Other local and regional grants as well as possible money from local municipalities will be pursued. The AWMF grant requires matching funds and time from the local agency and community and could fund the first three to four years of the project. This grant requires that work is done in conjunction with the local government. Given that there are several municipalities along the river any one of them could be the lead agency but will need the other local jurisdictions and King County Department of Natural Resources and Parks to ensure the project is successful. During the final year of the grant's funding, the need for future funding will be assessed by the Implementation Committee.

Select an Herbicide Contractor. An applicator will be selected for treatment of each of the three regulated shoreline weeds outlined in the IAVMP. The treatments will be done either "in house" by experienced King County DNRP or local municipal employees or by a competent contractor.

Select method for in water work: King County and local municipalities will work together to review and assess doing snorkel dredging and hand pulling "in house" by experienced King County DNRP staff or by a competent contractor.

Application of Herbicide. Application of herbicides will be completed as prescribed in the IAVMP, unless consultation with the citizens, local municipalities, Ecology and/or the applicator leads to defensible changes in the plan.

Public Education and Communication. Land owners along the Sammamish River will be notified about up-coming herbicide applications as determined by the NPDES permit, the results of yearly monitoring efforts, and any major changes made to the plan via mail, website postings on the King County and local municipal websites.

Monitoring Surveys. Surveys will be done yearly by King County staff with the help of local municipalities. Surveys will be done at the same time each year in order to get a comparable measure of the plants distribution and density.

Manual follow-up. Each year in late summer, a few weeks after herbicide treatment occurs, local jurisdiction staff will manually remove the reproductive parts of plants that were not treated. This will include removal of purple loosestrife flower heads, gathering of any nuisance dead water lily mats, and milfoil fragments.

Long-term Monitoring and Maintenance. This will be done by King County and the local jurisdictions after the satisfactory completion of the implementation plan.

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APPENDIX A:

BMPs

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Himalayan Blackberry

Rubus armeniacus, syn. Rubus discolor

Evergreen Blackberry

Rubus laciniatus
Rosaceae

**Class C Noxious Weeds
Control Recommended**

Legal Status in King County: Himalayan blackberry and evergreen blackberry are Class C noxious weeds (non-native species that can be designated for control based on local priorities) according to Washington State Noxious Weed Law, RCW 17.10. The State Weed Board has not designated these species for control in King County. The King County Weed Control Board recommends control of these species where feasible, but does not require it.

BACKGROUND INFORMATION

Impacts and History

- Highly invasive and can be found throughout King County.
- Can be very difficult to control.
- Out competes native understory vegetation and prevents the establishment of desirable native shade intolerant trees such as Pacific Madrone, Douglas Fir and Western White Pine.
- Can limit movement of large animals when forming large impenetrable thickets.

Description

- **Himalayan blackberry** is a robust, sprawling perennial with stems having large stiff thorns.
- Main canes up to 10 feet long with trailing canes reaching up to 40 feet.
- Trailing canes typically take root at the tips.
- Leaves are large, round to oblong and toothed typically come in sets of three (trailing canes) or five (main stems).
- Individual canes can reach a density of 520 canes per square meter.
- Flowers are white to pink, about one inch in diameter and borne in clusters of about 5 to 20 blooms.
- Develops edible black fruit that clings to the center core when picked.



Himalayan blackberry

- **Evergreen blackberry** is a robust trailing evergreen shrub that grows into impenetrable thickets.
- Ribbed reddish stems up to 10 feet in length with large curved thorns.
- Young canes arch as they grow longer, eventually reaching the ground and rooting at the nodes.
- Palmately compound leaves with 3 to 5 deeply lacerated leaflets.
- Flowers are white to pink about one inch in diameter borne in clusters.
- Develops edible black fruit that clings to the center core when picked.



© 2005 Virginia Tech
Evergreen blackberry

Habitat

- Blackberry can be found in a myriad of habitats such as vacant lands, pastures, forest plantations, roadsides, creek gullies, river flats, riparian areas, fence lines, and right-of-way corridors.
- Does not grow well in wetland areas, will grow if cane tip roots.

Reproduction and Spread

- Reproduces vegetatively by root and stem fragments and by seed.
- Plants begin flowering in spring with fruit ripening in midsummer to early August.
- Daughter plants can form where canes touch the ground.
- Seeds can remain viable in the soil for several years.

Local Distribution

Found throughout King County.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Plan your control effort including: 1) surveying of the area thoroughly for blackberry, 2) setting priorities for control, 3) selecting the best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**) and 4) monitoring the success of control and implementing follow up control as necessary.
- Control practices in critical areas should be selected to minimize soil disturbance. Any disturbed areas need to be stabilized to control erosion and sediment deposition. Refer to the King County Surface Design Manual for further information about sediment and erosion control practices. Minimizing disturbance also avoids creating more opportunities for germination of blackberry and other weeds.
- Generally work first in least infested areas, moving towards more heavily infested areas.
- Ensure habitat protection by targeting only blackberry and preserving all native and beneficial vegetation.
- For sites that provide important bird habitat, it is recommended to remove only one quarter of the blackberry infestation each year especially if there is little alternative habitat nearby. You may also want to consider refraining from large blackberry removal projects during nesting season (mid-March to the end of June).

Early Detection and Prevention

- Blackberry is easily identifiable throughout the year.
- Manually control new infestations as early as possible .
- Monitor the control site and remove any plants returning from root fragments

Manual

- Hand pull the stem close to the ground and uproot the root ball. This method is most effective with first year plants.
- Manual control works best after rain or in loose soils where the canes are suppressed because the blackberries are growing in a forest understory.
- Digging up root crowns and major side roots is slow but will control blackberry and is effective on small infestations.
- Using a claw mattock or pulaski/mattock is also effective.
- Recheck work area because large root fragments left can re-sprout.
- If removing dense patches, area should be replanted with native plants and mulched, or reseeded with a suitable grass.
- Hand pulling and the use of hand mechanical tools are allowable in all critical areas in unincorporated King County.

Mechanical

- Mowing, including the use of riding mowers and tractor mounted mowers, can be very effective in controlling blackberries but also may harm desirable plants present.
- Mowing should not be used where soils are highly susceptible to compaction or erosion, or where soils are very wet.

- Several cuttings a year over several years are necessary to exhaust the roots of their reserve food supply.
- If only one cutting is done per year, cut when the plants begin to flower. If no follow-up is done, the blackberry may re-sprout from the root crown at a greater density, and could overgrow any vegetation planted.
- Cultivation in agricultural areas utilizing cultivation machinery can be effective in controlling blackberry either alone or in conjunction with mowing but is not selective and may require specific sediment and erosion control measures (see Control of Large Infestations/Monocultures).

Biological

Biological control is the deliberate introduction of insects, mammals or other organisms which adversely affect the target weed species. Biological control is generally most effective when used in conjunction with other control techniques. Biological control methods that may assist in blackberry control include the use of goats and chickens as follows:

- Goats and pigs may be effective on clearing or controlling blackberry re-growth from a year to four years old. On mature stands, goats tend to only strip leaves off of the canes. Animals may prefer alternative forage available, so reduce opportunities for selective browsing. Grazing must be continuous or else regrowth will occur. Care needs to be taken to fence off or protect any native or other valuable vegetation. The King Conservation District can provide further information of the use and management of goats for weed control.
- Chickens can potentially decrease the seed bank in blackberry cleared areas by grazing on the seeds.

Chemical

- **Precautions:**
 - Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label of the product being used. **Follow all label directions.**
 - For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
 - For your personal safety, at a minimum wear gloves, long sleeves, long pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
- For control of large infestations, herbicide use may be effective, either alone or in combination with mowing. Infested areas should not be mowed until after the herbicide has had a chance to work and weeds are brown and dead.

- For several years following treatment, monitor areas for new plants germinating from the seed bank, or any missed plants.

Specific Herbicide Information

Herbicides are generally described here by the active ingredient. Many commercial formulations are available containing a specific active ingredient. References to product names are as an example only, and other equally, or more effective commercial products may be available.

Glyphosate: can effectively control blackberry. Treatment with glyphosate needs to be combined with effective re-vegetation of the site to prevent re-invasion by undesirable vegetation and to control erosion. Glyphosate is most effective on blackberry in September to October when canes are actively growing and after berries have formed. Fall treatments should be conducted before the first frost.

Selective Broadleaf Herbicides (such as triclopyr, 2,4-D and metsulfuron): most effective when blackberry is growing in a grassy area. Read the label of the product you are using to determine the optimal time to spray. Re-treatment the following year may be necessary to control any returning plants. Continue to monitor for new plants for several years after the initial treatment and following any disturbance to the soil such as tilling or construction. **NOTE: Certain additional restrictions apply for products containing 2,4-D and Triclopyr BEE (e. g. Garlon 4, Crossbow). Refer to the King County Noxious Weed Regulatory Guidelines for more details.**

Selective herbicides that are effective on blackberry include metsulfuron (e.g. Escort, Cimarron, Ally), triclopyr ester (e.g. Garlon 4) or triclopyr amine (e.g. Garlon 3A) and a combination treatment of triclopyr and 2,4-D (e.g. Crossbow).

Metsulfuron should be applied to fully leafed-out blackberry before fall leaf coloration. Good coverage is essential to achieve control.

Triclopyr (amine and ester) and triclopyr + 2,4-D should be applied when actively growing. Foliage must be thoroughly wetted with herbicide.

2,4-D can harm certain grasses, alfalfa, clover and other legumes. The addition of a suitable surfactant may improve the control results.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Properly identify targeted blackberries
- Mark all desirable vegetation around control area, ensuring that no native plants are removed.
- Small infestations of less than 200 square feet can be effectively and relatively easily hand-pulled or dug up. Isolated plants should be removed in order to prevent them from infesting a larger area.
- Cut above ground portion of blackberry with loppers or pruners. Dig up or pull the remaining root ball.
- Pull or dig up the plants when the soil is wet.
- Replace any divots created when removing the plants to lessen the amount of disturbed soil.
- Apply appropriate herbicide with wick wiper or by spot spray to the cut stumps to minimize off target injury.
- Monitor site throughout growing season and remove any new plants.
- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass.

Large Infestations/Monocultures

- Properly identify invasive blackberries.
- Mark all native vegetation in and around the control area, ensuring that no native plants are removed.
- Mow down the blackberry with weed-eaters, brush mowers or machetes.
- Following mowing, either dig up the root-ball if labor is available or treat re-sprouting blackberry regrowth with an appropriate herbicide (See the Chemical section of this BMP).
- Mechanical cultivation is also an option for controlling invasive blackberries in agricultural areas. After initially mowing down the above ground vegetation, deep cultivation of the land can control root balls if done multiple times. Yearly spot control of returning seedlings or re-growth will likely be necessary.
- For large areas, it may be more cost-effective to apply herbicide to the mature blackberry plants and then mow the dead canes.
- When large dense areas of blackberry are removed, the bare areas created need to be stabilized and re-vegetated with native or non-invasive vegetation to prevent erosion and re-invasion of blackberries and other weeds (refer to the King County Surface Water Design Manual or equivalent for incorporated areas). Ensure that a high standard of blackberry control has been achieved prior to re-vegetating the site.
- If a non-selective herbicide is used in grassy areas, the area needs to be re-seeded to prevent reinvasion by weeds.
- Infested areas will require follow-up management lasting for several years to control plants re-growing from the seed bank and rhizomes.

Riparian and Aquatic Area Control Issues

- Additional permits may be required for control of infestations in riparian areas. See the Noxious Weed Regulatory Guidelines for more information or contact your local jurisdiction.
- In some cases, the cleared area will need to be replanted with native or non-invasive vegetation and stabilized against erosion. See the King County Surface Water Design Manual for further information about sediment and erosion control practices (<http://www.kingcounty.gov/environment/waterandland/stormwater/documents/surface-water-design-manual> or call 206-296-6519).
- Focus on manual removal for small infestations if possible. Follow procedures listed above.
- For larger areas where herbicide use is warranted, spray using low pressure and large droplet size to reduce drift. If herbicide could potentially drift into the water or a wetland area, use only approved aquatic herbicides and surfactants.
- Blackberry shrubs can be found growing along wetland margins but are typically daughter plants off of a main cane. Control can be achieved by cutting the canes down to the ground. The roots can not withstand the anaerobic soil conditions without the supporting canes.

Road Rights-of-Way Control Issues

- Manually remove infestations if possible.
- If plants are in grassy areas, use a selective broadleaf herbicide; if controlled with a non-selective herbicide, re-seed after control is completed.
- An effective mowing program can control blackberries along a Right of Way. Any blackberries remaining outside the mowed area will quickly re-invade the cleared areas.
- Spot spray blackberries with glyphosate in areas with no desirable vegetation.

Disposal Methods

- Plant crowns and rootballs should be collected and discarded with the trash or yard waste or taken to a transfer station for disposal. Back yard composting of rootballs is not recommended.
- Stems can be composted, but they will root on moist soil so they need to be completely dried out or chipped up before composting.
- Dried out stems may be composted on site, disposed of in a city-provided yard waste container or in the green recycling at a transfer station.
- Stems with berries should be collected and put in the trash, yard waste container, or taken to a transfer station. If removal is not feasible, these stems can be left on site. However, there is a risk of spread from the seeds, so the area should be monitored for several years for seedlings. Stems should be left well away from waterways, shorelines, roads and un-infested areas.
- Never dump yard waste in parks or natural areas, as weeds may spread from yard waste piles.

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Brazilian Elodea

Egeria densa
Hydrocharitaceae

Class B Noxious Weed
Control Required except in Selected Areas

Legal Status in King County: Brazilian elodea is a class B noxious weed according to Washington State Noxious Weed Law, RCW 17.10 (non-native species that is harmful to environmental and economic resources and that landowners may be required to control based on distribution in the county and local priorities). The King County Noxious Weed Control Board requires property owners to control Brazilian elodea on private and public lands in the county except in Lakes Washington, Sammamish, Union and Fenwick (control, as defined by state law, means to prevent all seed production and to prevent the dispersal of all propagative parts capable of forming new plants). State quarantine laws prohibit transporting, buying, selling, or distributing plants, plant parts or seeds of Brazilian elodea.



BACKGROUND INFORMATION

Impacts and History

- Native to South America and introduced to the United States through the aquarium trade, it is found scattered throughout western Washington. In King County it is established in Lakes Washington, Sammamish, Union, Fenwick and Dolloff. It is also prolific in the Sammamish River and around Fisherman's Terminal on the Lake Washington Ship Canal.
- Very aggressive and can outcompete native aquatic plants, forming dense monotypic stands. Can reduce biodiversity, change the predator/prey relationships in the lake and adversely impact the food web.
- Impacts recreation by eliminating swimming opportunities, fouling boat motors and snagging fishing lines.
- When allowed to grow in dense stands and "top out", the floating mats prevent wind mixing and extensive areas of low oxygen can develop during the summer.
- Stagnant mats create mosquito breeding areas and increase the water temperature underneath by absorbing sunlight.
- These plants may die back in the fall, and



the resulting decay uses up dissolved oxygen and adds nutrients to the water, potentially increasing algae growth and related water quality problems.



Description, Reproduction and Spread

- Perennial, grows in up to 20 feet of water.
- Generally submergent but can form floating mats.
- Leaves are visibly smooth-edged (teeth are visible with magnification) and densely packed in whorls of four (or up to six).
- Relatively showy white flower has three petals and a yellow center. It is fragrant and floats on the water surface. Flowers are attached on slender stalks to the base of leaf whorls, and there are up to three flowers per whorl. Only male plants are known from the United States.
- Can thrive in relatively low light. High temperatures and high light conditions can cause senescence (die back).
- Often has two major growth periods, one in spring and one in fall. Some plants often persist through the winter.
- Is not known to seed in North America. Spreads by fragmentation.
- Can be confused with the native American waterweed (*Elodea canadensis*), which has a less robust appearance and smooth-edged leaves generally in whorls of three.
- In the nursery trade, also known as Brazilian waterweed, South American waterweed, Common waterweed, Egeria, and Anacharis.



Native *Elodea canadensis* (left) and *Brazilian elodea* (right)

Habitat

- Occurs in still and slow moving water up to about 20 feet deep, depending on water clarity.
- Tend to cluster at downwind ends of smaller water bodies or in quiet coves where fragments can settle out of the water column and take root.
- Tolerates a wide range of pH.



CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (refer to the King County Noxious Weed Regulatory Guidelines).
- Small infestations may be effectively removed using manual methods or hand tools.
- Brazilian elodea spreads by fragmentation, so extreme care must be taken to contain and remove all plant fragments when using manual or mechanical control methods. Otherwise, the infestation will spread.
- Any control actions taken will necessarily affect all landowners adjacent to the water body and will require their approval and participation in order to succeed. In addition, many control options will be expensive and it will be more cost-effective to pool resources.
- Commit to monitoring. Once initial control has been achieved, be sure to conduct follow up monitoring and control in subsequent years in order to catch any overlooked patches or returning infestations before they can spread. Without this, your control efforts can be wiped out within a few years. Monitor the site each year for at least three years after last observing any Brazilian elodea, and then again after three years.

Permitting and Regulatory Requirements

- Permits are required for all weed control work in natural water bodies.
- At minimum, the pamphlet [Aquatic Plants and Fish](#) is required. This pamphlet is published by the Washington State Department of Fish and Wildlife (available free of charge online at <http://wdfw.wa.gov/hab/aquaplnt/aquaplnt.htm> or by calling (360) 902-2534) and acts as a Hydraulic Project Approval (HPA) permit. This “pamphlet HPA” is all you will need for most manual or light mechanical control methods.
- More extensive control, including some bottom barrier placement and all herbicide use, will require additional permits from Washington State. See the sections below for details.
- Permits and licenses are required for all herbicide use in aquatic systems. Minimum requirements include a pesticide applicator’s license with an aquatic endorsement from

the Washington Department of Agriculture and a permit from the Washington Department of Ecology.

- Some incorporated cities also regulate any work conducted in natural waterbodies. Contact your local jurisdiction for details.
- **Permit requirements can change from year to year. Contact the King County Noxious Weed Control Program for more information on current permitting requirements.**

Early Detection and Prevention

- Look for new plants. Get a positive plant identification from an authority such as King County Noxious Weed Control Program staff.
- Look for plants along lake shorelines and in stagnant or slow-moving water in wetlands and streams. Since these plants are often spread as fragments attached to boat motors and trailers, check especially around boat launches. Also check at the downwind end of the waterbody, and anywhere else where fragments could congregate or settle out of the water column.
- The best time to begin surveys is late spring when plants are visible, and surveys can continue into fall when the plants begin to senesce (die back).
- Clean all plant material off of boats, motors and trailers, and check bilgewater for plant fragments any time you have been in an infested water body (or a potentially infested water body).
- **Never dump unwanted aquarium or water garden plants or animals into a natural water body.** Brazilian elodea is still sold in some areas as an aquarium plant, and it was probably introduced to Washington waters by careless dumping of aquariums. It has several other common names, including Brazilian waterweed, South American waterweed, and Anacharis.

Manual Control

- At minimum, an HPA pamphlet permit is required for all manual control activities in natural waterbodies. In incorporated areas, check with your local jurisdiction for other possible permit requirements.
- Hand pulling and the use of hand mechanical tools is allowable in all critical areas in unincorporated King County.
- Hand pulling can be successful for a very small area but is impractical for large infestations. Be sure to contain and remove all plants and plant fragments from the water.
- Weed rakes and weed cutters can assist in maintaining open water in a discrete area, such as around a dock, but will not eliminate the plants. Be sure to contain and remove all plants and plant fragments from the water.
- All manual control sites should be monitored for several years for signs of plants growing from roots or fragments.
- **DISPOSAL:** Brazilian elodea can be composted on land away from water or placed in yard waste bins. Do not leave any plant parts or fragments in the water or near the water's edge.

Mechanical Control

- At minimum, an HPA pamphlet permit is required for all mechanical control activities in natural waterbodies. In incorporated areas, check with your local jurisdiction for other possible permit requirements.
- Cutting and harvesting using boat-mounted cutters or in-lake harvesting barges is effective at maintaining open water in water bodies with 100% of the available habitat infested. It must be done on a regular basis to maintain control. However, these methods will quickly spread these plants by creating numerous fragments, so cutting and harvesting are not recommended for small or partial infestations. Neither method will eradicate an infestation. In unincorporated King County, only an HPA pamphlet permit is required for cutting and harvesting noxious weeds.
- Diver dredging using boat or barge mounted suction dredges can be effective for small infestations or as a follow-up to herbicide treatment. Thurston County successfully controlled Brazilian elodea in the Chehalis River using this method. Special care must be taken to remove all fragments. This method causes a temporary increase in turbidity and requires specific authorization from the Washington Department of Fish and Wildlife (WDFW).
- Rotovation (underwater rototilling) is not recommended since it causes severe fragmentation of the plants. Rotovation also results in significant short term turbidity and loss of water clarity and quality. Rotovation requires an individual HPA permit.

Cultural Methods

- An opaque bottom barrier can be used to suppress growth in small, discrete areas like at a boat launch or around a swimming area. Barriers need to be regularly cleaned because plants, including Brazilian elodea fragments, will root in the sediment that accumulates on top of them. This is not practical for large-scale infestations. Bottom barriers in Lake Washington and Lake Sammamish are not allowed without prior authorization by the Washington Department of Fish and Wildlife (WDFW) due to potential impact on sockeye salmon spawning areas. A pamphlet HPA at minimum is required for bottom barrier installation. Other permits may also be required.
- Waterbodies with control structures can sometimes use water level drawdown to control submerged weeds. Generally the bottom must be exposed to heat or cold long enough to dry out completely, something that can be difficult to achieve in rainy western Washington. Consecutive drawdowns may be more effective than a single attempt. Drawdowns can have major impacts on native plants and other aquatic organisms. Carefully weigh the pros and cons before deciding on this option. A drawdown is not covered by the pamphlet HPA. Consult your local WDFW office for permit information.

Chemical Control

- Permits and licenses are required for all chemical control in water.
- Herbicides may be the most reasonable option for eradication of large submerged noxious weed infestations. Professional licensed contractors are available for hire to perform this task.

- Herbicides can only be applied to aquatic systems in Washington State by a licensed pesticide applicator. Aquatic formulations of herbicides are not available for sale over the counter to anyone without an aquatic pesticide license. **NEVER apply non-aquatic herbicide formulations to water since most of them include ingredients that are toxic to aquatic organisms.**
- Multiple years of treatment may be required to eradicate a Brazilian elodea infestation. For several years following treatment, monitor areas for new plants. Remove any new growth using one of the manual control methods above.

Specific Herbicide Information

The only herbicide allowed in Washington waters that has been shown to be successful against Brazilian elodea is fluridone (e.g., brand name Sonar®). Endothall and diquat have proven successful in combination with copper compounds, but the use of copper is illegal in most Washington State waters due to its demonstrated toxicity to juvenile salmonids.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological

- Triploid grass carp can be an option for controlling Brazilian elodea. Tests have shown that the carp prefer Brazilian elodea to native species. However, in practice, grass carp may remove the entire plant community. Grass carp are not allowed in water bodies where the inlet and outlet cannot be screened. Care should be taken to evaluate potential impacts on the native plant community before choosing grass carp to control Brazilian elodea.
- Although research is being done on a variety of invertebrates and pathogens, there are currently no accepted biocontrol agents for Brazilian elodea other than grass carp.

SUMMARY OF BEST MANAGEMENT PRACTICES

- At all times a minimum of a pamphlet HPA permit is required to do any activity that disturbs a lake bottom, wetland or streambed. For more extensive work, more specific permits will be required.
- Hand pulling is recommended for small populations, with extreme care taken to remove all plants and fragments from the water.
- Where the plant has filled every possible inch of habitat in a waterbody and its connected waterways, cutting or harvesting can keep a large population under control when done consistently.

- Bottom barriers can maintain small areas of open water around boat launches, swimming areas or docks, as long as care is taken to keep them free of debris and fragments.
- Diver dredging has been effective in the Chehalis River and can be a good option in moving water.
- To eradicate large areas of Brazilian elodea , herbicides are probably the best option.
- **Do not apply any herbicide to water without the proper licenses.** Hire a contractor to do the work.

Control in small isolated or man-made ponds

- Permits may be required (see “Permitting and Regulatory Requirements” section above).
- Drawdowns can be very effective. Remove all plants and plant fragments. Let the bed dry out completely before refilling. Thoroughly clean pond liners. Examine or discard ornamental plants that may harbor plant fragments before re-introducing them to the pond.
- Manual control will work if the infestation is caught early and all fragments are removed.
- Bottom barriers may be effective over natural pond beds.
- Follow recommendations above for chemical control.
- Triploid grass carp may be an option if eradication is not desired.

Control in small lakes

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- Community involvement will be essential for successful control efforts.
- For small pioneering infestations, manual control or bottom barriers may be effective. Monitor the lake for fragments and additional infestation sites. Maintain bottom barriers to prevent sediment buildup.
- For large or whole-lake infestations, chemical control will be the most effective (see above for chemical recommendations). Mechanical control, or grass carp where allowed and appropriate, may be used to manage infestations, but will not eradicate the weeds. Bottom barriers, if properly maintained, will create open water in small areas.

Control in flowing water (rivers, streams, ditches)

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- The most effective control will start with the furthest upstream infestation and move downstream. If there are any weeds left upstream, any cleared site will likely be re-infested.
- If possible, contain the area being controlled with a boom to catch fragments before they float downstream.
- Diver dredging has proven effective in flowing water.

- Manual control may be the most practical for small infestations. Bottom barriers need to be securely anchored.
- Chemical control in flowing water is difficult. Consult an expert before considering this option.
- Grass carp will not be allowed in flowing water.

Control along shores of Lakes Washington and Sammamish

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- Eradication of submerged aquatic weeds from these waterbodies is not practical.
- Bottom barriers, if properly maintained, can provide open water around docks, marinas, swimming beaches, and similar areas. Prior authorization by the Washington Department of Fish and Wildlife (WDFW) is required in these lakes due to potential impact on sockeye salmon spawning areas.
- Manual control of small patches may be sufficient.
- Mechanical control can be effective for lakeside communities or large marinas. Be sure to remove all fragments from the water.
- Spot control using chemicals can be effective in the right conditions. It is possible that more than one species of submerged noxious weeds may be present (particularly Eurasian watermilfoil, which is widespread in these lakes). If this is the case, be sure to select an herbicide that will control all targeted weeds (consult BMPs for each weed or ask an expert for assistance in selecting herbicides). If there is any significant wave action or current, the chemicals will drift off target or quickly become diluted. Consult with a professional contractor before choosing this option. Neighboring property owners should be advised prior to spot chemical applications.
- Grass carp are not allowed in the Lake Washington and Lake Sammamish system.

Disposal Methods

- Brazilian elodea can be left on land to dry out and/or decompose where it will not move into a waterway.
- Brazilian elodea can be composted away from water or placed in yard waste bins.
- Never dispose of Brazilian elodea into waterways, wetlands, or other wet sites where it might grow and spread.

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Butterfly Bush

Buddleia davidii

Buddleia Family

Non-Regulated Noxious Weed: Control Recommended

Identification Tips

- Deciduous shrub up to 15 feet tall with arching branches
- Showy flower spikes at branch ends, upright or nodding, 4 to 30 inches long
- Flowers typically light purple with an orange center, but a range of cultivars come in a variety of colors, including magenta, blue, white and dark purple
- Leaves are 4 to 10 inches long, 1 to 3 inches wide, dark green on top and whitish underneath
- Leaves grow in opposite pairs
- Young stems are green, older stems have peeling, gray-brown bark

Biology

- Flowers from early June into mid-October
- Reproduces mainly by lightweight, winged seeds but can also develop roots on branches that have been buried or broken off
- It is quick to mature, often producing seeds during its first year of growth
- A single flower spike can produce 40,000 seeds
- Seeds remain viable in soil for 3 to 5 years

Impacts

- Widespread growth due to lightweight seeds that move easily by wind and water to new areas
- Invades riverbanks, forming dense thickets, crowding out native vegetation such as willows
- Also impedes forest regeneration
- Once established, butterfly bush is tough to eliminate

Distribution

- Found in disturbed areas such as riverbanks, roadsides, pastures and recently logged or burned forests as well as flower gardens and lawns
- Flourishes in well-drained soil and full sun, but can also grow in challenging conditions such as cracks in pavement, under bridges and along railroad tracks



Despite its friendly sounding name and pretty flowers, this plant doesn't provide suitable food or habitat for native butterfly larvae.



This popular garden plant has started moving into natural areas, creating problems.

Thurston County Noxious Weed Control Board

Questions?

King County Noxious Weed Control Program Line: **206-296-0290**
www.kingcounty.gov/weeds

What You Can Do

While there is no legal requirement for controlling butterfly bush in King County and it is still sold in Washington state, the King County Noxious Weed Control Board recognizes this plant as invasive and recommends prevention of spread into uninfested areas and control in natural areas where feasible.

Control Methods

Choose one or a combination of control methods listed below. Once established, this plant can be difficult to eradicate from an area. Consider alternative plants for your landscape. There are many showy, butterfly-attracting plants that are non-invasive and well suited for the Pacific Northwest (see box).

Prevention: If you have butterfly bush on your property and are reluctant to remove it, take measures to prevent it from establishing elsewhere. That can be easily done by preventing seeding. Remove spent flowerheads in the fall before they disperse seeds (don't wait until spring) and discard in the trash to avoid spreading seeds. Composting seedheads is not recommended.

Manual: Seedlings can be hand-pulled with little effort; larger bushes will take more time and labor. Branches should not be left on the bare ground as they can form roots and re-grow. Never discard any part of this plant in natural areas or on roadsides. Branches can be burned (if your area allows burning), put in your yard waste container, or taken to a landfill or composting facility. Seedheads, however, should always be placed in the trash.

Cultural/Grazing: Although goats will eat butterfly bush and can damage it, they will not kill or eradicate this plant. Consider using goat grazing as part of an integrated program with other methods, perhaps followed up with manual or chemical treatment.

Chemical: Controlling butterfly bush by spraying with a brush-control herbicide is somewhat effective, but for better results, cut the trunk off at the base and immediately apply concentrated glyphosate (such as Roundup) or triclopyr (such as Garlon or Brush B Gon) to the freshly cut surface. Always follow the label directions on any herbicide product you use to minimize any potential risks to you and the environment. **Follow all applicable laws and regulations regarding herbicide use on your site.** For more information, please contact the King County Noxious Weed Control Program at 206-296-0290.

Revised April 2009

A Better Alternative: California Lilac



California lilac is a profusely blooming evergreen shrub that makes a nice alternative to butterfly bush. It is fast-growing, drought-tolerant and has fragrant blue flowers that attract butterflies and honey bees. It also tolerates poor soils. Other alternatives include chaste tree for hot, sunny sites and Pacific ninebark for sunny or shady areas. Additionally, Chilean potato vine, red-flowering currant, orange-ball butterfly bush and fallowiana butterfly bush make wonderful flowering additions to the garden. Best of all, they won't escape to cause problems down the road!



King County

Department of Natural Resources and Parks
Water and Land Resources Division
Noxious Weed Control Program
206-296-0290 TTY Relay: 711

Common Reed – Phragmites

Phragmites australis
Poaceae

Class B Noxious Weed
Control Required

Legal Status in King County: According to Washington State Noxious Weed Law, RCW 17.10, common reed, also known as phragmites, is a Class B Noxious Weed. The King County Noxious Weed Control Board requires property owners to control common reed on private and public lands throughout the county (control, as defined by state law, means to prevent all seed production and to prevent the dispersal of all propagative parts capable of forming new plants).

BACKGROUND INFORMATION

Impacts and History

- The species *Phragmites australis* has been a native wetland inhabitant to the United States for over 3,000 years. However, recent research has shown that in the late 19th century, several European genotypes of *Phragmites australis* were introduced and had a competitive advantage over native strains as well as other native species. The introduced genotypes now have a widespread distribution in the United States and can be found in every state.
- The invasive strains of phragmites create tall, dense stands, up to 15 feet tall, which degrade wetlands and coastal areas by competing with native vegetation, (including the native phragmites), for space and resources, creating a monoculture.
- Elimination of native plant diversity and alterations in hydrology affect the food sources and habitat functions for a wide range of fish and wildlife species.
- Both the native and non-native genotypes are found in Washington State, therefore careful identification by an expert is needed before any eradication measures are taken.
- Phragmites spreads rapidly due to its vigorous rhizomes (horizontal roots that produce new shoots) which can exceed 60 feet in length, grow more than six feet per year, and readily grow into new plants when fragmented. The roots form a dense mat underground that can reach a depth of up to 6 feet.
- The rhizomatous roots of phragmites have an allelopathic effect on other plants, inhibiting root growth in the soil thereby weakening the growth neighboring plants.
- Phragmites can invade a new site by wind dispersal of seeds, however, it spreads more readily by rhizomes.



- Stands of phragmites can present a potential fire hazard in fall and winter once the stems have become dormant and dry.

Description

- Clonal, perennial grass species with woody hollow culms (stems) that can grow up to 15 feet in height.
- Primarily grows in coastal and interior wetlands, lake margins, and roadside ditches but can also be found in dry areas.
- Stems are tan, rough and rigid.
- Leaves are flat, stiff and lanceolate, ranging from 8-16 inches long and 0.5- 2.0 inches wide at the base. Foliage is gray-green during the growing season.
- Seed head plumes are purple-brown-silver and are 6 – 20 inches long and up to 8 inches broad. These plumes form at the end of the stalk and flower in July through October.
- The chart below describes the morphological variation between the native and the invasive phragmites:



TRAIT	NATIVE PHRAGMITES	INVASIVE PHRAGMITES
Leaf sheaths	Fall off in the fall or are very easily removed if they stay on the stem.	Leaf sheaths stay on the plant, occasionally basal ones fall off the stem. Leaf sheaths are difficult to remove (use a twisting motion)
Stem color at base (spring/summer) Note: Leaf sheath needs to be removed	 Red to Chestnut	 Tan
Stem texture Note: Run your finger across and up and down the stem after removing the leaf sheath	Smooth and shiny	Rough and dull (Stems are ribbed. Ridges visible with naked eye.)
Stem flexibility	Flexible	Rigid
Stem toughness	Low	High
Time of flowering	Early (July-August)	Intermediate (August - October)

TRAIT	NATIVE PHRAGMITES	INVASIVE PHRAGMITES
Inflorescence	 Sparse	 Dense
Leaf color	Yellow-green	Grey-green
Rhizome density	Low	High
Rhizome color	Yellowish	White to light yellow
Rhizome diameter	Usually under 15mm Almost perfectly round. Occasionally slightly compressed.	Few nodes under 15mm, most >15mm Mostly compressed (oval)
Clonal expansion rate	Slow	Rapid
Habitat requirements	Potentially restricted All examined native populations grow on moist soils. Sites can be under tidal influence but are never continuously inundated.	Wide range of conditions Introduced genotypes can grow on fairly dry sites and on sites where rhizomes are continuously inundated.

Habitat

- Most commonly found in tidal and non-tidal wetlands, brackish and freshwater marshes, river edges, shores of lakes and ponds, roadsides, and disturbed areas. Will occasionally grow in drier areas.
- Can grow in several feet of water.
- Grows in full sun, but can tolerate partial shade.



Reproduction and Spread

- Spreads rapidly by rhizomes. Broken rhizomes can take root and start another infestation.
- Rhizomes can grow up to 60 ft in length and reach a depth of 6 ft beneath the soil surface.
- Flower heads produce great quantities of seed between late September through January that are dispersed by wind, water and/or wildlife. However, seed viability is often low and a secondary source of spread.



Local Distribution

There are currently about 20 known sites of invasive phragmites in King County. The largest site is located under the 1st Avenue South Bridge in south Seattle. This infestation is approximately 4 acres in size. Other sites include the Union Bay Natural Area and Foster Island near the University of Washington; along the Sammamish River; and several ditches along roadsides and highways throughout King County.



Phragmites infestation under the 1st Avenue South Bridge in Seattle.
Photos taken in August 2003.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**).
- Control practices in critical areas should be selected to minimize soil disturbance or efforts should be taken to mitigate or reduce impacts of disturbance. Any disturbed areas need to be stabilized to control erosion and sediment deposition. Refer to the King County Surface Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information). Minimizing disturbance also avoids creating more opportunities for germination of weeds.
- Areas vulnerable to erosion (steep slopes or shorelines within the zone of influence of wave action) should not be dug up without erosion-prevention measures in place. Large

cleared areas need to be replanted with native or non-invasive vegetation and stabilized against erosion. Infestations in these situations may require more concentrated efforts to control.

- Small areas of seedlings may be effectively dug up, taking care to remove all of the roots and rhizomes, in order to stop them from infesting a larger area. Follow-up is important to control any regrowth from rhizome fragments.
- For larger infestations, the strategy will depend on the site. Generally work first in least infested areas, moving towards more heavily infested areas. On rivers and streams, begin at the infestation furthest upstream and work your way downstream.
- Properly dispose of all parts of the plant (see Disposal Methods section below).
- Minimize disturbance to avoid creating more opportunities for seed germination.

Early Detection and Prevention

- Look for new plants. Get positive plant identification by contacting your local noxious weed control program or extension service.
- Survey for phragmites in disturbed wet areas, such as wetlands, lakeshores, stream banks and ditches. Pay close attention to areas near known infestations
- Optimal timing window for survey is July through September; however, dried stems at established infestations may be visible throughout the winter and into the next growing season.
- Dig up isolated plants and return the following year to check for new seedlings and plants re-sprouting from root fragments.
- Prevent plants spreading from existing infestations by cleaning off equipment, boots, clothing and animals that have been in infested areas.

Manual Control

- The use of hand tools is allowable in unincorporated King County critical areas. Check with the local jurisdiction for regulations in other areas.
- Manual control is feasible for individual plants or small pioneering stands. Carefully dig out as much root and rhizome as possible; this plant doesn't pull well (breaks off from robust rhizomes leaving root fragments behind).
- Optimal timing for manual removal is early fall. Prior to digging, cut and bag flower heads before they seed (mid-summer).
- Care should be taken to minimize erosion when digging in saturated soils on shorelines.
- Brush off boots, clothes and animals before leaving the infested area.
- Effective removal of large stands of phragmites with hand tools has proven to be very labor intensive and is not recommended. Removing the rhizome layer (up to 6 ft in depth) is necessary to have positive results.
- In established stands, removing the mat of dead canes can assist in the growth of native vegetation.
- All manual control sites should be monitored for several years for signs of plants growing from rhizomes and from the seed bank.

Mechanical Control

- Removal of phragmites with hand-held mechanical tools is allowable in critical areas and their buffers within unincorporated King County. Check with the local jurisdiction for regulations in other areas.
- In unincorporated King County, riding mowers and light mechanical cultivating equipment may be used in critical areas if conducted in accordance with an approved forest management plan, farm management plan, or rural management plan, or if prescribed by the King County Noxious Weed Control Program.
- Cutting or mowing phragmites is most effective after herbicide application (see **Chemical Control** section below), however, repeated annual cuttings without herbicide can reduce spread.
- Depending on site wetness, mowing or cutting treated plants once after an herbicide treatment is recommended during late summer to fall (August to first hard frost) or in winter when the ground is frozen.
- Cutting/mowing without use of herbicide should be done in late July (before tassel set) when most of the energy is in the stalk and not the roots. **Cutting during other times may stimulate growth.**
- Cutting can be done using brush cutters (weed whackers), hedge trimmers, or loppers. Stems should be cut 4 inches above ground to minimize impact to wildlife and native plants.
- Cut stems should be collected immediately, bagged and removed from site to prevent possible seed spread and allow sunlight to reach the soil surface to promote germination of native plants.
- Bagged plant material should be thrown away with the trash or taken to a sanitary landfill. **Do not compost.**
- An annual regime of cutting and removing stems at the end of July for several years may result in successful control.

Chemical Control

- **Precautions:**
 - Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label of the product being used. **Follow all label directions.**
 - For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
 - Aquatic formulations of herbicides are not available for sale over the counter to anyone without an aquatic pesticide license. State permits are normally required whenever there is a likelihood that herbicide will enter any waterbody or wetland area. **NEVER apply non-aquatic herbicide formulations to water since many include ingredients toxic to aquatic organisms.**

- For your personal safety, at a minimum wear gloves, long sleeves, long pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
- Herbicides should be applied in early to late summer (June – September) when using imazapyr, or late summer (August – September) when using either glyphosate or a glyphosate/imazapyr mixture, to achieve effective control (see next section for details).
- Treated infestations should not be cut or mowed until after the herbicide has had a chance to work, which may take several weeks.
- Mowing or cutting individual stands to remove dead plant material after herbicide treatment is an important step toward achieving phragmites control. This encourages native plant growth and allows for identification of phragmites re-growth for herbicide spot treatment.
- Herbicide application methods for scattered plants or isolated plant stands include hand swiping or selective hand spraying.
- For at least three years following treatment, monitor areas for new plants germinating from rhizomes or the seed bank.

Specific Herbicide Information

- **Glyphosate** (e.g. Rodeo® or AquaMaster®) Apply to actively growing plants at full to late flowering stage. Application to pre-flowering plants or seedlings may also be effective, but unless the extent of the infestation is well known, plants can be difficult to locate when not in flower. Apply to foliage but avoid runoff. Caution: Glyphosate is non-selective and it will injure or kill other vegetation contacted by the spray including grasses, cattails and other monocots.
- **Imazapyr** (e.g. Habitat®) Apply to actively growing foliage. Caution: Imazapyr is non-selective: it will injure or kill other vegetation contacted by the spray including grasses, cattails and other monocots.

All the above listed herbicides require the addition of an approved surfactant. Follow label directions for selecting the correct type of surfactant. Be sure that the selected surfactant is approved for aquatic use in Washington State.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological Control

- There are no effective biocontrol agents for phragmites at this time.

Cultural

- Generally, prescribed burning does not reduce the growing ability of phragmites unless root burn occurs. Root burn seldom occurs, however, because the rhizomes are usually covered by a layer of soil, mud and/or water.
- Prescribed burning in late summer, before seed dispersal, can be effective in slowing the spread of phragmites.
- Burning of dead/decaying canes will allow space and light for other plant species to germinate and take hold. Phragmites tends to burn very hot and fast, and prescribed burns should be performed only by trained personnel.
- Burning in King County, outside the Puget Sound Clean Air Agency boundaries, requires a permit from your local fire district and certain regulations apply.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Hand digging is recommended for very young plants not yet established, when vegetative spread is less likely to occur. Take care to remove and properly dispose of all rhizome fragments.
- Replace any divots created when removing the plants to lessen the amount of disturbed soil.
- If the plants are in seed, **cut off and bag all seed heads**. It is very difficult to remove the plants without dispersing the seeds.
- Repeated cutting in late July (before tassel set) for several years may be effective to prevent spreading.
- If manual control is not possible due to site conditions or available labor, apply appropriate herbicide with wick wiper or spot spray to minimize off target injury.
- Monitor site throughout growing season and remove any new plants.

Large Infestations

- A comprehensive management strategy is most effective for controlling large stands of phragmites. Herbicide treatment in conjunction with prescribed burning and/or mechanical removal of dead stems has the best results.
- Regardless of the chosen management strategy, the control work will require a long-term commitment of at least several years.

Control on Shorelines or Riparian Areas

- Additional permits may be required for control of infestations in riparian areas. See the Noxious Weed Regulatory Guidelines for more information or contact your local jurisdiction.
- In some cases, the cleared area will need to be replanted with native or non-invasive vegetation and stabilized against erosion. See the King County Surface Water Design Manual for further information about sediment and erosion control practices

(<http://www.kingcounty.gov/environment/waterandland/stormwater/documents/surface-water-design-manual> or call 206-296-6519).

- Focus on manual removal for small infestations if possible.
- When removing vegetation on shorelines (by lakes, streams and wetlands) use barriers to prevent sediment and vegetative debris from entering the water system.
- Cutting or mowing will not eradicate large stands of phragmites but it can serve in the interim until more effective control measures can be utilized (see **Mechanical Control** section above).
- For larger areas where herbicide use is warranted, spray using low pressure and large droplet size to reduce drift. If herbicide could potentially drift into the water or a wetland area, use only approved aquatic herbicides and surfactants.
- When large areas of weeds are removed, the cleared area should be replanted with native or non-invasive vegetation to prevent re-invasion by weeds and stabilized against erosion.
- Infested areas will need to be monitored for several years to control plants growing from root fragments and germinating from the extensive seed bank.

Control along Road Rights-of-Way

- Dig up small infestations if possible.
- Spot spray with imazapyr or glyphosate if digging is not practical due to soil, site conditions, or size of infestation.
- If plants are in grassy areas, re-seed after control is completed.
- If plants are sprayed, wait until the herbicide has had a chance to work (up to several weeks) before cutting or mowing.

Disposal Methods

- Roots, rhizomes and seed heads should be placed in sturdy plastic bags and disposed of with trash or taken to a sanitary landfill for disposal. **Do not compost or put in yard waste.**
- Stems can be left on site to be composted or burned, but bagging and removing is recommended.

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**Written findings of the
Washington State Noxious Weed Control Board
(November 2004)**

Scientific Name: *Potamogeton crispus* L.,

Common Name: curly leaf pondweed

Family: Potamogetonaceae

Legal Status: Proposed as a class C noxious Weed 2005

Description and Variation:

Curly-leaf pondweeds grows entirely underwater except for the flower stalk which rises above the water. Curly leaf pondweed has distinctly wavy-edged, crispy olive-green to reddish-brown leaves. It usually grows early in spring and dies back in summer. Similar plants include Flat-stem pondweed. The leaves of flat-stem pondweed are long and narrow with smooth edges and the sharp-edged stem is flat and about the same width as the leaves.

Leaf: Alternate, all submersed, no leaf stalks. Curly leaf: oblong, stiff, translucent leaves (4-10 cm long, 5-10 mm wide) have distinctly wavy edges with fine teeth and 3 main veins. Sheaths (stipules) up to 1 cm long are free of the leaf base and disintegrate with age. Flat-stem: smooth-edged leaves (5-20 cm long, 2-5 mm wide) have many veins. Sheaths (stipules) 2-6 cm long are free of the leaf base and become fibrous with age.

Stem: Curly leaf: branched, up to 90 cm long, somewhat flattened. Flat-stem: generally few branched, up to 2 m long, 0.7-4 mm wide, flattened, with sharp edges.

Flower: Tiny, with 4 petal-like lobes. Curly leaf: in spikes 1-3 cm long on stalks up to 7 cm long. Flat-stem: in spikes up to 3 cm long on stalks up to 10 cm long.

Fruit: Seed-like achene. Curly leaf: 4-6 mm long including 2-3 mm beak, back ridged. Flat-stem: approximately 5 mm long, sharp ridge on back, short beak.

Economic Importance:

Detrimental: Curly leaf pondweed (*Potamogeton crispus*) is an invasive plant that forms surface mats that interfere with aquatic recreation. Dense colonies of curly pondweed can restrict access to docks and sport fishing areas during spring and early summer months. Curly-leaf pondweed has been noted as one of the most severe nuisance aquatic plants in the Midwest only out ranked Eurasian Watermillfoil. Because populations of curly pondweed usually decline during the summer months, it does not directly compete with many of the native submersed species. Cost for control and can range in the Millions per lake.

Beneficial: none known

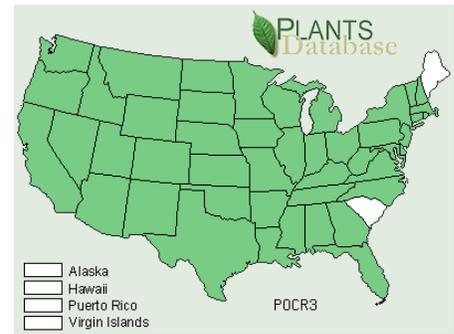
Habitat: Curly leaf: shallow to deep still or flowing water, tolerant of disturbance. Flat-stem: ponds, lakes, 1-2.5 m deep. Curly leaf: nearly worldwide. Flat-stem: widespread in temperate North America; found throughout Washington.



Geographic Distribution: Native to Eurasia, Africa, and Australia, this species has been found in most of the United States since 1950

Washington Distribution: Found in

History: Curly pondweed, *Potamogeton crispus* L., is native to Eurasia and apparently was introduced into the United States in the mid 1800's (Stuckey 1979). Prior to 1900, the distribution of *P. crispus* was the northeastern United States. By 1930 curly pondweed had spread westward to several states of the Great Lakes region. The species has since spread across much of the United States, presumably by migrating waterfowl, intentional planting for waterfowl and wildlife habitat, and possibly even as a contaminant in water used to transport fishes and fish eggs to hatcheries (Stuckey 1979).



Growth and Development: Curly pondweed perennial, rooted, submersed aquatic vascular plant that produces seed, but the importance of seed in the spread and maintenance of populations is unknown (Stuckey 1979) and is assumed to be less important than turions (Sastroutomo 1981). In most portions of its range, *Potamogeton crispus* typically reaches peak biomass in the late spring or early summer months, forms turions, then declines and "survives" the warmer months in a dormant state (i.e., as a turion) (Cypert 1967, Stuckey 1979, Sastroutomo 1981, Tobiessen and Snow 1984, Nichols and Shaw 1986). As water temperatures cool during the late summer or fall months, the turions germinate, grow through the winter months with the plants reaching peak biomass in the spring before most other submersed macrophytes begin their growth cycle. Once established, the plants regrow and form colonies from rhizomes.

Curly leaf pondweed has a unique life cycle which gives it competitive advantages over many native aquatic plants. Unlike most native plants, curly leaf pondweed may be in a photosynthetically active state even under thick ice and snow cover (Wehrmeister and Stuckey, 1978). Therefore, it is often the first plant to appear after ice out. By late spring it can form dense mats which may interfere with recreation and limit the growth of native aquatic plants (Catling and Dobson, 1985). Curly leaf plants usually die back in early summer in response to increasing water temperatures, but they first form vegetative propagules called turions (hardened stem tips). New plants sprout from turions in the fall (Catling and Dobson, 1985).

Control:

Chemical - active ingredients that have been successful in treating curly-leaf pondweed include diquat (*G*), copper with diquat (*G*), endothall (*E*), and fluridone (*E*). *E* = excellent, *G* = good

Reward is a liquid diquat formulation that has been effective on curly-leaf pondweed and is more effective if mixed with a copper compound. It is a contact herbicide. Contact herbicides act quickly and kill all plants cells that they contact.

Citrine Plus, K-Tea, Captain, Algae Pro, Clearigate are all chelated or compound copper herbicides and can be used in a mixture with Reward or Aquathol K. Other chelated or compound copper formulations are available but are not linked to this web site.

Aquathol, Aquathol K, and Aquathol Super K are dipotassium salts of endothall and comes in both liquid and granular formulations. These endothall products have been effective on curly-leaf pondweed and can be mixed with copper compounds for additional effectiveness. Contact herbicides act quickly and kill all plants cells that they contact. This herbicide has been found to be an effective and ideal method. If applied in early spring, Aquathol K will not harm the native plants since curly-leaf is the first plant to grow in the spring. It dissipates quickly leaving no residue and does not bio-accumulate in fish or hydro-soil. This treatment should kill curly-leaf, reduce or eliminate seed and turion production in the treated areas, and have less negative impact on native plants than treatments done later in summer.

Hydrothol 191 is an alkylamine salt of endothall and comes in both liquid and granular formulations. It is a contact herbicide and has been effective on curly-leaf pondweed. Contact herbicides act quickly and kill all plant cells that they contact. Hydrothol can be toxic to fish.

Sonar and **Avast** are fluridone compounds, come in both liquid and granular formulations, and have been effective on curly-leaf pondweed. These are broad spectrum, systemic herbicides. Systemic herbicides are absorbed and move within the plant to the site of action. Systemic herbicides tend to act more slowly than contact herbicides.

One danger with any chemical control method is the chance of an oxygen depletion after the treatment caused by the decomposition of the dead plant material. Oxygen depletions can kill fish in the pond. If the pond is heavily infested with weeds it may be possible (depending on the herbicide chosen) to treat the pond in sections and let each section decompose for about two weeks before treating another section. Aeration, particularly at night, for several days after treatment may help control the oxygen depletion.

One common problem in using aquatic herbicides is determining area and/or volume of the pond or area to be treated

The **mechanical and physical** control methods have been used with minimal success for the management of curly leaf pondweed. These methods include: Benthic Barrier, Drawdown, Dredging/Sediment Removal, Hand Removal, Harvesting Rotovation, Shading/Light Attenuation

Aquashade is a non-toxic dye or colorant. It prevents or reduces aquatic plant growth by limiting sunlight penetration, similar to fertilization. However, Aquashade does not enhance the natural food chain and may suppress the natural food chain of the pond.

Biological - Grass carp will seldom control aquatic vegetation the first year they are stocked. They will consume curly-leaf pondweed. Grass carp stocking rates to control curly-leaf pondweed are usually in the range of 7 to 15 per surface acre.

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Rationale for Listing: Dense colonies of curly pondweed can restrict access to docks and sport fishing areas during spring and early summer months.

English Ivy

Hedera helix

Ginseng Family

Non-Regulated Noxious Weed: Control Recommended

Identification Tips

- Woody, evergreen perennial vine
- Two growth stages: juvenile and mature
- **Juvenile leaves** are dull green with distinct light veins, deeply lobed; stems produce roots at the nodes.
- **Mature leaves** are glossy green, not lobed; stems produce umbrella-like clusters of greenish flowers, followed by dark berry-like fruits
- Both juvenile and mature ivy have waxy leaves
- Older vines can reach over 90 feet long with stems one foot in diameter

Biology

- Climbing vines form small rootlets that have a glue-like substance that attaches to any surface
- Spreads vegetatively from stem and root fragments during the juvenile stage
- Once mature (after 10 years) also spreads by seeds that are found in berry-like fruits dispersed by birds
- Flowers in the fall, fruit matures in early spring
- Long-lived; one plant reported to be 400 years old

Impacts

- In natural areas, it outcompetes natives and takes over the forest floor, the shrub layer and the canopy
- Adds substantial weight to trees, which can contribute to blowdowns
- Forms thick mats that can accelerate rot and deteriorate structures
- Takes water and nutrients away from other plants
- Provides hiding areas for rats and other vermin
- Entire plant contains slightly toxic compounds; sap can cause dermatitis and blistering in some people

Distribution

- Found throughout King County; most abundant in urban and suburban forests, but also present in remote areas
- Can grow in a wide range of conditions, from relatively dry to moist soils and from full sun to shade

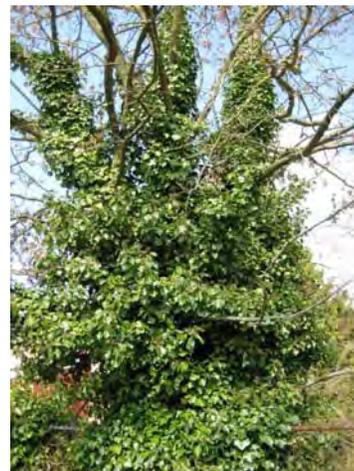


Invasive cultivars of English ivy are extremely common in King County.

Juvenile ivy (top and right) has deeply lobed leaves.



Mature ivy has fuller, glossy, unlobed leaves and produces clusters of black fruit.



Too much of a good thing: ivy is an aggressive climber and can topple or severely impact the growth of trees.

Questions?

King County Noxious Weed Control Program Line: **206-296-0290**
www.kingcounty.gov/weeds

What You Can Do

While there is no legal requirement for controlling English ivy, the King County Noxious Weed Control Board recognizes four cultivars* sold as ornamental plants as invasive and is encouraging landowners to remove them when possible and to choose alternatives for their landscaping needs.

Control Methods

For best results, control methods should be employed throughout several growing seasons. When working in critical areas such as stream banks, care must be taken to minimize soil disturbance; any disturbed area must be stabilized to control erosion and sediment deposition.

Manual: For ivy growing on the ground, the most effective control method is pulling or digging out plants and removing the roots. Fall to spring is usually the best time for this since the ground is moist. Vines may re-root if left on soil, so pile them up or discard with yard waste. Since sap can cause a reaction in some people, gloves and protective clothing is recommended. **For ivy growing in trees,** the key is separating the climbing vines from their roots. Ivy can only grow from roots in soil (it cannot root itself to tree bark). Cut and remove all vines to a comfortable height around the trunk of the tree. This will kill the upper vines; the lower vines will need to be pried off the tree and pulled out of the ground. Try to minimize damage to tree bark. Mulch area afterward.

Smothering: Apply at least eight inches of mulch either directly over the ivy or cut and remove it before adding the mulch. Laying out cardboard before applying mulch will increase the effectiveness. Keep in place for at least two years before attempting to replant. This is not an option for steep slopes or areas where the mulch can be easily washed away.

Chemical: Foliar treatment is difficult due to the waxy coating on ivy leaves, so a good surfactant (spreader-sticker) is essential. Spray leaves with a 2 to 5 percent solution of either glyphosate or triclopyr combined with a non-ionic surfactant. The best time for herbicide application is from late summer to early spring. Repeat treatment may be needed. Winter spraying reduces damage to native plants that are dormant. It should be over 55 degrees for a few days with no rain expected for at least 24 hours. Leaves are most susceptible when they first appear, so very early spring treatment or cutting first and treating fresh re-growth may increase effectiveness. Cut stem application with triclopyr or glyphosate is effective as well and can be done late summer to early spring. Apply herbicide directly to freshly cut surfaces of living rooted stems using a spray bottle, sponge or brush. Amount of active ingredient varies by product so consult the label to find out what concentration to use for the cut stem method. Always follow all directions on the label when using any herbicide.

*Four cultivars of English ivy currently considered invasive are: *Hedera helix* 'Baltica'; *H. helix* 'Pittsburgh'; *H. helix* 'Star'; *H. hibernica* 'Hibernica'

Alternatives to English Ivy

Like the look and growing ease of English ivy, but don't want the invasive headaches? Want to do the right thing and remove the ivy growing in your yard but don't know what to plant in its place? The good news is there are several alternatives that provide the benefits of traditional English ivy without the drawbacks.

For evergreen foliage and mat-like spreading, consider kinnikinnick (*Arctostaphylos uva-ursi*). This native groundcover grows in well drained sandy soils, likes sun and is drought tolerant once established.



Native kinnikinnick is a great alternative.

Another alternative is crinkle-leaf creeper (*Rubus pentalobis*). It forms a thick carpet of evergreen leaves; it works well for slopes and covers large spaces.

Other possibilities include beach strawberry (*Fragaria chiloensis*), fringe cup (*Tellima grandiflora*) and low Oregon grape (*Mahonia nervosa*).

For more alternatives, visit the Northwest Plant Guide at www.kingcounty.gov/gonative. This site offers many planting suggestions and gardening tips.



King County

Department of Natural Resources and Parks
Water and Land Resources Division
Noxious Weed Control Program
206-296-0290 TTY Relay: 711

English Holly

Ilex aquifolium

Aquifoliaceae or Holly Family

Weed of Concern: Control Recommended

Identification Tips

- Large, dense, slow-growing evergreen tree or shrub
- Can reach 15 to 50 feet tall and up to 15 wide
- Can grow as either a single tree or a multi-stemmed thicket
- Leaves are thick, glossy, dark green and wavy, 1-3 inches long
- Leaves usually have sharp spines along the edges although may be smooth on older branches
- Flowers are small, whitish, sweetly scented
- Produces red, yellow or orange berries in the winter

Biology

- English holly has both male and female plants that are bee pollinated
- Reproduces mainly by seeds that are contained within the berries; birds eat the berries and disperse the seeds to new areas
- Can also spread vegetatively through suckering and layering

Impacts

- Berries are toxic to humans
- Invades native forest habitats where dense thickets suppress germination and growth of native trees and shrubs
- A glutton for water, holly can prevent surrounding plants from obtaining sufficient moisture

Distribution

- Found throughout King County from urban landscapes to undisturbed natural areas and native forests
- Grows in shade or sun in well drained soil
- Is grown commercially for decorations and floral arrangements



It may make a festive holiday decoration, but English holly is not welcomed in natural areas where it crowds out native plants.



English holly can grow up to 50 feet tall and be extremely difficult to remove once established.

Questions?

King County Noxious Weed Control
Program Line: 206-296-0290
www.kingcounty.gov/weeds

What You Can Do

While there is no legal requirement for eradicating or controlling English holly in King County, the King County Noxious Weed Control Board recognizes this plant as a weed of concern and recommends prevention of spread into natural areas and urban forests.

Control Methods

In areas where English holly is established and widespread, removal is generally only recommended as part of a larger effort to restore natural landscapes. For uninfested areas, remove encroaching plants as soon as possible to avoid future problems.

Manual: Small plants can be dug or pulled up when soil is moist. Be aware that mature trees have deep and extensive roots; digging large holly trees or thickets is labor-intensive and results in considerable soil disturbance if all the roots are removed. Weed wrenches can be used on larger shrubs to pry up the entire plant. If you would like to borrow a weed wrench, please contact our office at 206-296-0290.

Mechanical: Cutting holly trees at the base usually results in re-sprouting, but with monitoring and follow up the holly can be suppressed.

Chemical: When dealing with large trees or thick stems, chop or cut the holly as close to the ground as possible and apply a herbicide with the active ingredient glyphosate (such as Roundup) directly into the cut portion. Frilling (making deep cuts at 45 degree angles into the tree's bark using an axe or sharp chisel) and pouring glyphosate into the cuts immediately afterward is also effective. **Always follow label rates and instructions.** Monitor for seedlings and root re-sprouting. Foliar herbicide treatment (spraying herbicides directly on the leaves) is not recommended due to holly's thick, waxy leaves which prevent the chemicals from being absorbed. For more information, please contact the King County Noxious Weed Control Program.

Revised November 2008

Alternatives to English Holly

English holly's dense evergreen foliage make it a traditional hedgerow shrub in the Pacific Northwest. And its contrasting bright red berries make it a favorite holiday decoration at Christmas

time. But there are alternatives that still provide the benefits of traditional English holly without the drawbacks. For screening and hedging in a sunny site, consider tall Oregon grape (*Mahonia aquifolium*). This native plant grows up to 10 feet tall and produces bright yellow flowers in



Tall Oregon grape is a great alternative.

the spring and blue-black berries in the summer. Another alternative is false holly (*Osmanthus heterophyllus*). This plant looks like holly with variegated evergreen leaves, but it does not produce berries. It grows 15 feet or more, making it ideal for screening. For more alternatives, see the *Garden Wise* booklet produced by the Washington State Noxious Weed Board. Copies may be obtained by calling the King County Noxious Weed Control Program at 206-296-0290 or by going to our website at www.kingcounty.gov/weeds.

Photo courtesy of the Native Plant Landscaping Guide website www.kingcounty.gov/GoNative



King County

Department of Natural Resources and Parks
Water and Land Resources Division
Noxious Weed Control Program
206-296-0290 TTY Relay: 711

Fragrant Water Lily

Nymphaea odorata
Nymphaeaceae

Class C Noxious Weed
Control Recommended

Legal Status in King County: Fragrant water lily is a Class C noxious weed (non-native species that can be designated for control based on local priorities) according to Washington State Noxious Weed Law, RCW 17.10. The State Weed Board has not designated this species for control in King County. The King County Weed Control Board recommends control of this species where feasible, but does not require it.



BACKGROUND INFORMATION

History and Impacts

- *Nymphaea odorata* is native to the eastern half of North America, including southern Canada. It has been introduced as an ornamental in many parts of the world and is now found throughout North America. Although found throughout Washington, fragrant water lily is especially prevalent in western Washington lakes where it has been intentionally planted by property owners who admired the showy flowers.
- It is believed that fragrant water lily was originally introduced into Washington during the Alaska Pacific Yukon Exposition held in Seattle in the late 1800s.
- Left unmanaged, water lilies can restrict lake-front access and hinder recreation.
- Drownings in King County have been attributed to swimmers getting tangled in dense water lily stems.
- Water lilies foul boat motors and restrict passage for non-motorized boats.
- When allowed to grow in dense stands, the floating leaves prevent wind mixing and extensive areas of low oxygen can develop under water lily beds during the summer.
- Aggressive water lily mats can outcompete native plants, reduce biodiversity, change the predator/prey relationships in the lake and adversely impact the food web.
- Stagnant mats create mosquito breeding areas and increase the water temperature underneath by absorbing sunlight.
- Water lilies die back in the fall, and the resulting decay uses up dissolved oxygen and adds nutrients to the water, potentially increasing algal growth and related water quality problems.

Description

- Perennial floating leaved rooted aquatic plant, growing in about three to six feet of water. Blooms June to October.
- **Round, green leathery leaves** up to 10 inches across have a basal slit. The flexible leaf stalk is attached at the base of the slit. The leaves float on the surface of the water, rarely sticking up above it as water level drops.
- **Many-petaled Flowers** are showy and range from white to pink (rarely yellow). They are borne on an individual stalk which curls like a corkscrew after the flower has been fertilized and pulls the flower under water. Seeds are leathery capsules with numerous small seeds.
- Both flower and leaf stalks arise from **thick fleshy rhizomes**.
- Adventitious roots attach the horizontal creeping and branching rhizomes.

Habitat

- Fragrant water lily occurs in shallow freshwater ponds and lake margins 3-6 feet deep.
- It will also grow in slow moving water.
- It can tolerate a wide range of pH, and it prefers substrates from mucky to silty.

Reproduction and Spread

- Spreads by floating seed and by rhizomes.
- Seeds disperse through the water by wind and wave action.
- Rhizome pieces can also break off and move through the water before establishing in a new location.
- A planted rhizome will spread to cover about a 15-foot diameter circle in five years.
- Primary source of distribution to new water bodies is deliberate planting. Many cultivars of *Nymphaea odorata* are available in the nursery trade. However, waterfowl can also spread the plant between water bodies.

Local Distribution

- While fragrant water lily is widely present in western Washington, it is less so in eastern Washington and uncommon to absent in western Oregon lakes.
- *Nymphaea odorata* was found in 27 of 36 surveyed lakes in the developed areas of King County in 1996. The number of ponds and smaller wetlands containing the plant is considerably larger.
- Requests for water lily control represent a high percentage of the herbicide permit requests received by the Washington State Department of Ecology.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**).
- Small infestations may be effectively removed using manual methods or hand tools.
- For many lake and wetland infestations, the whole community will need to be engaged. Any control actions taken will necessarily affect all landowners adjacent to the water body and will require their approval and participation in order to succeed. In addition, many control options will be expensive.
- Commit to monitoring. Once initial control has been achieved, be sure to conduct follow up monitoring in subsequent years in order to catch any overlooked patches or returning infestations before they can spread. Without this, your control efforts can be wiped out within a few years.

Early Detection and Prevention

- Look for new plants. Get a positive plant identification from an authority such as King County Noxious Weed Control Program staff.
- Look for plants along lake shorelines and in stagnant or slow-moving water in wetlands and streams.
- The best time to begin surveys is late spring when new leaves arise, and they can continue into early fall when the plants senesce.
- Dig up small isolated patches.
- Don't plant fragrant water lily in natural water bodies. It is legal to buy and plant water lilies, but their use as an ornamental should be restricted to small self-contained ponds and other man-made water features with no hydrologic connection to any natural body of water.

Manual

- Hand pulling or cutting can be successful for a small area if repeated on a regular basis. Impractical for large infestations. Must remove all pulled or cut plants and plant parts from the water. HPA pamphlet permit required.
- Carbohydrate depletion is a technique whereby during each growing season, all emerging leaves are consistently removed. Reports indicate that it takes about two to three seasons to kill the plants. This method is difficult to sustain and impractical for large infestations.
- To completely remove plants by hand you must dig up the entire rhizome. HPA pamphlet permit required.
- All manual control sites should be monitored for several years for signs of plants growing from root fragments and from the seed bank.
- Hand pulling and the use of hand mechanical tools is allowable in all critical areas.
- Fragrant water lily can be composted on land or placed in yard waste bins.

Mechanical

- Permits are required for all mechanical control methods.
- An opaque bottom barrier can be used to suppress growth in small, discrete areas like at a boat launch or around a swimming area. Barriers need to be regularly cleaned because plants will root in the sediment that accumulates on top of them. Not practical for large-scale infestations.
- Cutting and Harvesting using boat-mounted cutters or in-lake harvesting barges is a reasonable long-term control solution. These must be done on a regular basis to maintain control. Neither method will eradicate an infestation.
- Rotovation (underwater rototilling) dislodges the large, fleshy waterlily rhizomes which can then be removed from the water. This process results in the permanent removal of waterlily rhizomes. Rotovation results in significant short term turbidity and loss of water clarity and quality.
- Other mechanical solutions that have been tried include mounting a backhoe to a barge and digging the plants out.

Chemical

- Herbicides may be the most reasonable option for eradication of large fragrant water lily infestations. Professional licensed contractors are available for hire to perform this task.
- Herbicides can only be applied to aquatic systems in Washington State by a licensed pesticide applicator. Aquatic formulations of herbicides are not available for sale over the counter to anyone without an aquatic pesticide license. **NEVER apply non-aquatic herbicide formulations to water since most of them include ingredients that are toxic to aquatic organisms.**
- For several years following treatment, monitor areas for new plants germinating from the seed bank. Eradicate any new growth using one of the manual control methods above.

Specific Herbicide Information

Glyphosate (e.g. Rodeo™ or Aquamaster™) Apply to actively growing foliage. Avoid runoff. Caution: Glyphosate is non-selective: it will injure or kill other vegetation contacted by the spray. NEVER substitute Round-up™ or other landscape formulations of Glyphosate: these have additives that can devastate aquatic systems.

Imazapyr (Habitat®) Apply to actively growing foliage. Caution: Imazapyr is non-selective: it will injure or kill other vegetation contacted by the spray.

Triclopyr (Renovate[†]3). Apply to actively growing foliage. Triclopyr is selective: it will injure other broadleaved plants but not grasses or other monocots such as cattails, rushes, or most native aquatic plants.

All the above listed herbicides require the addition of an approved surfactant. Follow label directions for selecting the correct type of surfactant. Be sure that the selected surfactant is approved for aquatic use.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological

- There is currently no biological control approved for fragrant water lily.
- Although a number of organisms have been studied in the past, there is no current plan to pursue biological control for fragrant water lily due to the widespread use of the plant as an ornamental in private, isolated water features.

SUMMARY OF BEST MANAGEMENT PRACTICES

- At all times at minimum a pamphlet HPA permit is required to do any activity that disturbs a lake bottom or wetland or streambed. For more extensive work, more specific permits will be required.
- Hand pulling, cutting or digging is recommended for small populations.
- Where this is not practical, cutting or harvesting can keep a large population under control when done consistently.
- Bottom barriers can maintain small areas of open water around boat launches, swimming areas or docks.
- To remove large areas of water lilies, mechanical methods (such as rotovation) or herbicides can be used.
- **Do not apply any herbicide to water without the proper licenses.** Hire a contractor to complete the work.

Disposal Methods

- Fragrant water lily can be left on land to dry out and/or decompose in an area where it will not move into a waterway.
- Fragrant water lily can also be composted away from water or placed in yard waste bins.
- Never dispose of fragrant water lily into waterways, wetlands, or other wet sites where it might grow and spread.

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Garden Loosestrife

Lysimachia vulgaris
Primulaceae

**Class B Noxious Weed
Control Required**

Legal Status in King County: Garden loosestrife is a Class B Noxious Weed (non-native species harmful to environmental and economic resources that landowners may be required to control based on distribution in the county and local priorities) according to Washington State Noxious Weed Law, RCW 17.10. In accordance with state law, the King County Noxious Weed Control Board requires property owners to control garden loosestrife on private and public lands throughout the county (control means to prevent all seed production and to prevent the dispersal of all propagative parts capable of forming new plants). In addition, state quarantine laws prohibit transporting, buying, selling, or distributing plants, plant parts or seeds of garden loosestrife.



BACKGROUND INFORMATION

Impacts and History

- Garden loosestrife displaces native vegetation along streambanks, wetlands and shorelines and reduces habitat needed by waterfowl and fish, including several important salmon species.
- Garden loosestrife can clog shallow waterways, increase sediment retention and interfere with water flow.
- Garden loosestrife is a native of Eurasia, where it occurs in fens, wet woods, lake shores, and river banks.
- In eastern North America, garden loosestrife is naturalized in parts of most states and provinces from Minnesota east to Newfoundland and Maryland and appears to be increasing in the Ohio River Valley (Cusick 1986). In the west, the species is present in Colorado, Montana, Oregon, Washington and British Columbia (NRCS Plants Database).
- Although the species is being monitored in most eastern states and provinces, it is currently considered a noxious weed only in Connecticut and Washington State. This may be due to colder winters providing a measure of control in some regions.
- First documented in Washington in 1978 in the NE corner of Lake Washington near Juanita Junction, garden loosestrife is probably an escaped garden plant.

- In Washington, infestations of garden loosestrife are currently known in King County, Whatcom County, Skagit County, Thurston County and Stevens County.

Description

- Perennial emergent plant that appears to remain in the vegetative stage for some time prior to blooming. The presence of a flowering specimen generally indicates it has been in an area for some years.
- Flowers are yellow, showy and primrose-like (5 petals), with the biggest cluster atop the stem and smaller clusters on stalks from the base of the upper leaves. Stamens are red-orange. Blooms from July to late August or September.
- Stems are round with soft hairs, occasionally broadly flattened.
- Leaves are 3-5 inches long, ovate, hairy beneath, and irregularly arranged (usually in whorls of 3-4, sometimes opposite) , with small orange or black glands on the underside visible with magnification.
- Seed pods are egg-shaped capsules with a few seeds each.
- Can be confused with the less aggressive *Lysimachia punctata* (spotted loosestrife, sometimes also called garden loosestrife), which bears single or small clusters of larger, more star-shaped flowers in leaf axils only, never in a terminal cluster like *Lysimachia vulgaris*.



Garden loosestrife (*Lysimachia vulgaris*) flowers are in clusters near the top of the stem; petals are somewhat rounded.



Spotted loosestrife (*Lysimachia punctata*) flowers are in leaf axils; petals are more pointed.

Habitat

- Occurs in freshwater wetlands, fens, wet woods, lakeshores, and river and stream banks.
- Grows on moist or saturated soils.
- Sometimes cultivated as a garden ornamental or used for landscaping purposes.

Reproduction and Spread

- Garden loosestrife spreads primarily vegetatively (by rhizomes) and also by seed.

- Produces extensive reddish-colored rhizomes that will reach out into the adjacent open water. Rhizomes have been recorded growing up to 15 feet long into the water.
- Seeds can disperse through water and are a secondary source of spread.

Local Distribution

- Found on lake shores and waterways in several areas of King County.
- Major infestations located on the shorelines of Lakes Washington and Sammamish, and along the Sammamish River.
- Smaller or pioneering infestations are present on Lake Burien, Rutherford Slough, the lower Snoqualmie River, the Raging River and a small number of other locations.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines or local jurisdictions**).
- Areas vulnerable to erosion (steep slopes or shorelines within the zone of influence of wave action) should not be dug up without erosion-prevention measures in place. Large cleared areas need to be replanted with native or non-invasive vegetation and stabilized against erosion. Infestations in these situations may require more concentrated efforts to control.
- Control practices in critical areas should be selected to minimize soil disturbance or efforts should be taken to mitigate or reduce impacts of disturbance. Any disturbed areas need to be stabilized to control erosion and sediment deposition. Refer to the King County Surface Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information).
- Generally work first in least infested areas, moving towards more heavily infested areas.
- Properly dispose of all parts of the plant (see Disposal Methods section below).
- Small areas of seedlings may be effectively dug up. Isolated plants should be removed, taking care to remove all of the rhizomes, in order to stop them from infesting a larger area.

- For larger infestations, the strategy will depend on the site. Generally work first in least infested areas, moving towards more heavily infested areas. On rivers and streams, begin at the infestation furthest upriver and work your way downstream.
- Minimize disturbance to avoid creating more opportunities for seed germination.

Early Detection and Prevention

- Look for new plants. Get a positive plant identification by contacting your local noxious weed control program or extension service.
- Look for plants along river and lake shorelines, wetlands, ditches and wet pastures.
- The best time to survey is in July and August when the plants are in flower, however seedlings may not flower in the first year.
- Look for seedlings starting in June.
- Dig up small isolated patches.
- Prevent plants spreading from existing infestations by cleaning off equipment, boots, clothing and animals that have been in infested areas.
- Don't buy or plant garden loosestrife. According to state quarantine laws it is illegal to buy, sell or offer garden loosestrife or any of its cultivars for sale.

Manual

- Hand pulling and the use of hand mechanical tools is allowable in unincorporated King County critical areas. Check with the local jurisdiction for regulations in other areas.
- Manual control is feasible for individual plants or small pioneering stands. Carefully dig out as much root and rhizome as possible; this plant doesn't pull well (breaks off from long rhizomes leaving root fragments behind).
- Hand digging is recommended for very young plants not yet established.
- Larger plants from isolated small populations can be dug out from moist upland areas. This may be impractical to impossible when trying to remove hardy, woody roots or extensive rhizome networks in compacted soils. Care should be taken to minimize erosion when digging in saturated soils on shorelines.
- If the plants are in seed, **cut off and bag all seed heads** before removing plants. Brush off boots, clothes and animals before leaving the infested area.
- All manual control sites should be monitored for several years for signs of plants growing from rhizomes and from the seed bank.
- **DISPOSAL:** Garden loosestrife seed heads, plant parts and roots must be bagged, removed from the site, and discarded in the trash or taken to a transfer station. **Do not compost or place in yard waste.**

Mechanical

- Removal of garden loosestrife with hand held mechanical tools is allowable in critical areas and their buffers within unincorporated King County. Check with the local jurisdiction for regulations in other areas.
- In unincorporated King County, riding mowers and light mechanical cultivating equipment may be used in critical areas if conducted in accordance with an approved

forest management plan, farm management plan, or rural management plan, or if prescribed by the King County Noxious Weed Control Program.

- Repeated mowing may keep garden loosestrife contained and slow dispersal by seed, but won't kill the plants or prevent spread by rhizomes. Plant fragments will root if left behind, so if care is not taken to remove all plant fragments, mowing may also facilitate spread rather than control.
- Cutting alone is not a control option for garden loosestrife. New plants will grow from the rhizomes.
- Sheet mulching or covering using black plastic, landscape fabric, or cardboard and six inches of mulch is an interim option for dense seedling infestations. It does not kill the roots of mature plants, but it does slow down growth and seed dispersal. The covering must extend several feet beyond the edges of the infestation and be weighted so the plants cannot push it up. The edges of the covered area must be monitored for plants coming up from rhizomes extending beyond the sheet. Covering materials should also be monitored for damage or gaps and repaired or re-installed as needed.

Chemical

- **Precautions:**
 - Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label of the product being used. **Follow all label directions.**
 - For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
 - For your personal safety, at a minimum wear gloves, long sleeves, long pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
 - Aquatic formulations of herbicides are not available for sale over the counter to anyone without an aquatic pesticide license. **NEVER apply non-aquatic herbicide formulations to water since many include ingredients toxic to aquatic organisms.**
- For control of large infestations, herbicide use may be necessary. Infested areas should not be mowed until after the herbicide has had a chance to work, which may take several weeks.
- For several years following treatment, monitor areas for new plants germinating from the seed bank. In some cases several years of treatment may be necessary.
- When treating an area intermixed with native monocots (cattails, grasses, sedges, etc), we recommend using a selective herbicide. The monocots will not be harmed by the herbicide and will be able to help suppress new plants emerging from the seed bank.

Specific Herbicide Information

Glyphosate (e.g. Rodeo® or AquaMaster®): Apply to actively growing plants at full to late flowering stage. Application to pre-flowering plants or seedlings may also be effective, but unless the extent of the infestation is well known, plants can be difficult to locate when not

in flower. Apply to foliage but avoid runoff. Caution: Glyphosate is non-selective and it will injure or kill other vegetation contacted by the spray including grasses, cattails and other monocots.

Imazapyr (Habitat®): Apply to actively growing foliage. Caution: Imazapyr is non-selective: it will injure or kill other vegetation contacted by the spray including grasses, cattails and other monocots.

Triclopyr (Garlon 3A® and Renovate 3®). Apply when plants are in the mid to full-bloom stage. Application to pre-flowering plants or seedlings may also be effective, but unless the extent of the infestation is well known, plants can be difficult to locate when not in flower. Triclopyr is a selective herbicide and will kill only dicots. It will not harm monocots such as grasses, sedges, cattails and many native aquatic plants.

All the above listed herbicides require the addition of an approved surfactant. Follow label directions for selecting the correct type of surfactant. Be sure that the selected surfactant is approved for aquatic use in Washington State.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological

- No biological control agents are presently known. No research is currently being conducted.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Hand digging is recommended for very young plants not yet established, when vegetative spread is less likely to occur.
- Larger plants from isolated small populations can be dug out from moist upland areas. This may be impractical to impossible when trying to remove hardy, woody roots in compacted soils. Care should be taken to minimize erosion when digging in saturated soils on shorelines.
- If the plants are in seed, **cut off and bag all seed heads**. It is very difficult to remove the plants without dispersing the seeds.
- Replace any divots created when removing the plants to lessen the amount of disturbed soil.
- If manual control is not possible due to site conditions or available labor, apply appropriate herbicide with wick wiper or spot spray to minimize off target injury.

- If using an herbicide in an area that has desirable monocots, use a selective herbicide to avoid injury to those plants.

Large Infestations in Areas with Monocots

- Cutting alone is not a control option for garden loosestrife. New plants will develop from rhizomes.
- Sheet mulching using black plastic, landscape fabric, or cardboard and six inches of mulch is an interim option for dense seedling infestations. It does not kill the roots of mature plants, but it does slow down growth and seed dispersal. This method is also non-selective.
- If an area has desirable monocots present, use a selective herbicide and encourage the growth of the monocots.

Control on Shorelines

- Additional permits may be required for control of infestations in riparian areas. See Noxious Weed Regulatory Guidelines for more information.
- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion. Refer to the King County Surface Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information).
- Survey area and document extent of infestation.
- Focus on manual removal for small infestations if possible.
- When removing vegetation on shorelines (by lakes, streams and wetlands) use barriers to prevent sediment and vegetative debris from entering the water system.
- Cutting or mowing will not control garden loosestrife but it can serve in the interim until more effective control measures can be utilized.
- For larger areas where herbicide use is warranted, spray using low pressure and large droplet size to reduce drift. If herbicide could potentially drift into the water or a wetland area, use only approved aquatic herbicides and surfactants after obtaining the necessary permits.
- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation to prevent re-invasion by weeds and stabilized against erosion.
- Infested areas will need to be monitored for several years to control plants growing from root fragments and germinating from the extensive seed bank.

Control along Road Rights-of-Way

- Hand dig small infestations if possible.
- Spot spray larger infestations. Use a selective broadleaf herbicide in areas with desirable monocots such as grasses, sedges or cattails; if controlled with a non-selective herbicide, re-seed after control is completed.

- If plants are about to flower, they can be cut until a more effective control strategy can be used.
- If plants are sprayed, wait until the herbicide has had a chance to work before mowing.

Disposal Methods

- All garden loosestrife flowers, seed heads, plant parts, and roots must be bagged and discarded in the trash or taken to a transfer station.
- **Do not compost or place in yard waste. Never dump plant material as weeds may spread from yard waste piles.**

References

Cusick, A.W. 1986. Distributional and taxonomic notes on the vascular flora of West Virginia. *Castanea*. 51: 56-65.

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http://www.nwcb.wa.gov/weed_info/Lysimachia_vulgaris.html (Accessed 1/10/2008).

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Common Tansy

Tanacetum vulgare
Asteraceae

**Class C Noxious Weed
Control Recommended**

Legal Status in King County: Common tansy is a Class C noxious weed according to Washington State Noxious Weed Law, RCW 17.10 (non-native species that can be designated for control based on local priorities). The State Weed Board has not designated this species for control in King County. The King County Weed Control Board recommends control of this species where feasible, but does not require it.

BACKGROUND INFORMATION

Impacts and History

- Toxic to livestock and humans. Animals rarely ingest common tansy due to its strong smell. Human consumption of concentrated plant extracts for medicinal purposes has resulted in illness and death.²
- Often confused with the Class B Noxious Weed tansy ragwort (*Senecio jacobaea*) due to its highly visible yellow flowers that bloom at the same time.
- Can spread in pastures, reducing overall pasture productivity because animals are reluctant to eat it.³
- Introduced to the United States from Europe as a garden plant and for medicinal purposes⁵ as early as the 1600s. Reported in Kansas in 1912 and widespread in California by 1952.⁶
- Although some insects feed on the plant in Europe, there are few natural predators to control it in the United States.³
- Foliage contains the insecticide pyrethrin, neurotoxin thujone, toxic oil tanacetin, and camphor. Unpleasant tasting milk results when dairy cattle eat the leaves.³



Description

- Aromatic perennial with 2 to 6 foot tall purplish stems topped with dense clusters of bright yellow "button" flowers.⁸
- Each flower head has 20-200 button-like disk flowers that do not have petals.³ Flower heads turn brown and maintain their shape at seed set.
- Distinguished from tansy ragwort by lack of ray petals and more sharply toothed leaves
- Alternate leaves are deeply toothed and appear fern-like when emerging in the spring.

- Tenacious, fibrous root system produces creeping rhizomes; cannot be easily pulled out.

Habitat

- Generally found in full sun along trails and roadsides, on streambanks, in waste areas and vacant lands, and pastures.
- Commonly seen in vacant lands and along roadsides in King County.

Reproduction and Spread

- Reproduces by seed and rhizomes, often forming dense vegetative colonies.³
- Often found in areas lacking human disturbance where natural disturbance may be a factor in its spread.⁹
- Plants can flower from July to September.¹
- New plants can be produced from earth-moving operations that spread the rhizomes.³
- Seeds can be transported by birds and animals, in hay and on equipment and vehicles, in ballast water and small distances by wind. Seeds likely float and spread through movement of water such as streams and stormwater.⁹
- Greater than 1000 viable seeds produced per square meter and the duration of seed viability is unknown.⁹

Local Distribution

Found throughout King County. The heaviest concentrations are in vacant lands and roadsides in south and central King County, especially in the areas surrounding Auburn, Enumclaw, Maple Valley, Kent, Covington and Vashon/Maury Islands.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines or local jurisdiction regulations**).
- Control practices in critical areas should be selected to minimize soil disturbance or efforts should be taken to mitigate or reduce impacts of disturbance. Any disturbed areas need to be stabilized to control erosion and sediment deposition. Refer to the King County Surface Design Manual for further information about sediment and erosion

control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information).

- Small infestations can be dug up. Follow-up is important to control regrowth from severed roots.
- For larger infestations, the strategy will depend on the land use of the site. In pastures, good grazing practices and management of grass and forage species will greatly improve control of common tansy. Specific suggestions are given in the Best Management section.
- Generally work first in least infested areas, moving towards more heavily infested areas.
- Minimize disturbance to avoid creating more opportunities for seed germination.

Early Detection and Prevention

- Common tansy is easy to find in spring when the fern-like leaves start growing and in summer once it flowers. Monitor pastures, areas used by livestock, vacant lands and roadsides for new populations in June and July, and contact your local noxious weed board or extension office for help with identification.
- Dig up isolated or small populations. If the colony is more than you can remove manually, it may be necessary to treat the area with an appropriate herbicide in the summer or the following spring.⁷
- Prevent plants from spreading away from existing populations by washing vehicles, boots and animals that have been in infested areas.
- If animals are being moved from an infested pasture to an uninfested pasture, if possible, first isolate them for at least five days so that the seeds pass out of the animals' digestive system.

Manual

- **Dig out plants when they emerge in the spring.** Typically this is from April to June. Because this is a toxic plant, gloves and protective clothing should be worn.
- Plants in flower can form viable seeds even after they are pulled, so carefully bag and dispose of all flowering plants.¹
- Roots break off easily and re-sprout with new plants, so be sure to remove as much root as possible. Completely removing plants is easiest when the soil is loose or moist.
- Return to the same location in the following summer and spring to remove plants coming up from broken roots and seeds already in the soil. Continue to monitor the area for several years.
- The use of hand tools is allowable in all critical areas in unincorporated King County, check with your local jurisdiction for further information about weed control in critical areas.

Mechanical

- Mowing will not control common tansy effectively. Plants are able to re-sprout and flower again in the same season when mowed.

- Regular mowing can reduce seed production but must be repeated to eliminate regrowth from rootstock.¹
- Common tansy can be effectively controlled through cultivation.¹⁰

Chemical

- **Precautions:**
 - Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label of the product being used. **Follow all label directions.**
 - For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
 - For your personal safety, at a minimum wear gloves, long sleeves, long pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
- For control of large infestations on roadsides and other non-pasture areas, herbicide use may be necessary. For common tansy, it is most effective to apply selective broadleaf herbicides in the spring.⁷ Infested areas should not be mowed until after the herbicide has had a chance to work and the weeds are brown and dead.
- For several years following treatment, monitor areas for new plants germinating from the seed bank or resprouting from rootstock.

Specific Herbicide Information

Glyphosate: can effectively control common tansy when applied in the early flower bud stage. Glyphosate is non-selective and will kill non-target vegetation. Treatment with glyphosate needs to be combined with effective re-vegetation of the site to prevent common tansy from re-infesting the area.¹

Selective Broadleaf Herbicides: most effective when common tansy is growing in a grassy area. Re-treatment the following year is necessary to control resprouting plants. Continue to monitor for new plants for at least four years after the initial treatment and following any disturbance to the soil such as tilling or construction.

Selective herbicides that are effective on common tansy include dicamba (e.g. Vanquish™ or Banvel®), metsulfuron (e.g. Escort®), chlorsulfuron (e.g. Telar®).⁷

Apply selective herbicides in the spring before any flowers appear. The best control is early in the spring after growth begins. Dicamba can be effective at the early bud development to bloom stage as well.⁷ Apply herbicide on warm days when winds are low. Check label for specific information on wind and rain guidelines.

Dicamba can harm certain grasses, alfalfa, clover and other legumes. The addition of a suitable surfactant may improve the control results. Do not apply chlorsulfuron to cropland.⁷

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product.

Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological

Biological control is the deliberate introduction of insects, mammals or other organisms that adversely affect the target weed species. Biological control is generally most effective when used in conjunction with other control techniques.

- No known biological control for common tansy exists at this time.^{1,6}

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Dig out plants when soil is moist.
- Replace any divots created when removing the plants to lessen the amount of disturbed soil.
- If digging is not possible due to site conditions or available labor, apply an appropriate herbicide by wiping on leaves and stems, by spot spraying plants or by applying herbicide to cut stems to minimize off-target damage.
- Monitor site throughout growing season and remove any new plants.
- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass.

Large Infestations in Grassy Areas

- Mowing is not effective for eradicating common tansy. Mowing can be used if the infestation is found later in the year to keep the plants from flowering until an approved control method can be used. Do not mow common tansy that has gone to seed.
- Large infestations can be controlled with selective herbicides. (See the Chemical section of this BMP).
- Suppression of large infestations of common tansy with a selective herbicide will help to increase grass production, which in turn increases the suppression of the common tansy.
- Promote healthy grassy areas by seeding and fertilizing. Use a mix of grass and clover species to improve resistance to common tansy. Fertilize according to the soil needs.
- If grassy area is used for grazing, the area should be managed to promote grass and clover vigor. Graze uniformly and move animals from area to area in a planned

sequence. Avoid grazing when soil is very wet because holes can be opened up to new weed infestations. Some winter grazing by smaller animals can stimulate growth of clover and improve grass health.

- Be sure to monitor for common tansy on edges of pastures and disturbed areas around fences and watering holes. Remove isolated colonies before they flower.
- In fields densely infested with common tansy, remove all cattle and horses until the common tansy is reduced to isolated colonies.
- If needed, apply a nitrogen fertilizer after the selective herbicide application and then manage grazing so that 4 to 6 inches of grass re-growth remains at the end of the growing season so that grasses can effectively resist re-invasion by the common tansy.
- For more information on pasture management, contact the King Conservation District (<http://www.kingcd.org>).

Control in Riparian Areas

- Additional permits may be required for control of infestations in riparian areas. See the Noxious Weed Regulatory Guidelines for more information or contact your local jurisdiction.
- In some cases, the cleared area will need to be replanted with native or non-invasive vegetation and stabilized against erosion. See the King County Surface Water Design Manual for further information about sediment and erosion control practices (<http://www.kingcounty.gov/environment/waterandland/stormwater/documents/surface-water-design-manual> or call 206-296-6519).
- Focus on manual removal for small infestations if possible.
- For larger areas where herbicide use is warranted, spray using low pressure and large droplet size to reduce drift. If herbicide could potentially drift into the water or a wetland area, use only approved aquatic herbicides and surfactants.
- Mowing will not eradicate common tansy but it can serve to contain it in the interim until more effective control measures can be utilized.
- If a non-selective herbicide is used in grassy areas, the area should be re-seeded to prevent reinvasion by weeds.
- Infested areas will need to incorporate a management plan lasting for several years to control plants germinating from the seed bank and regrowth from rootstock.

Control in Road Rights-of-Way

- Dig out small infestations if possible.
- Spot spray with glyphosate if weeds are in areas with no desirable grasses.
- If plants are in grassy areas, use a selective broadleaf herbicide and re-seed after control is completed.
- If plants are about to flower, they can be mowed until a more effective control strategy can be used.

Disposal Methods

- Flowering or seeding stems should be collected and discarded with the yard waste or trash or taken to a transfer station for disposal. Back yard composting of seeds is not generally recommended unless it can be closely monitored.
- Non-flowering plants can be composted, although there is a risk that root balls may contain seeds that would survive in the compost and that roots and rhizomes may produce new plants. If this is a concern, plants may also be discarded with yard waste.
- If disposing of plants on site, leave plants roots up and chop up with a shovel to reduce risk of plant re-rooting. Plants should be left well away from waterways, shorelines, roads and un-infested areas.
- Never dump yard waste in parks or natural areas, as weeds may spread from yard waste piles.

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King County

Department of
Natural Resources and Parks
Water and Land Resources Division

Noxious Weed Control Program

BEST MANAGEMENT PRACTICES

Invasive Knotweeds

**Bohemian Knotweed, Japanese Knotweed,
Giant Knotweed, Himalayan Knotweed**

*Polygonum bohemicum, P. cuspidatum,
P. sachalinense, P. polystachyum*
Polygonaceae

Class B Noxious Weed; Not Designed for Control

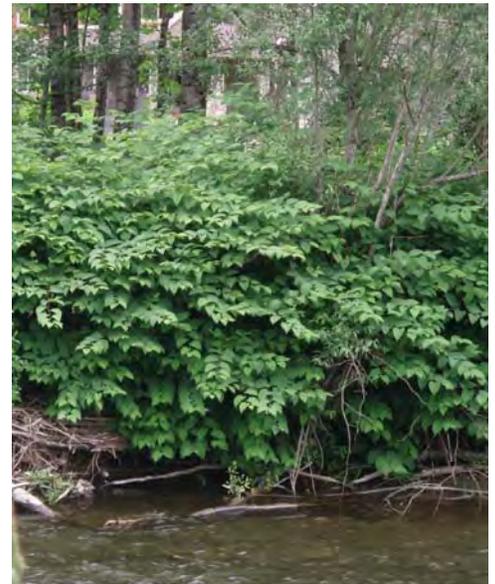
Legal Status in King County: Class B non-designated noxious weed (non-native species listed on the Washington State Weed List, but already widespread in this area). The King County Noxious Weed Control Board recommends, but does not require, property owners to control and prevent the spread of invasive knotweeds on public and private lands throughout the county. State quarantine laws prohibit transporting, buying, selling or offering invasive knotweed for sale or distributing plants, plant parts or seeds.



BACKGROUND INFORMATION

Impacts and History

- Displaces native vegetation due to its aggressive growth.
- Creates bank erosion problems and is considered a potential flood hazard. Despite knotweed's large rhizome mass, it provides poor erosion control.
- Lowers quality of riparian habitat for fish and wildlife.
- Thickets can completely clog small waterways.
- Forms dense stands that crowd out all other vegetation, degrading native plant and animal habitat.
- Difficult to control because of extremely vigorous rhizomes that form a deep, dense mat.
- Plants can resprout from stem or root fragments; plant parts that fall into the water can create new infestations downstream.
- Japanese and giant knotweeds are native to northeastern Asia. Giant and Japanese knotweeds hybridize to produce Bohemian knotweed. Himalayan knotweed is native to south and central Asia, including the Himalayas.
- Introduced in the U.S. in the late 1800s as ornamental plants and for erosion control.



Bohemian knotweed on the Cedar River

Description

- Large, clump-forming, herbaceous perennial with 4 to 12 feet tall, round canes with thin, papery sheaths and creeping roots. The hollow stems are jointed and swollen at the nodes, giving a bamboo-like appearance.
- Japanese, giant, Bohemian and Himalayan knotweed are members of the buckwheat family (Polygonaceae).
- Rhizomes can spread at least 23 feet (7 meters) from the parent plant and can penetrate more than 7 feet (2 meters) into the soil.
- Forms large, dense clones of either male or female plants.
- Stems are thick and hollow, resembling bamboo, green to reddish in color, often red-speckled. Young shoots look similar to red asparagus.
- Leaves are alternate, bright green with smooth edges. Leaf shape ranges from an elongate triangle (Himalayan knotweed), through rounded with a flat base (Japanese knotweed), somewhat heart-shaped (Bohemian knotweed) to huge, “elephant ear” type leaves (giant knotweed). Hybrids blur these distinctions. Leaf size may vary, however they are generally 4 to 6 inches long by 3 to 4 inches wide on Japanese knotweed and 7 to 9 inches long on hybrid Bohemian knotweed. Giant knotweed leaves often exceed 12 inches across, twice the size of Japanese knotweed leaves.
- Flowers are small, white/green on Japanese, Bohemian and giant knotweed and light pinkish-white on Himalayan knotweed and grow in showy plume-like branched clusters. Flowers form in July and August and grow in dense clusters from the leaf joints. Flowers are either all female (form seeds) or all male (don't form seeds) on each plant.
- Flowers in late July, typically start to form seeds by mid-August.

Habitat

- Can grow in partial shade or full sun.
- Knotweed thrives in any moist soil or river cobble, but can also grow in dry areas
- Most commonly found in the flood zone along rivers and creeks, it also grows in roadside ditches, railroad rights-of-way, unmanaged lands, wetlands, neglected gardens, and other moist areas.

Reproduction and Spread

- Knotweed typically starts growth in April, but can begin as late as June in higher elevations.
- Reproduces by seed and vegetatively from rhizomes and roots. Knotweed can spread rapidly due to its ability to reproduce vegetatively.
- Invasive knotweeds spread mainly by rhizomes. Rhizome and root fragments are dispersed by natural causes (flood, erosion) or man-made dispersal (roadside clearing, fill dirt).
- Root fragments, as small as ½ in (1 cm) can form new plant colonies and can also be spread in contaminated fill material.
- Cut or broken stems will sprout if left on moist soil or put directly into water, or if moved by beavers or earth-moving equipment. Each node on the plant stock is able to produce roots and new plants.

- Seeds can be viable for as long as 15 years. Seeds in the upper 1 inch (2 cm) of soil generally are viable for 4 to 5 years. Below 1 inch (2 cm), the seeds remain dormant longer. However, knotweed seedlings are not often found in the wild and most dispersal is by root and stem fragments.
- Knotweed canes die back with the first hard frost (Pridham and Bing 1975) and go dormant during the winter. The dead, brown stems may remain standing through the winter with new canes developing in the spring from the same rootstock.

Local Distribution

Found throughout King County. The heaviest concentrations of invasive knotweeds are found along riparian corridors and road rights-of-way. Infestations can also be found in residential gardens, wetlands, and upland areas.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**).
- Specific suggestions are given in the Best Management section.
- It is possible, but not easy, to control knotweed, especially on a landscape scale.
- Because of knotweed's incredibly extensive root system and sprouting ability, landscape level control requires long-term planning and follow-up.
- Because the plant spreads easily downstream by water, it is necessary to begin control from the furthest upstream infestation, including all tributaries and other upstream sources of possible re-infestation.
- Even on a patch-by-patch basis, successful eradication is likely to take several years and multiple treatments.
- Although there are potentially successful mechanical or manual control options for small patches, landscape level projects and large sites will likely require integrating herbicide into the control strategy.

- Outreach to all public and private landowners and the broader community, as well as volunteer recruitment and coordination, will improve the success of large landscape scale projects.
- Work with volunteers and other organizations in the community to expand the ability to physically get the work done.
- Landscape level projects may have a greater chance of success under a coordinated effort such as a Cooperative Weed Management Area (CWMA).
- Grants are available for invasive vegetation removal, such as knotweed, that benefits public resources, especially for work done through non-profit organizations or government agencies.

Early Detection and Prevention

- Monitor for new populations in May and June.
- Dig up isolated or small populations (50 stems or less). If there are more stems than you can remove manually, it may be necessary to treat the area with an appropriate herbicide in the late summer/early fall.
- Prevent plants from spreading away from existing populations by washing vehicles, machinery, and equipment that have been in infested areas.
- Prevent knotweed from entering waterways.
- Do not discard stems or root fragments in waterways or on moist soil.

Manual or Mechanical Control

- **When to use manual methods:** If there is easy access to the site and patches are reasonably small (50 stems or less), commit to following an intensive control regimen.
- **Variations:** Cutting, mowing, pulling, digging, covering.
- Cutting, mowing and pulling stimulates shoot growth and depletes the roots. The more shoots there are per linear foot of root, the more likely it will be to physically pull out the roots, exhaust them by depriving them of energy (i.e. by cutting the shoot off) or eradicating them with an herbicide treatment.
- When controlling knotweed manually, be sure to practice the four T's: timely, tenacious, tough and thorough (Soll 2004).
- Hand pulling and the use of hand mechanical tools to control noxious weeds are generally allowable in critical areas in unincorporated King County (refer to the **King County Noxious Weed Regulatory Guidelines** for details).
- Be aware that repeated cutting tends to produce numerous small stems that may make future treatment with stem injection more difficult.
- **CUT** stems close to the ground **TWICE A MONTH OR MORE** between April and August, and then once a month or more until the first frost, over 3 to 5 consecutive years (Soll 2004).
 - Try to keep plants from growing taller than 6 inches.
 - Using a machete, loppers or pruning shears, cut the stems to the ground surface. Using a mower/weed-eater, cut as low as possible and as often as possible. Be sure not to scatter stems or root fragments.
 - Rake and pile up the cut stems where they will dry out because stems or stem fragments can sprout, and the area (or adjacent areas) may become re-infested.

- Goats are reported to eat knotweed and in some circumstances, controlled goat grazing may be an option similar to intensive mowing. Be aware that goats will eat desirable vegetation as well as knotweed.
- Do not allow cut, mowed or pulled vegetation to enter waterways.
- **DIG** up as much root as possible in August over at least three consecutive years; reported to work for small, isolated patches.
 - Each time you see new sprouts (start looking a week after you pull), uproot them as well, trying to pull out as much of the root as you can each time.
 - Be sure to carefully dry or dispose of the roots. Do not put them in a compost pile.
 - Be sure to search at least 20 feet (7 meters) away from the original patch center.
- **COVER** with heavy duty geo-textile fabric or black plastic.
 - Works better with isolated and smaller patches on open terrain.
 - Plan to leave the covering material in place throughout three to five growing seasons.
 - First, cut stems down to ground surface. Next, cover the area with geo-textile fabric or heavy duty black plastic extending beyond the plant base and stems at least 7 feet beyond the outside stems. Leave covering material loose and clean of debris, weighted down with heavy rocks or cement blocks. Watch for holes in the fabric and at the perimeters for any new growth. Every two to four weeks during the growing season, stomp down re-growth under covering material and clean debris.
 - Try this method at the beginning of the year or after cutting the plant down several times during the growing season which will reduce some of the rapid plant growth.

Chemical

- Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label. **Follow all label directions.**
- For your personal safety, at a minimum, wear gloves, long sleeves and pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
- For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
- **Variations:** foliar spray, wick wipe, cut and pour, or stem injection.
- Herbicides with the active ingredient glyphosate (Rodeo, Aquamaster, AquaNeat, among others), dicamba (Banvel, Clarity, among others), and imazapyr (Habitat, Arsenal) have shown to be variably effective in controlling knotweed either separately or in combination. Each offers benefits and potential risks.
- **Non-selective herbicide, injection method (glyphosate):** can effectively control knotweed. Currently only glyphosate products are labeled for the injection method. Aquamaster/Rodeo/AquaNeat, (aquatic formulations of glyphosate) can be used on or near aquatic sites while Roundup Pro, a non-aquatic formulation, can be used on terrestrial sites.
- **Non-selective herbicides, foliar applications (such as glyphosate, imazapyr)** are most effective when used in combination at a 2% - 1% ratio (2% glyphosate, 1% imazapyr). Glyphosate translocates to roots and rhizomes of perennial weeds and has no apparent soil

activity, while imazapyr is readily absorbed through foliage and roots and can be applied pre-emergent or post-emergent.

- **Selective Broadleaf Herbicides (such as dicamba)** may be more appropriate for knotweed patches adjacent to grass fields or in lawns. Dicamba is a growth regulating broadleaf herbicide, dicamba is readily absorbed and translocated from either roots or foliage. Do not apply to areas where roots of desirable species are growing.

Description of Chemical Control Methods

Foliar Application

- Backpack sprayer or large volume sprayer.
- Easiest and fastest method, risk of drift onto desirable vegetation and into water and soil.
- Use a systemic herbicide which translocates from leaves to the roots.
- Non-selective herbicides, such as glyphosate (Roundup) will harm all actively growing plants if leaves are sprayed. Selective broadleaf herbicides will not harm grasses.

Timing

The right time to apply herbicides is greatly affected by herbicide choice. According to Oregon Department of Agriculture literature, the ideal time to spray most deep-rooted perennials is when they are in bud to early flowering stage. However, because knotweed may be 15 feet tall when it begins to flower (July or August in the Pacific Northwest (PNW)), this is not always practical. Also, spraying taller plants means creating more risk of pesticide drift and older plants may not be as efficient in chemical translocation.

The best time, from a practical standpoint, is when the patches are 3 to 6 feet (1-2 m) tall. Although shorter plants may not have adequate leaf surface to absorb, and translocate, enough chemical to be effective, young, rapidly growing plants do have a more efficient biological process to translocate chemicals. A spring herbicide application or cutting will set back the plant so that it can be sprayed at an effective height and growth stage later in the year. Plants controlled later in the season can be cut to 5 ft in height immediately before spraying, although control effectiveness is somewhat reduced. TNC field data analysis suggest treatment done in April or May is not as effective as those done in June or July.

Regardless of herbicide choice, rate or spray timing, large, established patches (hundreds or thousands of stems) will almost certainly require foliar treatments over two or more years. Similar to treating patches mechanically, be sure to search for new shoots up to 20 feet or more away from the central patch after herbicide treatment begins (Soll 2004).

Specific Herbicide Information

Glyphosate: 2% to 5 % solution.

- Apply as coarse spray with complete, uniform coverage.
- Apply when knotweed is actively growing and most have reached the bud to early flowering stage until the first hard frost.
- Aquamaster/Rodeo plus surfactant (LI-700, Competitor, Agridex) are approved for aquatic sites.

- Roundup Pro (has surfactant mixed in) can be used on terrestrial sites.

Imazapyr : slow-acting and expensive but effective. Can be used alone or in combination with glyphosate.

- 1% solution with 0.25% surfactant or 0.5 to 1 lb per acre.
- Apply from midsummer after seed set until first killing frost.
- Habitat – approved for aquatic sites.
- Arsenal – approved for non-aquatic sites (see label for crop rotation and other restrictions).

Dicamba: 0.25 lb active ingredient with 1 gal water per 400 sq ft.

- Cut plants in June and then apply dicamba to regrowth in late August.
- Apply as basal spray to stems at ground level.
- For upland applications only.

Wick Wipe

- Use an applicator wand with a sponge on the end of a reservoir for the herbicide. Wipe the sponge soaked with herbicide on the leaves and stem of the plants.
- Use glyphosate at 33 to 75 % concentration.
- Greatly reduces drift.
- Hard to get chemical on leaf surface and seems to increase personal contact with herbicide.

Cut and Pour

- Good for small patches and greatly reduces drift.
- Cut stems between lowest 2 nodes.
- Put 3 ml undiluted (concentrated) glyphosate into stem cavity (can use a large needle with measured reservoir to be precise).
- Be very careful not to splash herbicide onto the ground.
- Follow label directions on amount applied per acre (i.e. for the 7.5 quart per acre label rate, can only treat 2375 stems per acre at 3 ml per stem).
- Timing best in late summer or early fall.
- Need to remove cut stems away from water where they can dry out and not spread off site.

Stem-Injection

- Use stem injection gun or similar tool.
- Follow directions carefully especially on calibrating and cleaning the equipment.
- Highly effective; 90% or more controlled in first year.
- Greatly reduces drift and is highly selective.
- No cut stems to deal with.
- Need to inject every cane in the stand; very time and labor intensive compared with foliar spraying.
- Can only inject stems over ½ inch in diameter so there will always be small stems that can't be injected in a population, especially in the second year of treatment.

- Inject 3 ml into each stem between first and second nodes from the ground, or between second and third node if cane is too woody lower down.
- Glyphosate is the only product labeled for injection method, and at 3 ml per cane, can only inject approximately 2375 canes per acre (label maximum is 7.5 quarts per acre).
- Timing best from early July to end of September.

Combination of Methods

- Using a combination of methods can increase efficacy.
- **Cut/Spray:** Cutting stems, followed by foliar spray 3 to 4 weeks later, instead of spraying twice, will reduce overall herbicide input into the watershed and is probably more labor efficient (can use volunteers or unlicensed crews to cut the infestation).
- **Bend/Spray:** This method is highly effective. Bend stems and then approximately 3 to 4 weeks later, spray site. Can use volunteers or unlicensed crews to bend the stems prior to foliar application.
- **Cut/Cover:** This method is moderately effective. Needs constant monitoring and controlling of plants around perimeter and scattered plants that grow through sheet mulch through holes/overlap areas. Every two to four weeks need to stomp down re-growth under covering material and clean off debris.
- **Spray/Spray:** Spring or summer spray followed by fall foliar spray; sets plants back so they can be sprayed at the appropriate growth stage and at the best (easiest) height. This method increases the amount of overall herbicide input into the watershed but takes the least time of all the methods other than spraying once.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.

Biological

- Biological control is the deliberate introduction of insects, mammals or other organisms which adversely affect the target weed species. Biological control is generally most effective when used in conjunction with other control techniques.
- Research is underway for possible biological control agents that have been identified in the knotweed's native range. However, there are currently no biological control agents available for managing invasive knotweed.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Dig up plants by hand if soil is wet.
- Apply appropriate herbicide with wick wiper or by spot spray to minimize off target injury.
- Monitor site throughout growing season and remove any new plants. Remember to search at least 25 feet from the original infestation.

- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass or use a wick wiper or stem injector.

Large Infestations/Monocultures

- Mowing is not effective for controlling invasive knotweed infestations.
- Large infestations can be controlled with herbicides. (See the Chemical section of this BMP).
- Eradication of knotweed with a single herbicide application is difficult. Typically it takes several treatments, over 4 to 5 years to get an infestation under control.
- Be sure to monitor for invasive knotweeds on edges of sheet-mulched sites, at overlapped areas in the sheet-mulch, where sheet-mulch has been staked, and around edges of chemically treated areas.

Control in Riparian Areas

- Additional permits may be required for control of infestations in riparian areas. See Noxious Weed Regulatory Guidelines for more information ([http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Noxious Weeds Regulatory Guidelines.pdf](http://dnr.metrokc.gov/wlr/lands/weeds/pdf/Noxious_Weeds_Regulatory_Guidelines.pdf)).
- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion. Refer to the King County Surface Water Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://dnr.metrokc.gov/wlr/Dss/Manual.htm> for information).
- Survey area and document extent of infestation from the headwaters of waterways down.
- Focus on manual removal for small (less than 50 stems) infestations if possible.
- Target the knotweed, retain all native and beneficial plants.
- Inject plants directly adjacent to waterways with glyphosate.
- For larger areas where herbicide use is warranted, apply with a wick wiper or spot spray using low pressure and large droplet size.
- Use aquatic formulations if there is any risk of herbicide entering the water.
- Infested areas will need to incorporate a management plan lasting at least several years to control plants re-sprouting from the rhizome mass, skipped plants and any regrowth.
- Mowing will not control invasive knotweed species, but it can serve as the first step in a combination approach to control.

Control on Road Rights-of-Way

- Dig up small infestations if possible.
- Spot spray with appropriate herbicides.
- Mowing is not an effective means of control and can spread knotweed infestations along road rights-of-way, but it can serve as the first step in a combination approach to control.

Knotweed Disposal Methods

- Knotweed crowns and rhizomes should be collected and discarded with the trash or taken to a transfer station for disposal. Composting crowns and rhizomes is not recommended.
- Knotweed stems can be composted, but they will root on moist soil so they need to be completely dried out before composting.

- Stems can be left on site to dry out and decompose if they are in a dry area where they will not move into waterways or onto moist soil. The area should be monitored for re-growth and stems should not be moved to an un-infested area.
- Dried out stems may be broken up or chipped into pieces less than an inch long and then composted on site, disposed of in a city-provided yard waste container or in the green recycling at a transfer station.
- Stems of knotweed with seeds should be collected and put in the trash or taken to a transfer station. If removal is not feasible, these stems can be left on site. However, there is a risk of spread from the seeds, so the area should be monitored for several years for seedlings. Stems should be left well away from waterways, shorelines, roads and un-infested areas.
- Never dispose of knotweed plants or plant parts into waterways, wetlands, or other wet sites where they might take root.

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Eurasian Watermilfoil

Myriophyllum spicatum

Class B Non-Regulated Noxious Weed
Control Recommended

Variable-leaf Milfoil

Myriophyllum heterophyllum

Class A Noxious Weed
Control Required

Haloragaceae

Legal Status in King County: Variable-leaf milfoil is a Class A Noxious Weed according to Washington State Noxious Weed Law, RCW 17.10 (non-native species that is harmful to environmental and economic resources and that landowners are required to eradicate). In accordance with state law, the King County Noxious Weed Control Board requires property owners to eradicate variable-leaf milfoil from private and public lands throughout the county (eradicate means to eliminate a noxious weed within an area of infestation). Eurasian watermilfoil is a Class B Non-Regulated Noxious Weed (non-native species that can be designated for control based on local priorities). The State Weed Board has not designated this species for control in King County. The King County Weed Control Board recommends control of Eurasian watermilfoil where feasible, but does not require it. State quarantine laws prohibit transporting, buying, selling, or distributing plants, plant parts or seeds of these milfoils.

BACKGROUND INFORMATION

Impacts and History

- Eurasian watermilfoil is native to Eurasia but is widespread in the United States, including Washington. In King County it is present in numerous lakes and slow moving streams and rivers.
- Variable-leaf milfoil is native to the eastern United States. It was introduced to southwestern British Columbia several decades ago and was confirmed in Thurston and Pierce Counties in 2007.
- Both of these plants are very aggressive and can outcompete native aquatic plants, forming dense



monotypic stands. They can reduce biodiversity, change the predator/prey relationships in a lake and adversely impact the food web.

- These milfoil species impact recreation by eliminating swimming opportunities, fouling boat motors and snagging fishing lines.
- When allowed to grow in dense stands and “top out”, the floating mats or emergent flower stems prevent wind mixing, and extensive areas of low oxygen can develop during the summer.
- Stagnant mats create mosquito breeding areas and increase the water temperature underneath by absorbing sunlight.
- These plants die back in the fall, and the resulting decay uses up dissolved oxygen and adds nutrients to the water, potentially increasing algae growth and related water quality problems.



Description, Reproduction and Spread

Milfoil species (*Myriophyllum* spp.) can be very difficult to tell apart, particularly when not in flower. Not only can the vegetative structures look very similar, but Eurasian watermilfoil (*M. spicatum*) is known to cross with the native northern milfoil (*M. sibiricum*), creating an invasive hybrid. Anyone who finds a new, aggressive population of milfoil should consult an expert to get a positive identification before taking action to control it.

Eurasian watermilfoil (*Myriophyllum spicatum*)

- Perennial, rhizomatous plant grows in water to 20 feet (possibly up to 30 feet) deep.
- Forms tangled underwater stands and dense floating mats.
- Leaves are in whorls of four, and are feathery, with generally more than 14 leaflet pairs per leaf. Leaves often appear squared-off at the tip. Leaves usually collapse against the stem when the plant is pulled from the water.
- Stems are long, branched near the surface, and usually reddish.
- Flowers are tiny and borne on reddish spikes above the water surface.
- Spread is generally by plant fragments or rhizomes.



- Can be confused with the native northern milfoil (*Myriophyllum sibiricum*), which generally has fewer than 14 leaflet pairs per leaf. The native milfoils also tend to retain their shape when pulled from the water rather than collapsing against the stem.



Variable-leaf milfoil (*Myriophyllum heterophyllum*)

- Perennial, rhizomatous plant grows in water to 15 feet deep.
- Forms tangled underwater stands and dense floating mats.
- Submersed leaves are in whorls of four to six, and are feathery, with six to 14 leaflet pairs per leaf.
- Flowering spikes emerge up to six inches above the water and have bright green, leaf-like bracts that are in whorls of 4 to 6 with toothed to entire margins.
- Flowers are tiny and borne in the axils of the leaf-like bracts.
- Submersed stems are stout (up to 8 mm in diameter), reddish, often with numerous branches. A cross-section of the stem will reveal “pie-shaped” air chambers.
- Spread is by plant fragments, rhizomes and seed.
- Has the ability to produce terrestrial plants with leaves resistant to drying. These apparently do not colonize new areas, but aid in the survival of the species in years when the water level is unusually low.
- Can be confused with the native western milfoil (*M. hippuroides*), which also has emergent flower stems with leaf-like bracts, and vegetative plants can be confused with the native northern milfoil (*Myriophyllum sibiricum*), which also has fewer than 14 leaflet pairs per leaf.

Habitat

- Milfoils grow in still and slow moving water, generally up to about 20 feet deep for Eurasian watermilfoil, and six to 15 for variable-leaf milfoil, depending on water clarity.
- They tend to cluster at downwind ends of smaller water bodies or in quiet coves where fragments can settle out of the water column and take root.
- Both tolerate a wide range of pH.
- Eurasian watermilfoil can tolerate brackish water.

Local Distribution

- Eurasian watermilfoil is widespread in western Washington and in King County, with established populations in the large lakes (Lakes Washington, Sammamish and Union), the Sammamish River, and a number of smaller lakes (notably Green Lake in Seattle).
- Variable-leaf milfoil was discovered in a lake in Thurston County in 2007, the first confirmed record in Washington State. It has since been found in another lake in Thurston County, as well as in two lakes in Pierce County (Blue and Clear Lakes), all four of which are privately owned. Since it is particularly difficult to distinguish from the native western milfoil (*M. hippuroides*), it may be established in other areas as well. The Washington State Department of Ecology is investigating other potential populations. At this writing, there are no confirmed populations of variable-leaf milfoil in King County.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (refer to the King County Noxious Weed Regulatory Guidelines).
- Small infestations may be effectively removed using manual methods or hand tools.
- Milfoil spreads by fragmentation, so care must be taken to contain and remove all plant fragments when using manual or mechanical control methods. Otherwise, the infestation will spread.
- Any control actions taken will necessarily affect all landowners adjacent to the water body and will require their approval and participation in order to succeed. In addition, many control options will be expensive and it will be more cost-effective to pool resources.
- Commit to monitoring. Once initial control has been achieved, be sure to conduct follow up monitoring and control in subsequent years in order to catch any overlooked patches or returning infestations before they can spread. Without this, control efforts can be wiped out within a few years. Monitor the site each year for at least three years after last observing any milfoil, and then again after three years.
- Any water body with a public boat launch should be monitored regularly since milfoils can be re-introduced easily from plant fragments on a boat or trailer.

Permitting and Regulatory Requirements

- Permits are required for all weed control work in natural water bodies.
- At minimum, the pamphlet **Aquatic Plants and Fish** is required. This pamphlet is published by the Washington State Department of Fish and Wildlife and acts as a Hydraulic Project Approval (HPA) permit. It is available free of charge online at <http://wdfw.wa.gov/hab/aquaplnt/aquaplnt.htm> or by calling (360) 902-2534. This “pamphlet HPA” is all you will need for most manual or light mechanical control methods.
- More extensive control, including some bottom barrier placement and all herbicide use, will require additional permits from Washington State. See the sections below for details.
- Permits and licenses are required for all herbicide use in aquatic systems. Minimum requirements include a pesticide applicator’s license with an aquatic endorsement from the Washington Department of Agriculture and a permit from the Washington Department of Ecology.
- Some incorporated cities also regulate any work conducted in natural waterbodies. Contact your local jurisdiction for details.
- **Permit requirements can change from year to year. Contact the King County Noxious Weed Control Program for more information on current permitting requirements.**

Early Detection and Prevention

- Look for new plants. Get a positive plant identification from an authority such as King County Noxious Weed Control Program staff.
- Look for plants along lake shorelines and in stagnant or slow-moving water in wetlands and streams. Since these plants are often spread as fragments attached to boat motors and trailers, check especially around boat launches. Also check at the downwind end of the waterbody, and anywhere else where fragments could congregate or settle out of the water column.
- The best time to begin surveys is late spring when plants are visible, and surveys can continue into early fall when the plants senesce (die back).
- Clean all plant material off of boats, motors and trailers, and check bilgewater for plant fragments any time you have been in an infested water body (or a potentially infested water body).
- **Never dispose of unwanted aquarium or water garden plants or animals in a natural water body.** Variable-leaf milfoil in particular is still sold in some areas as an aquarium plant, and may have been introduced to Washington waters by careless dumping of aquariums.

Manual Control

- At minimum, an HPA pamphlet permit is required for all manual control activities in natural waterbodies. In incorporated areas, check with your local jurisdiction for other possible permit requirements.

- Hand pulling and the use of hand mechanical tools is allowable in all critical areas in unincorporated King County.
- Hand pulling can be successful for a very small area but is impractical for large infestations. Be sure to contain and remove all plants and plant fragments from the water.
- Weed rakes and weed cutters can assist in maintaining open water in a discrete area, such as around a dock, but will not eliminate the plants. Be sure to contain and remove all plants and plant fragments from the water.
- All manual control sites should be monitored for several years for signs of plants growing from roots or fragments.
- **DISPOSAL:** Milfoils can be composted on land away from water or placed in yard waste bins. Do not leave any plant parts or fragments in the water or near the water's edge. Variable-leaf milfoil can grow on exposed soil during periods of low water, so extra care should be taken to dispose of it away from the water.

Mechanical Control

- At minimum, an HPA pamphlet permit is required for all mechanical control activities in natural waterbodies. In incorporated areas, check with your local jurisdiction for other possible permit requirements.
- Cutting and harvesting using boat-mounted cutters or in-lake harvesting barges is effective at maintaining open water in water bodies with 100% of the available habitat infested. It must be done on a regular basis to maintain control. However, these methods will quickly spread these plants by creating numerous fragments, so cutting and harvesting are not recommended for small or partial infestations. Neither method will eradicate an infestation. In unincorporated King County, only an HPA pamphlet permit is required for cutting and harvesting noxious weeds.
- Diver dredging using boat or barge mounted suction dredges can be effective for small infestations or as a follow-up to herbicide treatment. Special care must be taken to remove all fragments. This method causes a temporary increase in turbidity and requires specific authorization from the Washington Department of Fish and Wildlife (WDFW).
- Rotovation (underwater rototilling) is not recommended since it causes severe fragmentation of the plants. Rotovation also results in significant short term turbidity and loss of water clarity and quality, as well as destruction of benthic habitat. Rotovation requires an individual HPA permit.

Cultural Methods

- An opaque bottom barrier can be used to suppress growth in small, discrete areas like at a boat launch or around a swimming area. Barriers need to be regularly cleaned because plants will root in the sediment that accumulates on top of them. This is not practical for large-scale infestations. Bottom barriers in Lake Washington and Lake Sammamish are not allowed without prior authorization by the Washington Department of Fish and Wildlife (WDFW) due to potential impact on sockeye salmon

spawning areas. A pamphlet HPA at minimum is required for bottom barrier installation. Other permits may also be required.

- Waterbodies with control structures can sometimes use water level drawdown to control submerged weeds. Generally the bottom must be exposed to heat or cold long enough to dry out completely, something that can be difficult to achieve in rainy western Washington. Occasionally drawdowns can backfire and increase subsequent germination of weed seeds, especially with variable-leaf milfoil. Drawdowns can have major impacts on native plants and other aquatic organisms. Carefully weigh the pros and cons before deciding on this option. A drawdown is not covered by the pamphlet HPA. Consult your local WDFW office for permit information.

Chemical Control

- Permits and licenses are required for all chemical control in water.
- Herbicides may be the most reasonable option for eradication of large submerged noxious weed infestations. Professional licensed contractors are available for hire to perform this task.
- Herbicides can only be applied to aquatic systems in Washington State by a licensed pesticide applicator. Aquatic formulations of herbicides are not available for sale over the counter to anyone without an aquatic pesticide license. **NEVER apply non-aquatic herbicide formulations to water since most of them include ingredients that are toxic to aquatic organisms.**
- Multiple years of treatment may be required to eradicate a milfoil infestation. For several years following treatment, monitor areas for new plants germinating from the seed bank. Remove any new growth using one of the manual control methods above.

Specific Herbicide Information

Milfoil species are dicots, and therefore selective herbicides can be used to control them with minimal collateral damage to the primarily monocot native plant communities. 2,4-D, a selective herbicide, and fluridone, a non-selective herbicide, have both been used to control Eurasian watermilfoil to good effect in western Washington lakes. However, 2,4-D cannot be used in waterbodies that support salmonids (salmon and trout species). Triclopyr, another selective herbicide, has been approved for control of submerged plants as of 2008 and shows promise as an alternative herbicide for milfoil control. Endothall and diquat, which are both contact herbicides, will control existing vegetation, but will not kill the roots, so the control is temporary.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological

- Triploid grass carp have been tried as a control for milfoil species, but milfoil is not palatable to them, and they will generally eat everything else in the waterbody first. Grass carp are not allowed in water bodies where the inlet and outlet cannot be screened to prevent fish from leaving the waterbody. Grass carp are not allowed anywhere in the Lake Washington and Lake Sammamish system. They are not recommended as a control for milfoil, although they can be used if these species predominate. Care should be taken to evaluate potential impacts on the native plant community before choosing grass carp as a control method.
- In some situations, the native milfoil weevil (*Euhrychiopsis lecontei*) seems to control Eurasian watermilfoil. The weevil appears to prefer Eurasian watermilfoil over its native host, northern watermilfoil (*Myriophyllum sibiricum*), and in lakes where the weevil occurs naturally, Eurasian milfoil has been shown to be less of a problem. Ongoing research is exploring lake conditions in which the weevil may thrive, including water pH and the abundance of insect-eating fish. Although no permits are needed to use native insects as biocontrol, currently the weevils are difficult to obtain in quantities high enough to have an effect on milfoil populations. Even when they have been specially reared and introduced, it can take several years for populations in a waterbody to reach sufficient levels to control milfoil populations. Biocontrols of any type will not eradicate milfoil, but if effective should reduce a milfoil population to below the threshold of significant impact.

SUMMARY OF BEST MANAGEMENT PRACTICES

- At all times at minimum a pamphlet HPA permit is required to do any activity that disturbs a lake bottom or wetland or streambed. For more extensive work, more specific permits will be required.
- Hand pulling or digging is recommended for small populations, with extreme care taken not to let fragments spread.
- Where a population has filled every possible inch of habitat in a waterbody and its connected waterways, cutting or harvesting when done consistently can maintain open water and diminish the adverse affects of these species.
- Bottom barriers can maintain small areas of open water around boat launches, swimming areas or docks, as long as care is taken to keep them free of debris and fragments.
- Diver dredging can be effective for small infestations or as a follow-up to herbicide treatment.
- To eradicate large areas of milfoil, herbicides are probably the best option.
- **Do not apply any herbicide to water without the proper licenses.** Hire a contractor to do the work.

Control in small isolated or man-made ponds

- Permits may be required (see “Permitting and Regulatory Requirements” section above).
- Drawdown can be very effective. Remove all plants and plant fragments. Let the bed dry out completely before refilling. Thoroughly clean pond liners. Examine or discard ornamental plants that may harbor plant fragments before re-introducing them to the pond.
- Manual control will work if the infestation is caught early and all fragments are removed.
- Bottom barriers may be effective over natural pond beds.
- Follow recommendations above for chemical control.

Control in small lakes

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- Community involvement will be essential for successful control efforts.
- For small pioneering infestations, manual control or bottom barriers may be effective. Monitor the lake for fragments and additional infestation sites. Maintain bottom barriers to prevent sediment buildup.
- For large or whole-lake infestations, chemical control will be the most effective (see above for chemical recommendations). Mechanical control may be used to manage infestations, but will not eradicate the weeds. Bottom barriers, if properly maintained, will create open water in small areas.

Control in flowing water (rivers, streams, ditches)

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- The most effective control will start with the furthest upstream infestation and move downward. If there are any weeds left upstream, any cleared site will likely be re-infested.
- If possible, contain the area being controlled with a boom to catch fragments before they float downstream.
- Manual control may be the most practical. Bottom barriers need to be securely anchored.
- Chemical control in flowing water is difficult. Consult an expert before considering this option.

Control along shores of Lakes Washington and Sammamish

- Permits will be required for all control work (see “Permitting and Regulatory Requirements” section above).
- Eradication of submerged aquatic weeds from these waterbodies is not practical.
- Bottom barriers, if properly maintained, can provide open water around docks, marinas, swimming beaches, and similar areas. Prior authorization by the Washington

Department of Fish and Wildlife (WDFW) is required due to potential impact on sockeye salmon spawning areas.

- Manual control of small patches may be sufficient.
- Mechanical control can be effective for lakeside communities or large marinas. Be sure to remove all fragments from the water.
- Spot control using chemicals can be effective in the right conditions. It is possible that more than one species of submerged noxious weeds may be present (particularly Brazilian elodea, which is increasing in these lakes). If this is the case, be sure to select an herbicide that will control all targeted weeds (consult BMPs for each weed or ask an expert for assistance in selecting herbicides). If there is any significant wave action or current, the chemicals will drift off target or quickly become diluted. Consult with a professional contractor before choosing this option. Neighboring property owners should be advised prior to spot chemical applications.
- Grass carp are not allowed in the Lake Washington and Lake Sammamish system.

Disposal Methods

- Eurasian watermilfoil can be left on land to dry out and/or decompose where it will not move into a waterway.
- Variable-leaf milfoil should not be left on the bank since it may root in damp soil.
- Both milfoils can be composted or placed in yard waste bins.

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Poison Hemlock

Conium maculatum

Parsley Family

Non-regulated Noxious Weed: Control Recommended

Identification Tips

- Tall biennial, reaching 8 to 10 feet the second year
- Bright green, fernlike leaves with strong musty smell
- First year plants form low clumps of lacy leaves with reddish or spotted stems
- Second year stems are stout, hollow, hairless, ribbed, with reddish or purple spotting/streaking
- Flowering plants covered with numerous small, umbrella-shaped clusters of tiny white flowers that have five petals
- Seeds form in green, ridged capsules that eventually turn brown

Biology

- Reproduces by seed. First year grows into a rosette; second year, develops tall stems and flowers
- Rapid growth from March to May, flowers in late spring
- Up to 40,000 seeds per plant are produced
- Seeds fall near the plant and are moved by erosion, animals, rain and human activity
- Seeds viable up to 6 years and germinate throughout the growing season; do not require a dormant period

Impacts

- Acutely toxic to livestock, wildlife, humans; causes death by respiratory paralysis after ingestion
- Aggressive growth crowds out desirable vegetation
- Early spring growth makes it more likely to be eaten by animals when there is limited forage available

Distribution

- Widespread in King County; found along roadsides, riparian areas, ravines, fields, ditches and un-managed yards and vacant lots
- Prefers moist soil and sun, but can adapt to dryer soil and shadier conditions

Questions?

King County Noxious Weed Control
Program Line: 206-296-0290
www.kingcounty.gov/weeds



Poison hemlock has thick stems with purple spotting, white flowers and fernlike leaves



All parts of this plant (the roots, stems, flowers, seeds, leaves) are poisonous.



Poison hemlock quickly invades open areas, displacing beneficial plants.

What You Can Do

Poison hemlock is so widespread in King County control is not required, but this plant should be removed whenever possible, especially in areas that are accessible to people, pets and livestock. **All parts of the plant are poisonous when eaten and even dead canes remain toxic for up to three years.** Toxins can also be absorbed through the skin and respiratory system so always wear protective clothing (gloves, glasses, mask) when handling this plant. If you suspect poisoning, call for help immediately. In both humans and animals, quick medical treatment can reverse the effects of hemlock poisoning.



In late winter, look for mounds of bright green, lacy leaves. The largest clumps are second-year plants building up energy to flower and seed later in the spring.

Control Methods

Manual: For small sites, pull or dig up plants. Remove entire root. Wear protective clothing including eye protection and wash your hands thoroughly after handling plant matter. To be fully effective, all mature plants need to be removed so no new seeds are produced. Do not leave flower heads on the ground as the seeds can remain viable. Composting is not recommended; instead place in a plastic trash bag and toss into your regular trash.

Mechanical: Plants can be mowed or cut back with a weed-eater before going to flower. Protect yourself with a dust mask to avoid inhaling toxins while mowing. Adding a layer of mulch to the area after it has been cleared or replanting with desirable vegetation will reduce germination of poison hemlock seeds present in the soil.

Chemical: Follow labels exactly as written and only use products appropriate and legal for the site. Herbicides should only be applied at the rates specified on the label. Foliar herbicides are most effective if applied to actively growing plants in the spring, followed by another application later in the summer for late sprouts. Spray plants before they flower for best results. Spraying may not prevent seed production in mature plants. A selective broadleaf herbicide with the active ingredient triclopyr, 2,4-D or metsulfuron will work well for lawn or pasture areas as it won't harm grasses. Glyphosate products (such as Roundup) work also but they kill grass as

well as broadleaf plants. Apply the herbicide to the entire leaf and stem surface and do not cut down the treated plants until they have died. This may take two weeks or more. Seeds germinate throughout the season, so repeat treatment is necessary to eliminate all plants. Chemical control options may differ for private, commercial and government agency users. For questions about herbicide use, contact the King County Noxious Weed Control Program.



Don't be fooled: Wild carrot (sometimes called Queen Anne's Lace) is often confused with poison hemlock.

Wild Carrot

*Poison hemlock is often confused with wild carrot (*Daucus carota*) as well as other similar-looking members of the parsley family including fennel, chervil and anise. However, poison hemlock can be distinguished in a couple of ways. It grows to heights of 8 feet or more; its leaves give off a strong musty smell; and its hairless stems have reddish or purple blotches/spotting. In contrast, wild carrot typically only grows to about 3 feet; its plain green stems have fine hairs with fewer branches; and it flowers later in the summer.*

Purple Loosestrife

Lythrum salicaria
Lythraceae

**Class B Noxious Weed
Control Required**

Legal Status in King County: Purple loosestrife is a Class B Noxious Weed (non-native species harmful to environmental and economic resources that landowners may be required to control based on distribution in the county and local priorities) according to Washington State Noxious Weed Law, RCW 17.10. In accordance with state law, the King County Noxious Weed Control Board requires property owners to control purple loosestrife on private and public lands throughout the county (control means to prevent all seed production and to prevent the dispersal of all propagative parts capable of forming new plants). In addition, state quarantine laws prohibit transporting, buying, selling, or distributing plants, plant parts or seeds of purple loosestrife.



BACKGROUND INFORMATION

Impacts and History

- Purple loosestrife is an invasive and competitive noxious weed that alters wetland ecosystems by replacing native and beneficial plants. Water-dependent mammals and waterfowl and other birds leave wetlands when their food source, nesting material and shelter are displaced by purple loosestrife.
- Dense infestations of purple loosestrife also alter the landscape by trapping sediments and thereby raising the water table.
- Although young shoots of purple loosestrife are palatable to cattle (and to white-tailed deer), larger plants are not, and so cattle graze preferentially on pasture grasses, giving purple loosestrife a distinct advantage in grazed areas. Over time, mature purple loosestrife plants will dominate, removing the use of the land as pasture. Similar processes can lead to destruction of hay meadows. Occasionally, deer browse the tops of mature plants in wetlands, but this doesn't appear to reduce the overall density of purple loosestrife.
- Purple loosestrife was introduced to the United States in the early 1800's at northeastern port cities, in ship ballast obtained from European tidal flats. Over the next 100 years it spread through canals and other waterways as far as the Midwest. It arrived in marine

estuaries in the Pacific Northwest in the early 1900s, suggesting that it was spread by maritime commerce.

- Purple loosestrife has also been commonly cultivated for the horticultural trade and became prized by bee-keepers in the mid 1900s. Deliberate planting and escapes from cultivation undoubtedly aided in the spread of infestations across the country.
- Purple loosestrife was first collected in Washington in 1929 from Lake Washington. The first eastern Washington collection was in the 1940s from the Spokane area, although there are reports that it escaped from a garden to the Spokane River ten years earlier.

Description

- Perennial emergent aquatic plant, reaching over 9 feet tall and 5 feet wide. As many as 30-50 herbaceous stems annually rise from a persistent perennial tap root and spreading rootstock.
- **Square stems** (usually 4-sided, sometimes 6-sided). Leaves are usually opposite. The leaves are linear in shape, 1.5 to 4 inches long, with smooth edges, and are sometimes covered with fine hairs.
- The showy **magenta or purple flowers appear from July to October** on flowering spikes. The flowers have 5 to 7 greenish sepals, 5 to 7 magenta petals and 12 stamens. Flowers will continue until frost.
- In winter months, dead, brown flower stalks remain with old seed capsules still visible.



Habitat

- Occurs in freshwater and brackish wetlands, lake and river shorelines, ponds, shallow streams and ditches, wet pastures and other wet places.
- Grows on moist or saturated soils or in shallow water. Can tolerate a range of soil pH and nutrients.
- Requires partial to full sunlight. Productivity is significantly reduced at 40% of full light.

Reproduction and Spread

- Spreads mainly by seed but also by stem and root fragmentation. A mature plant may have as many as thirty flowering stems capable of producing an estimated two to three million, pepper-sized seeds per year. Most seeds remain viable after two years in a natural water body, and stored in laboratory conditions they are viable for about three years.
- Dispersal is mainly by water, but seeds can also be transported on feathers and fur of waterfowl and other wetland animals as well as in mud on boots, tires, boats and pets. There is also some evidence of wind dispersal.
- Seedling densities sharply fall beyond 34 feet of the parent plant.
- Seed banks build for years, unnoticed until the right conditions of disturbance appear, resulting in a population explosion. Mature plants can live for 20 years.
- Vegetative spread is also possible. Buried stems harbor adventitious buds with the ability to produce shoots or roots. Breaking off stems or roots during incomplete plant removal initiates bud growth. Removed stems left on moist soil will also grow roots and sprout.

Local Distribution

- Found on lakes and waterways throughout King County, with 1,214 total sites reported in 2010.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines or local jurisdictions**).
- Control practices in critical areas should be selected to minimize soil disturbance, or efforts should be taken to mitigate or reduce impacts of disturbance. Any disturbed areas need to be stabilized to control erosion and sediment deposition. Refer to the King County Surface Design Manual for further information about sediment and erosion

control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information).

- Small infestations can be effectively hand-pulled or dug up if conditions allow (see section on Manual Control for more information). Isolated plants should be carefully removed in order to stop them from infesting a larger area.
- For larger infestations, the strategy will depend on the site. Generally work first in least infested areas, moving towards more heavily infested areas. On rivers, begin at the infestation furthest upriver and work your way downstream.
- Minimize disturbance to avoid creating more opportunities for seed germination.
- Properly dispose of all parts of the plant (see Disposal Methods section below).

Early Detection and Prevention

- Look for new plants. Get a positive plant identification by contacting your local noxious weed control program or extension service.
- Look for plants along river and lake shorelines, in ponds, wetlands, ditches and wet pastures.
- The best time to survey is in July and August when the plants are flowering; however, seedlings may not flower in the first year.
- Look for seedlings starting in June.
- Dig up or pull small isolated patches.
- Prevent plants spreading from existing infestations by cleaning off equipment, boots, clothing and animals that have been in infested areas.
- Don't buy or plant purple loosestrife. According to state quarantine laws it is illegal to buy, sell or offer purple loosestrife or any of its cultivars for sale.

Manual

- Hand pulling and the use of hand mechanical tools is allowable in unincorporated King County critical areas. Check with the local jurisdiction for regulations in other areas.
- If the plants are in flower or seed, **cut off and bag all flower stalks and seed heads.** It is very difficult to pull the plants without dispersing the small, lightweight seeds. Brush off boots, clothes and animals before leaving the infested area.
- Hand pulling is recommended when plants are rooted in mucky, sandy or other loose, wet soil. Grasp the base of the plant and pull slowly with steady pressure to release the roots from the soil. Pulling purple loosestrife by hand is easiest when plants are young. Older plants have larger roots that can be eased out with a garden fork. Remove as much of the root system as possible, because broken roots may sprout new plants.



- Cutting plants at the base when in flower may prevent seeding, but cut plants may continue to produce flowers. Sites should be consistently and regularly monitored until frost to cut and remove any subsequent flowers. Cutting will not kill the plants, and they will need to be controlled every year. Do not leave cut plant parts on site, because root and stem fragments can take root and form new plants.
- All manual control sites should be monitored for several years for plants growing from root fragments and from the seed bank.
- **DISPOSAL:** All purple loosestrife plant parts, including flowers, seed heads, stems, leaves and roots must be securely bagged, and discarded in the trash or taken to a transfer station. **Do not compost or place in yard waste. Plants may regenerate in compost. If you have the ability to burn plants, following all local regulations and restrictions, burning vegetative material is an acceptable disposal method. Do not burn flowering stems or seed heads.**
- **NOTE:** Under the Washington State Lythrum quarantine (WAC 16.752.400-415), it is illegal to transport, buy, sell, offer to sell, or to distribute plants, plant parts or seeds of purple loosestrife into or within the state of Washington. However, by following the recommendations in this Best Management Practices document you are covered under the King County Noxious Weed Control Program's permit to transport purple loosestrife for the purpose of taking it to a transfer station or landfill.

Mechanical

- Removal of purple loosestrife with hand held mechanical tools is allowable in critical areas and their buffers within unincorporated King County. Check with the local jurisdiction for regulations in other areas.
- Mowing is not recommended. Since plant fragments can produce new shoots, mowing may facilitate spread rather than control.
- Cutting alone is not a control option for purple loosestrife. New plants will grow from the roots. Cutting late in the season but before seed set reduces shoot production more than mid-summer cutting.
- Sheet mulching or covering using black plastic, landscape fabric, or cardboard and six inches of mulch is an interim option for dense seedling infestations. It does not kill the roots of mature plants, but it does slow down growth and seed dispersal. The covering must extend several feet beyond the edges of the infestation and be weighted so the plants cannot push it up. The edges of the covered area must be monitored for plants coming up from rhizomes extending beyond the sheet. Covering materials should also be monitored for damage or gaps and repaired or re-installed as needed.

Chemical

- **Precautions:**
 - Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label of the product being used. **Follow all label directions.**
 - For herbicide use in critical areas and their buffers, certain restrictions apply depending on the site and jurisdiction. In unincorporated King County, refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current

- restrictions and regulatory compliance issues. Elsewhere, check with the local jurisdiction.
- For your personal safety, at a minimum wear gloves, long sleeves, long pants, closed toe shoes, and appropriate eye protection. Follow label directions for any additional personal protection equipment needed.
 - A Washington State pesticide license with an aquatic endorsement is required for the purchase of aquatic herbicides. **NEVER apply non-aquatic herbicide formulations to water since many include ingredients toxic to aquatic organisms.**
 - For large infestations of purple loosestrife, herbicide use may be necessary for effective control.
 - Cutting after spraying is not necessary. If cutting is desired, infested areas should not be cut until after the herbicide has had a chance to work, which may take several weeks.
 - In sensitive areas or areas prone to erosion, careful spot-spraying will create less disturbance than manual or mechanical control.
 - For several years following treatment, monitor areas for new plants germinating from the seed bank. In some cases several years of treatment may be necessary.
 - When treating an area intermixed with native monocots (cattails, grasses, sedges, etc), using a selective broadleaf herbicide is recommended. The monocots will not be harmed by the herbicide and will be able to help suppress new plants emerging from the seed bank.

Specific Herbicide Information

Glyphosate (e.g. Rodeo®, AquaMaster® or Aqua Neat®): Apply to actively growing plants at early flowering stage. Application to pre-flowering plants or seedlings may also be effective, but unless the extent of the infestation is well known, plants can be difficult to locate when not in flower. Glyphosate works slowly, so plants may not appear to be affected for a couple of weeks. A second application a few weeks after the first may be helpful to control plants not in flower or otherwise skipped during the first application. Apply to foliage but avoid runoff. Caution: Glyphosate is non-selective and it will injure or kill other vegetation contacted by the spray including grasses, cattails and other monocots.

Imazapyr (Habitat®, Polaris®): Apply to foliage any time the plant is actively growing. Caution: Imazapyr is non-selective and highly effective even at low doses: it will injure or kill other vegetation contacted by the spray including trees, desirable vegetation, and grasses, cattails and other monocots. Also, imazapyr is soil-active and can harm trees and other plants rooted in the spray area or sometimes immediately downhill from the area being sprayed.

Triclopyr (Garlon 3A® and Renovate 3®). Apply when plants are in the mid to full-bloom stage. Application to pre-flowering plants or seedlings may also be effective, but unless the extent of the infestation is well known, plants can be difficult to locate when not in flower. Triclopyr is a selective herbicide and will kill only dicots (broadleaf plants and trees). It will not harm monocots such as grasses, sedges, cattails and many native aquatic plants.

All the above listed herbicides require the addition of an approved surfactant. Follow label directions for selecting the correct type of surfactant. Be sure that the selected surfactant is approved for aquatic use in Washington State.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological

- Biological control can take up to six years to have a significant impact on the infestation. Purple loosestrife population density and the number of flowering plants can be reduced, but there will always be some plants remaining when using biological control agents. Releases should be made only at sites where loosestrife infestations are large and immediate eradication of the weed is not the primary objective.
- All biological control agents approved for use on purple loosestrife in Washington State will not feed on any plant species other than purple loosestrife in our area.
- Where feasible, biological control plans should incorporate another non-chemical control method to be able to prevent all seed production as required by state law. If the infestation is inaccessible, remove flowers at the edges of the infestation to the greatest extent possible. If *Galerucella* or *Hylobius* species are present, flower heads should be cut, bagged and properly disposed of by the time of flower drop in mid to late August. If *Nanophyes marmoratus* weevils are present, flower/seedheads should be cut very carefully in early September after emerging adult weevils have left the flowerheads for the season. If there is any chance of mature seeds being present in the seed heads, extreme care should be taken to avoid spread.

- Biological control is not recommended or prescribed for small infestations.
- Two species of *Galerucella* beetles were first released in Washington in 1992 and subsequently have been released in King County several times in many locations. These small golden-brown leaf-feeders defoliate plants and attack the terminal bud area, halting or drastically reducing seed production. The larvae feed constantly on the leaf underside. Loosestrife seedling mortality is high. These beetles are highly mobile and are often found in King County in locations far from release sites. *Galerucella* beetles do not do well near salt water.
- *Hylobius transversovittatus* is a root-mining weevil that also eats leaves. The adult beetle is reddish brown and ½ inch long. It eats from the leaf margins, working



Galerucella beetles feeding on purple loosestrife



Hylobius transversovittatus

inward. Eggs are laid in the lower 2-3 inches of the stem, or sometimes in the soil near the root. The larvae then work their way to the root, where they eat the carbohydrate reserves. Evidence of larvae in the root is a zig-zag pattern. *Hylobius* tolerates coastal areas and is a better choice for infestations near salt water.

- *Nanophyes marmoratus* is a tiny seed weevil. Larvae and adults impact purple loosestrife by feeding on unopened flower buds. Flower buds with larval feeding damage usually abort and fail to produce seeds. Adults also feed on developing leaves, further weakening plants. *Nanophyes* can also be successful when used in conjunction with *Hylobius*.



Nanophyes weevil on purple loosestrife

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Hand pulling is recommended for young plants or older plants in loose, wet soil.
- Larger plants from isolated small populations can be dug out from moist upland areas. This may be impractical to impossible when trying to remove hardy, woody roots in compacted soils. Care should be taken to minimize erosion when digging in saturated soils on shorelines.
- If the plants are in flower or in seed, **cut off and bag all flower heads**. Pulling plants in seed will disperse the small, lightweight seeds. Cut plants may continue to produce flowers, so these sites will have to be consistently and regularly monitored until frost to cut and remove any subsequent flowers.
- When digging or pulling on shorelines, take appropriate erosion control measures.
- If manual control is not possible due to site conditions or available labor, apply appropriate herbicide with wick wiper or spot spray to minimize off target injury.
- If using an herbicide in an area that has desirable grasses and other monocots, use a selective broadleaf herbicide to avoid injury to grasses and other monocots.

Large Infestations in Areas with Monocots

- Cutting alone is not a control option for purple loosestrife. Shoots and adventitious roots will develop. Cutting late in the season but before seed set reduces shoot production more than mid-summer cutting. Cut plants may continue to produce flowers, so these sites will have to be consistently and regularly monitored until frost to cut and remove any subsequent flowers.
- Sheet mulching using black plastic, landscape fabric, or cardboard and six inches of mulch is an interim option for dense seedling infestations. It does not kill the roots of mature plants, but it does slow down growth and seed dispersal. This method is also non-selective.
- If an area has desirable monocots present, use a selective herbicide and encourage the growth of the monocots.

- If the infestation is in a pasture, encourage healthy grassy areas by seeding and fertilizing. Use a mix of grass and clover species to improve resistance to purple loosestrife. Fertilize according to the soil needs.
- If using biological control, areas need to be monitored and any flowers removed and properly disposed of where feasible. If the infestation is inaccessible, remove flowers around the edges of the infestation to the greatest extent possible. If *Galerucella* or *Hylobius* insects are present, flower heads should be cut, bagged and properly disposed of by the time of flower drop in mid to late August. If *Nanophyes marmoratus* weevils are present, flower/seedheads should be cut very carefully in early September after emerging adult weevils have left the flowerheads for the season. If there is any chance of mature seeds being present in the seed heads, extreme care should be taken to avoid spread.

Control on Shorelines

- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion. Refer to the King County Surface Design Manual for further information about sediment and erosion control practices (call 206-296-6519 or go to <http://kingcounty.gov/wlr/Dss/Manual.htm> for more information).
- Survey area and document extent of infestation.
- Focus on manual removal for small infestations if possible.
- When removing vegetation on shorelines (by lakes, streams and wetlands) use barriers to prevent sediment and vegetative debris from entering the water system.
- Cutting will not control purple loosestrife but it can serve in the interim until more effective control measures can be accomplished.
- For larger areas where herbicide use is warranted, spray using low pressure and large droplet size to reduce drift. If herbicide could potentially drift into the water or a wetland area, use only approved aquatic herbicides and surfactants after obtaining the necessary permits.
- Infested areas will need to be monitored for several years to control plants growing from root fragments and germinating from the extensive seed bank.

Control along Road Rights-of-Way

- Pull small infestations if possible.
- Spot spray larger infestations. Use a selective broadleaf herbicide in areas with desirable monocots such as grasses, sedges or cattails; if controlled with a non-selective herbicide, re-seed after control is completed.
- If plants are about to flower, they can be cut until a more effective control strategy can be used. Be sure to dispose of cut plant parts properly.
- If plants are sprayed, wait until the herbicide has had a chance to work before conducting any regular right-of-way mowing.

Disposal Methods

- All purple loosestrife plant parts, including flowers, seed heads, stems, leaves and roots must be securely bagged, and discarded in the trash or taken to a transfer station. **Do not compost or place in yard waste. Plants may regenerate in compost. If you have the ability to burn plants, following all local regulations and restrictions, burning vegetative material is an acceptable disposal method. Do not burn flowering stems or seed heads.**
- **NOTE:** Under the Washington State Lythrum quarantine (WAC 16.752.400-415), it is illegal to transport, buy, sell, offer to sell, or to distribute plants, plant parts or seeds of purple loosestrife into or within the state of Washington. However, by following the recommendations in this Best Management Practices document you are covered under the King County Noxious Weed Control Program's permit to transport purple loosestrife for the purpose of taking it to a transfer station or landfill.

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Reed Canarygrass

Phalaris arundinacea

Grass Family

Non-regulated Noxious Weed: Control Recommended

Identification Tips

- Large, coarse perennial wetland grass that grows 3 to 9 feet tall
- Hairless stems with gradually tapering leaf blades
- Leaves are flat and have a rough texture on both sides and are at a 45-degree angle to stem
- Flower heads are found in narrow clusters on the stems high above the leaves
- Leaves are bright green (compared with the bluish-green leaves of phragmites)
- Grows mostly in wet places or along creeks and lakes

Biology

- Spreads by seeds and vegetatively by rhizomes that produce a thick mat of stems
- Frost tolerant; one of the first grasses to sprout in the spring
- Vegetative growth peaks in mid-June and declines in mid-August; goes dormant in the winter with visible dead stalks

Impacts

- Can cause indigestion or illness in livestock
- Displaces native plants due its aggressive, dense root system; wetland species diversity declines drastically
- Increases flooding
- Rhizomes accumulate sediment and clog small streams and drainages
- Dense colonies can form a physical barrier to migrating salmon

Distribution

- Very common in King County; found in wet pastures, ditches, wetlands and shorelines
- Establishes easily in wet areas with sun, but also can grow on dry soils in upland habitats in part shade (however cannot tolerate full shade)

Questions?

King County Noxious Weed Control
Program Line: 206-296-0290
www.kingcounty.gov/weeds



Look for new shoots to start growing very early in the spring; seedheads (right) form May to mid-June.



Reed canarygrass spreads quickly and out-competes desirable grasses.

What You Can Do

While there is no legal requirement for controlling reed canarygrass, the King County Noxious Weed Control Board recognizes that this species is invasive, creating a damaging impact on the environment and resources of King County. The Board encourages control and containment of existing populations, especially for restoration projects or revegetation plans.



Removal of well-established infestations of reed canarygrass takes a lot of labor, dedication and planning.

Control Methods

Most control methods need to be applied over a number of years to be successful.

Prevention: First make sure to identify reed canarygrass correctly. There are several similar looking ornamental and pasture grasses not considered noxious and northwest native grasses that grow in the same habitat, so identification can be difficult. Watch for new patches of reed canarygrass and control them early to prevent future problems. This weed does not grow well in dense shade, so the best long-term solution is to establish a tree and shrub canopy. Evergreens work well for this as they provide year-round shade; native willows also works well. Additional control methods should be used while the shade canopy is developing.

Manual: Hand pulling or digging is only practical for small patches. Make sure to remove the entire root mass. Small infestations that are up from the shoreline (stems not underwater) can be controlled by tarping with heavy duty black plastic or non-woven geotextile fabric. However, this method will not completely eliminate the infestation, only reduce the density.

Mechanical: If the stems are not underwater and access is possible, mowing may be a viable control method as it removes seed heads. This might be enough to allow surrounding vegetation to move in, although it is unlikely to completely eliminate the reed canarygrass.

Chemical: Larger patches most likely will need herbicide treatments to be effective which will likely require a permit issued by the state Department of Ecology if the site is wet or along the water's edge. Feel free to contact us for permitting information or information on hiring a licensed aquatic weed contractor. Using an aquatic formulation of glyphosate (such as Aquamaster, Aquaneat and other products) or imazapyr (such as Habitat) will be most effective in the summer or early fall. Mowing first and allowing the reed canarygrass to grow back to a few feet tall can increase the effectiveness of herbicide spraying. Established populations will usually require at least 2 to 3 years of follow-up treatment and several herbicide applications may be necessary to inhibit seed bank recolonization.

August 2011



King County

Department of Natural Resources and Parks
Water and Land Resources Division
Noxious Weed Control Program
206-296-0290 TTY Relay: 711

Scotch Broom

Cytisus scoparius

Pea Family

Non-Designated Noxious Weed: Control Generally Not Required*

Identification Tips

- Evergreen shrub
- Reaches heights of 6 to 10 feet
- Branches are erect and angled with prominent ridges
- Small yellow flowers along the entire stem
- Small, short-lived leaves can be simple but are generally three-parted

Biology

- Flowers from March to June
- Reproduces primarily by seed; when mature, the seedpods split and eject seeds up to 20 feet away
- Over 10,000 seeds can be produced per plant
- Seeds can remain viable in the soil for 5 to 60 years

Impacts

- Displaces native and beneficial plants and prevents reforestation
- Renders rangeland and grasslands worthless
- Seeds toxic to humans, horses and livestock
- Dense stands impede the movement of wildlife
- Considered a potential fire hazard

Distribution

- Found throughout King County including in pastures, vacant lands, harvested timberlands and along roadsides and rights-of-way
- Thrives in full sun, but will also establish in shady areas

* Control of Scotch broom is required on State Route 2 and I-90, between mile marker 34 and the King/Kittitas County line; control is not required for the remainder of the county, but it is recommended wherever feasible.



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Scotch broom (also called Scot's broom) was brought to United States from the British Isles and central Europe as an ornamental and for erosion control.



In the Pacific Northwest, Scotch broom spreads rapidly, growing so dense that it is often impenetrable.

Questions?

King County Noxious Weed Control
Program Line: **206-296-0290**
www.kingcounty.gov/weeds

What You Can Do

There is no legal requirement to control Scotch broom in most of King County, but removal is recommended as part of forestry, pasture and natural area management. You can help prevent Scotch broom from spreading by washing vehicles, boots and animals that may have been in infested areas and removing it from your property whenever possible.

Control Methods

For best results, control methods should be adaptive and employed throughout several growing seasons.

Manual: For small sites with few plants, pull or dig up plants and remove as much root as possible so the plant will not re-sprout. This method can be highly labor-intensive and to be fully effective, all mature plants need to be removed so no new seeds are produced. Pulling of medium to large plants is much easier with specially designed steel weed wrenches (www.weedwrenches.com). Wrenches are available to borrow from the King County Noxious Weed Control Program (call for more info). Controlled burning can also be effective for removing dense broom infestations. Check local regulations for special permits, burn bans or other restrictions.



Specially designed weed wrenches work well for Scotch broom removal.

Mechanical: Cutting down mature shrubs is fairly effective but mowing young, green plants is not and will result in a dense carpet of short broom plants. For mature plants, clear thick stands or multibranching plants with manually operated tools: chainsaws, brush cutters, axes, machetes or loppers. Cut plants near ground level where the stem is more yellow than green; much more effective when done in the dry season (August-September) but take care to avoid spreading mature seed pods to un-infested areas. Cut large, mature plants at chest height or below and cut off side branches during the dry season. Key to success is to keep seeds from forming after initial clearing.

Chemical: **Follow labels exactly as written and only use products appropriate and legal for the site. Herbicides should only be applied at the rates specified on the label.** Foliar herbicide application

Spanish Broom: Removal Required

Due to its limited distribution in King County, Spanish broom is a Class A noxious weed. While it looks similar to the more common Scotch broom, this plant can be identified by its smooth, round, primarily leafless stems and fragrant flowers. Spanish broom is also non-native and highly invasive in the same types of habitat as Scotch broom. It is found in both urban and rural areas where it has escaped ornamental plantings.



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Saint Mary's College

Eradication is required for Spanish broom.

is most effective after full leaf development and before fall senescence. Basal or cut stump treatment methods are also effective. Products containing glyphosate are most effective if applied to actively growing plants. Glyphosate is absorbed by the growing leaves (not woody stems). However, glyphosate is “non-selective” and will injure any foliage that it comes in contact with, so make sure not to drip on desirable plants. Selective broadleaf herbicides with the active ingredient of triclopyr, 2,4-D and metsulfuron work well for lawn or pasture areas as they won't harm grasses. After applying herbicides, do not cut down the

treated brooms until they have died completely. This can take two weeks or more. Chemical control options may differ for private, commercial and government agency users. For questions about herbicide use, contact the King County Noxious Weed Control Program.



King County

Department of Natural Resources and Parks
Water and Land Resources Division
Noxious Weed Control Program
206-296-0290 TTY Relay: 711

BEST MANAGEMENT PRACTICES

Tansy Ragwort—*Senecio jacobaea* Asteraceae

Class B Noxious Weed

Legal Status in King County: Class B Noxious Weed (non-native species designated for control by State Law RCW 17.10 and by the King County Noxious Weed Control Board). The King County Noxious Weed Control Board requires property owners to control and prevent the spread of tansy ragwort on private and public lands throughout the county. Control is defined by state law as the prevention of all seed production.



BACKGROUND INFORMATION

Impacts and History

- Serious threat to livestock. Contains pyrrolizidine alkaloids that are converted to toxic pyrroles in the liver after ingestion. The damage to the liver is irreversible and cumulative. Continued significant ingestion will usually kill the affected animal.
- The most toxic part is the leaves, which are ingested while the animal forages for grasses and other desirable plants growing near the tansy ragwort.
- Dried leaves maintain their toxicity but not the bitter taste, and when mixed with hay or other silage it is not possible for the animal to detect or avoid the tansy ragwort.
- Cattle and horses are most vulnerable to poisoning but deer, pigs and goats are also at risk.
- Reduces overall pasture productivity and stocking levels in livestock areas.
- First reported in North America in 1913 in British Columbia, reported in Portland, Oregon in 1922 and by the 1950s, had become a serious economic problem west of the Cascades

Description

- Tap-rooted biennial or short-lived perennial with 2 to 4 foot tall erect stems, branched near the top, with dense clusters of bright yellow daisy-like flower heads.
- Each flower head has 10 to 15 ray flowers (petal-like flowers) surrounding yellow disk flowers and the flower clusters grow near the top of the stem.
- First year plants are dense rosettes with dark green ruffled or lobed leaves on purplish stems.

Habitat

- Typically found in full sun or partial shade in pastures, on roadsides and horse trails, in forest clear-cuts and on vacant lands.
- More common in disturbed habitats and overgrazed or poorly managed pastures.
- Also common on cleared forestlands, adjacent roadsides and fields, and in unmaintained areas in new developments.

Reproduction and Spread

- Reproduces by seed. Plants that go to seed die at the end of the season.
- **Plants can flower from June to October** but typically start to **form seeds by mid August**.
- Seeds are borne a short distance by wind and longer distances by animals, in hay and on equipment and vehicles. Large plants may produce as many as 150,000 seeds.
- Seeds can be viable for as long as 15 years. Seeds in the upper 2 cm of soil generally are viable for 4 to 5 years. Below 2 cm, the seeds remain dormant longer. Tilling, grazing or other disturbance will cause these dormant seeds to germinate.

Local Distribution

The heaviest concentrations of tansy ragwort are in livestock grazing areas in south and central King County, especially in the areas surrounding Auburn, Enumclaw, Maple Valley and Covington. There are also significant infestations on Vashon Island, in the Woodinville and Kenmore areas, and other rural areas of the county. Tansy ragwort is also found on vacant properties that were logged or cleared for development and along city, county and state roads.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods which reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management will require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines**).
- Small infestations can be effectively hand-pulled or dug up. Isolated plants should be carefully removed in order to stop them from infesting a larger area.
- For larger infestations, the strategy will depend on the land use of the site. In pastures, good grazing practices and management of grass and forage species will greatly improve control of tansy ragwort. Specific suggestions are given in the Best Management section.
- Generally work first in least infested areas, moving towards more heavily infested areas.
- Minimize disturbance to avoid creating more opportunities for seed germination.

Early Detection and Prevention

- Tansy ragwort is easy to find once it flowers. Monitor pastures, areas used by livestock, horse trails and roadsides for new populations of tansy ragwort in **June and July**.
- Dig up isolated or small populations. If there are more rosettes than you can remove manually, it may be necessary to treat the area with an appropriate herbicide in the early fall or the following spring.
- Prevent plants from spreading away from existing populations by washing vehicles, boots and animals that have been in infested areas.
- If animals are being moved from an infested pasture to an uninfested pasture, first isolate them for at least five days so that the seeds pass out of the animals' digestive system.

Manual

- **Pull the plants after they bolt but before they flower.** Typically this is from May to June. Because this is a toxic plant, gloves and protective clothing should be worn.
- Plants in flower can form viable seeds even after they are pulled, so carefully bag and dispose of all flowering plants. If the plants are seeding, it is very difficult to bag the seed heads without dispersing the seeds, so bag flowering plants well before seeds mature.
- In areas where mature plants are pulled, there are usually many small rosettes and seeds left in the soil. Carefully search the area for rosettes and dig them up. Roots break off easily and re-sprout with new plants, so use a digging tool. Completely removing plants is easiest when the soil is loose or wet.
- Return to the same location in the following spring and summer to remove plants coming up from seeds already in the soil and continue to monitor the area for several years.
- Hand pulling and the use of hand mechanical tools are allowable in all critical areas in unincorporated King County.

Mechanical

- Mowing will **not** control tansy ragwort effectively. Plants are able to re-sprout and flower again in the same season when mowed. Plants that are regularly mowed can persist as short-lived perennials or can flower below the level of the mower.
- Mowing may increase the amount of toxin ingested by the animals because grazing animals are often unable to avoid eating small tansy ragwort plants growing among pasture grasses.

Chemical

- Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label. **Follow all label directions.**
- Herbicides may be used in accordance with Federal and State Law in critical areas and their buffers with certain restrictions. Refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues.

- For control of large infestations on roadsides and other non-pasture areas, herbicide use may be necessary. For tansy ragwort, it is most effective to apply selective broadleaf herbicides in the spring and again in the fall. Infested areas should not be mowed until after the herbicide has had a chance to work.
- For several years following treatment, monitor areas for new plants germinating from the seed bank.

Specific Herbicide Information

Glyphosate: can effectively control tansy ragwort. Treatment with glyphosate needs to be combined with effective re-vegetation of the site to prevent tansy ragwort seedlings from re-infesting the area.

Selective Broadleaf Herbicides (such as triclopyr, 2,4-D and dicamba): most effective when tansy ragwort is growing in a grassy area. Re-treatment the following year is necessary to control late-germinating plants. Continue to monitor for new plants for at least four years after the initial treatment and following any disturbance to the soil such as tilling or construction.

NOTE: Certain additional restrictions apply for products containing 2,4-D and Triclopyr BEE (e. g. Garlon 4, Crossbow). Refer to the King County Noxious Weed Regulatory Guidelines for more details.

Selective herbicides that are effective on tansy ragwort include 2,4-D (many products), dicamba (e.g. Vanquish or Banvel), a combination treatment of dicamba and 2,4-D (e.g. Weedmaster) and a combination treatment of triclopyr and 2,4-D (e.g. Crossbow).

Apply selective herbicides in the spring before any flowers appear. The best control is early in the spring after growth begins. A 2,4-D+dicamba formulation can be effective at the early flowering stage as well. Fall applications after rains have initiated seed germination can also be effective. Apply herbicide on warm days when winds are low. Check label for specific information on wind and rain guidelines.

Both dicamba and 2,4-D can harm certain grasses, alfalfa, clover and other legumes. The addition of a suitable surfactant may improve the control results.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product. Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Biological

- Biological control can take up to six years to have a significant impact on the infestation. Population density and the number of flowering plants can be reduced but there will always be some plants remaining when using biological control agents.
- Any biological control plan needs to incorporate another non-chemical control method to be able to prevent all seed production as required by state law.
- Biological control is not recommended or prescribed for small infestations.
- The ragwort flea beetle (*Longitarsus jacobaeae*) larvae mine the roots of the rosettes and kill plants in the spring when they start to bolt. Heavy feeding by adult flea beetles on the leaves can kill rosettes in the fall and winter. Flea beetles are most effective in sunny pastures that do not flood and are below 2400 feet in elevation.
- The cinnabar moth (*Tyria jacobaeae*) does best in sunny, warm areas at elevations less than 3000 feet where the tansy ragwort densities are greater than 4 per 10 sq. ft. (4/m²). It does not do well on the coast and in shady areas under trees or where the plant density is below 1 plant per 20 sq. ft.
- The most effective biological control method is to release the ragwort flea beetle and the cinnabar moth together.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Pull plants by hand if soil is wet; the plants may need to be dug up in dry compacted soil.
- Replace any divots created when removing the plants to lessen the amount of disturbed soil.
- Apply appropriate herbicide with wick wiper or by spot spray to minimize off target injury.
- Monitor site throughout growing season and remove any new plants.
- If using an herbicide in a grassy area, use a selective herbicide to avoid injury to the grass.

Large Infestations in Grassy Areas

- Mowing is not effective for controlling tansy ragwort. Mowing can be used if the infestation is found later in the year to keep the plants from flowering until an approved control method can be used. Do not mow tansy ragwort that has gone to seed.
- Large infestations can be controlled with selective herbicides. (See the Chemical section of this BMP).
- Suppression of large infestations of tansy ragwort with a selective herbicide will greatly increase grass production, which in turn increases the suppression of the tansy ragwort.
- Promote healthy grassy areas by seeding and fertilizing. Use a mix of grass and clover species to improve resistance to tansy ragwort. Fertilize according to the soil needs.
- If grassy area is used for grazing, the area should be managed to promote grass and clover vigor. Graze uniformly and move animals from area to area in a planned sequence. Avoid

grazing when soil is very wet because holes can be opened up to new weed infestations. Some winter grazing by smaller animals can stimulate growth of clover and improve grass health.

- Be sure to monitor for tansy ragwort on edges of pastures and disturbed areas around fences and watering holes. Remove isolated plants before they flower.
- In fields densely infested with tansy ragwort, remove all cattle and horses until the tansy ragwort is reduced to isolated plants.
- If needed, apply a nitrogen fertilizer after the selective herbicide application and then manage grazing so that 4 to 6 inches of grass re-growth remains at the end of the growing season so that grasses can effectively resist re-invasion by the tansy ragwort.
- If utilizing biological control, areas need to be checked to control all flowering tansy not controlled by the biological control agents.

Control in Riparian Areas

- Survey area and document extent of infestation.
- Focus on manual removal for small infestations if possible.
- Mowing will not control tansy ragwort but it can serve in the interim until more effective control measures can be utilized.
- For larger areas where herbicide use is warranted, apply with a wick wiper or spot spray using low pressure and large droplet size.
- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion.
- If a non-selective herbicide is used in grassy areas, the area should be re-seeded to prevent reinvasion by weeds.
- Infested areas will need to incorporate a management plan lasting for several years to control plants germinating from the seed bank.

Control Along Road Rights-of-Way

- Pull small infestations if possible.
- Spot spray with glyphosate if weeds are in areas with no desirable vegetation.
- If plants are in grassy areas, use a selective broadleaf herbicide; if controlled with a non-selective herbicide, re-seed after control is completed.
- If plants are about to flower, they can be mowed until a more effective control strategy can be used.

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King County
Department of
Natural Resources and Parks
Water and Land Resources Division

Noxious Weed Control Program

BEST MANAGEMENT PRACTICES

Yellow-flag iris
(Iris pseudacorus)
Iridaceae

**Class C Noxious Weed; Not Designated
for Control**

**Legal Status in King
County:**

Class C Noxious Weed (non-native species that can be designated for control under State Law RCW 17.10 based on local priorities.) The King County Noxious Weed Control Board does not require property owners to control yellow-flag iris, but control is recommended.



BACKGROUND INFORMATION

Impacts and History

- Alternate common names include yellow flag, paleyellow iris and yellow iris.
- On state weed lists in Connecticut, Massachusetts, Montana and New Hampshire in addition to Washington. Also on the USDA Natural Resources Conservation Service invasive plants list and on the Exotic Plant Pest List of the California Exotic Pest Plant Council.
- Yellow-flag iris displaces native vegetation along streambanks, wetlands, ponds and shorelines and reduces habitat needed by waterfowl and fish, including several important salmon species.
- It clogs small streams and irrigation systems, and it dominates shallow wetlands, wet pastures and ditches. Its seeds clog up water control structures and pipes.
- Rhizome mats can prevent the germination and seedling growth of other plant species. These mats can also alter the habitat to favor yellow-flag iris by compacting the soil as well as increasing elevation by trapping sediments.
- Studies in Montana show that yellow-flag iris can reduce stream width by up to 10 inches per year by trapping sediment, creating a new bank and then dominating the new substrate with its seedlings, creating still more sediment retention (Tyron 2006).
- Even when dry, yellow-flag iris causes gastroenteritis in cattle (Sutherland 1990), although livestock tend to avoid it. All plant parts also cause gastric distress in humans when ingested, and the sap can cause skin irritation in susceptible individuals.
- Native to Europe and the Mediterranean region, including North Africa and Asia Minor. Found as far north as 68 degrees North in Scandinavia.

- The earliest North American record comes from Newfoundland in 1911, and it was established in British Columbia by 1931. By 1961 yellow-flag iris was reported to be naturalized in Canada (Cody 1961). It was established in California by 1957 and in Montana by 1958 (Tyron 2006). It is now naturalized in parts of most states and provinces throughout North America except in the Rocky Mountains. (NRCS Plants Database).

Description

- A perennial, emergent iris that creates dense stands along freshwater margins. It is the only naturalized, emergent yellow iris in King County.
- Grows to 5 feet (1.5 m) tall.
- Has numerous thick, fleshy rhizomes.
- Flowers are yellow, showy, and sometimes have brown to purple veins at the base of the petals. Several flowers can occur on each stem.
- Can bloom from April to August; in western Washington usually blooms May into July. It will remain green all winter in mild years.
- Broad, flat, pointed leaves are folded and overlap one another at the base. They are generally longer in the center of the plant and fan out in a single plane toward the edges of the plant. The leaves are dark green to blue-green.
- Fruits are large capsules to 3 inches (8 cm) long. They are 3-angled, glossy green and contain rows of many flattened brown seeds.
- Seeds are corky, large - about ¼ inch (7 mm) across, and float. Seed pods grow in clusters that resemble little bunches of bananas. Seeds spread by water and usually germinate after the water recedes along the edges of the shore. They do not usually germinate under water.
- When not in flower or seed, can be confused with cattails (*Typha sp.*), which are round at the base and taller than yellow-flag iris, while iris are flattened along one plane and shorter. Can also be mistaken for native bur-reeds (*Sparganium sp.*), which have thick, spongy leaves that are somewhat narrower than iris leaves.

Habitat

- Occurs in freshwater wetlands, fens, ponds, lake shores, river and stream banks, wet pastures and ditches.
- Grows in standing water or next to it on saturated soils. Prefers silty, sandy or rocky soil.
- Generally grows in shallow water, but can create extensive mats over deeper water.
- Sometimes cultivated as a garden ornamental or used for landscaping purposes.

Reproduction and Spread

- Spreads by seed and vegetatively (rhizomes).
- Produces extensive thick, fleshy rhizomes, forming dense mats that exclude native wetland species. Up to several hundred flowering plants may be connected rhizomatously. Rhizome fragments can form new plants if they break off and drift to suitable habitat. Rhizomes that dry out remain viable and will re-infest an area if they are re-moistened.

- Flat spongy seeds disperse through water and germinate after the water recedes along shorelines. Submersed seeds will generally not germinate.
- Plants take three years to mature before flowering (Tyron 2006).
- The flowers are pollinated by bumble-bees and long-tongued flies.

Local Distribution

- Widespread throughout King County.
- Present along most lake shores and many stream banks in the developed areas of the county.
- A few shallow wetlands significantly impacted.

CONTROL INFORMATION

Integrated Pest Management

- The preferred approach for weed control is Integrated Pest Management (IPM). IPM involves selecting from a range of possible control methods to match the management requirements of each specific site. The goal is to maximize effective control and to minimize negative environmental, economic and social impacts.
- Use a multifaceted and adaptive approach. Select control methods that reflect the available time, funding, and labor of the participants, the land use goals, and the values of the community and landowners. Management may require dedication over a number of years, and should allow for flexibility in method as appropriate.

Planning Considerations

- Survey area for weeds, set priorities and select best control method(s) for the site conditions and regulatory compliance issues (**refer to the King County Noxious Weed Regulatory Guidelines or local jurisdictions**).
- Isolated plants can be effectively dug up. Take care to remove all of the rhizomes, in order to stop them from infesting a larger area.
- For larger infestations, the strategy will depend on the site. Generally work first in least infested areas, moving towards more heavily infested areas. On rivers and streams, begin at the infestation furthest upstream and work your way downstream.
- If conducting manual control, be sure to collect any rhizome fragments that may float free.
- Minimize disturbance to avoid creating more opportunities for seed germination.

Early Detection and Prevention

- Look for new plants. Get a positive plant identification by contacting your local noxious weed control program or extension service.
- Look for plants along river and lake shorelines, wetlands, ditches and wet pastures.
- The best time to survey is in April to June when the plants are in flower.
- Look for seedlings starting in late winter.
- Dig up small isolated patches, being sure to remove all the rhizome.
- Don't buy, move or plant yellow-flag iris.

- Clean any tools and machinery that were used in an infested area before moving to another site.

Manual

- Hand removal with the use of hand tools is allowable in all critical areas in unincorporated King County. Check with the local jurisdiction for regulations in other areas.
- When removing manually, care should be taken to protect the skin, as resins in the leaves and rhizomes can cause irritation.
- Manual control is feasible for individual plants or small stands. You can easily pull seedlings in damp or wet soil.
- Dig out mature plants, taking care to remove all the rhizome. The rhizome is tough and may require heavier tools, such as pickaxes, pulaskis or saws. If you do not get all the rhizome, more plants will be produced. Keep watching the location after you have removed the plants, and new leaves will show you where you missed any sections of rhizome. Continue to remove the rhizome, and in this way you can eradicate a small patch.
- Simon (2008) found that for plants emergent in standing water for the entire growing season, cutting all leaves and stems off below the waterline can result in good control. This method is most effective if the plants are cut before flowering.
- Be sure to dispose of any removed pieces of rhizome away from wet sites. Composting is not recommended for these plants in any home compost system, because rhizomes can continue growing even after three months without water (Sutherland 1990).

Mechanical

- Removal of yellow-flag iris with hand held mechanical tools is allowable in critical areas and their buffers in unincorporated King County. Check with the local jurisdiction for regulations in other areas.
- In unincorporated King County, riding mowers and light mechanical cultivating equipment may be used in critical areas if conducted in accordance with an approved forest management plan, farm management plan, or rural management plan, or if prescribed by the King County Noxious Weed Control Program.
- Repeated mowing or cutting may keep yellow-flag iris contained and can potentially kill it by depleting the energy in the rhizomes after several years of intensive mowing (Tu 2003).

Cultural

- Small patches can be covered with a heavy tarp weighted at the edges for several years (Simon 2008). Be sure to extend the tarp well beyond the edges of the infestation and check periodically to ensure that plants are not growing up around the tarp. Other materials (heavy plastic, landscape cloth) are not as effective.
- Burning is not recommended. Seeds germinate and grow well after late summer burning (Sutherland 1990), and plants have a strong tendency to resprout from rhizomes after burning (Clark et al. 1998).

Biological

- Although a number of insects and pathogens are known to attack yellow-flag iris (Tu 2003), no biological control agents are presently known, and no research is currently being conducted.

Chemical

- Herbicides should only be applied at the rates and for the site conditions and/or land usage specified on the label. **Follow all label directions.**
- Herbicides can only be purchased and applied to aquatic systems in Washington State by a licensed pesticide applicator (contact Washington State Department of Agriculture for more information on pesticide licenses).
- There are federal, state and local restrictions on herbicide use in critical areas and their buffers. Refer to the **King County Noxious Weed Regulatory Guidelines** for a summary of current restrictions and regulatory compliance issues.
- For control of large infestations, herbicide use may be necessary. Infested areas should not be mowed until after the herbicide has had a chance to work, which may take several weeks, depending on the herbicide used.
- Due to dense growth, re-application a few weeks after initial treatment will probably be needed to get complete coverage (Tyron 2006).
- For several years following treatment, monitor areas for new plants germinating from the seed bank or from rhizome fragments. In some cases several years of treatment may be necessary.

Specific Herbicide Information

Since yellow-flag iris is a monocot, only non-selective herbicides are effective. However, non-selective herbicides will injure or kill any plant they contact, so special care must be taken when using these chemicals. Both of the herbicides discussed below are non-selective.

Glyphosate (e.g. Rodeo™ or Aquamaster™). This is the most frequently used chemical for controlling yellow-flag iris. Apply to actively growing plants in late spring or early summer. Apply directly to foliage, or apply immediately to freshly cut leaf and stem surfaces. Avoid runoff. (Tu, 2003). Follow the label for recommended rates for yellow-flag iris since higher rates may provide better results. A study in Montana showed good results with 5% Rodeo plus Competitor (Tyron, 2006). Glyphosate at lower rates is not as effective as either imazapyr or imazapyr and glyphosate combined.

Imazapyr (e.g. Habitat®). Simon (2008) found that 1% imazapyr (with 1% non-ionic surfactant) sprayed in the fall resulted in good control. Imazapyr sprayed in the spring, or a combination of imazapyr (1%) and glyphosate (2.5%) sprayed in fall both result in good control, but slightly less effective than imazapyr alone. Note that imazapyr has been shown to have some residual soil activity, so care should be taken to avoid spraying in the root zone of desirable plants, and do not replant the treated area for several months after application.

The above listed herbicides require the addition of an approved surfactant. Follow label directions for selecting the correct type of surfactant. Be sure that the selected surfactant is approved for aquatic use.

The mention of a specific product brand name in this document is not, and should not be construed as an endorsement or as a recommendation for the use of that product.

Chemical control options may differ for private, commercial and government agency users. **For questions about herbicide use, contact the King County Noxious Weed Control Program at 206-296-0290.**

Experimental

Preliminary trials indicate that injecting herbicide into the cut flowering stems of yellow-flag iris may provide a successful alternative treatment method with little or no non-target damage. Check with your local weed control agency for progress.

SUMMARY OF BEST MANAGEMENT PRACTICES

Small Infestations in Native and/or Desirable Vegetation

- Hand digging is recommended for very young plants not yet established.
- Larger plants from isolated small populations can be dug out from moist upland areas. This is difficult but possible with persistence.
- Replace any divots created when removing the plants to lessen the amount of disturbed soil.
- Plants emergent in standing water can be cut below the waterline.
- If manual control is not possible due to site conditions or available labor, apply appropriate herbicide by spot spray, stem-injection or wick-wiper to minimize off target injury.

Large Infestations

- Persistent mowing or cutting over several years may be effective. Cutting flowering plants will stop seed dispersal.
- Herbicide use may be necessary.
- If the infestation is in a pasture, combine control methods with ongoing good pasture management. Encourage healthy grassy areas by seeding and fertilizing. Use a mix of grass and clover species to improve resistance to weeds. Fertilize according to the soil needs.

Control in Riparian Areas or Lake Shores

- Survey area and document extent of infestation. Start eradication efforts at the headwaters and progress downstream whenever possible.
- Focus on manual removal for small infestations if possible.

- When removing vegetation near streams and wetlands use barriers to prevent sediment and vegetative debris from entering the water system.
- For larger areas where herbicide use is warranted, use the method that will cause the least amount of damage to desirable vegetation, such as spot spraying or wick wiping.
- When large areas of weeds are removed, the cleared area needs to be replanted with native or non-invasive vegetation and stabilized against erosion.
- Control of larger areas will need to incorporate a management plan lasting for several years to remove plants germinating from the seed bank and rhizome fragments.

Control on Road Rights-of-Way

- Dig up small infestations if possible.
- Spot spray if digging is not practical due to soil, site conditions or size of infestation.
- If plants are in grassy areas, re-seed after control is completed.
- If plants are sprayed, wait until the herbicide has had a chance to work (up to several weeks) before mowing.

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APPENDIX B:

Herbicide Labels

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ATTENTION:

This specimen label is provided for general information only.

- This pesticide product may not yet be available or approved for sale or use in your area.
- It is your responsibility to follow all Federal, state and local laws and regulations regarding the use of pesticides.
- Before using any pesticide, be sure the intended use is approved in your state or locality.
- Your state or locality may require additional precautions and instructions for use of this product that are not included here.
- Monsanto does not guarantee the completeness or accuracy of this specimen label. The information found in this label may differ from the information found on the product label. You must have the EPA approved labeling with you at the time of use and must read and follow all label directions.
- You should not base any use of a similar product on the precautions, instructions for use or other information you find here.
- Always follow the precautions and instructions for use on the label of the pesticide you are using.

2119514-25



Complete Directions for Use in Aquatic and Other Non-crop Sites.

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

EPA Reg. No. 524-343

2009-2

GROUP	9	HERBICIDE
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Read the entire label before using this product.

Use only according to label instructions.

Not all products listed on this label are registered for use in California. Check the registration status of each product in California before using.

Read the "LIMIT OF WARRANTY AND LIABILITY" statement at the end of the label before buying or using. If terms are not acceptable, return at once unopened.

THIS IS AN END-USE PRODUCT. MONSANTO DOES NOT INTEND AND HAS NOT REGISTERED IT FOR REFORMULATION (OR REPACKAGING). SEE INDIVIDUAL CONTAINER LABEL FOR REPACKAGING LIMITATIONS.

PRODUCT INFORMATION

1.0 INGREDIENTS

ACTIVE INGREDIENT:

*Glyphosate, N-(phosphonomethyl)glycine, in the form of its isopropylamine salt	53.8%
OTHER INGREDIENTS:	46.2%
	100.0%

*Contains 648 grams per liter or 5.4 pounds per U.S. gallon of the active ingredient glyphosate, in the form of its isopropylamine salt. Equivalent to 480 grams per liter or 4.0 pounds per U.S. gallon of the acid, glyphosate.

No license granted under any non-U.S. patent(s).

2.0 IMPORTANT PHONE NUMBERS

FOR PRODUCT INFORMATION OR ASSISTANCE IN USING THIS PRODUCT,
CALL TOLL-FREE,
1-800-332-3111.

IN CASE OF AN EMERGENCY INVOLVING THIS PRODUCT, OR FOR MEDICAL
ASSISTANCE, CALL COLLECT, DAY OR NIGHT,
(314) 694-4000.

3.0 PRECAUTIONARY STATEMENTS

3.1 Hazards to Humans and Domestic Animals

Keep out of reach of children.

CAUTION!

Remove contaminated clothing and wash clothing before reuse.
Wash thoroughly with soap and water after handling.

3.2 Environmental Hazards

Do not contaminate water when cleaning equipment or disposing of equipment washwaters. Treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss can cause fish suffocation.

In case of: SPILL or LEAK, soak up and remove to a landfill.

3.3 Physical or Chemical Hazards

Spray solutions of this product should be mixed, stored and applied using only stainless steel, fiberglass, plastic or plastic-lined steel containers.

DO NOT MIX, STORE OR APPLY THIS PRODUCT OR SPRAY SOLUTIONS OF THIS PRODUCT IN GALVANIZED STEEL OR UNLINED STEEL (EXCEPT STAINLESS STEEL) CONTAINERS OR SPRAY TANKS. This product or spray solutions of this product react with such containers and tanks to produce hydrogen gas which may form a highly combustible gas mixture. This gas mixture could flash or explode, causing serious personal injury, if ignited by open flame, spark, welder's torch, lighted cigarette or other ignition source.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in any manner inconsistent with its labeling. This product can only be used in accordance with the Directions for Use on this label or in separately published Monsanto Supplemental Labeling. Supplemental labeling can be found on the www.cdms.net or www.greenbook.net websites or obtained by contacting your Authorized Monsanto Retailer or Monsanto Company representative. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulations.

4.0 STORAGE AND DISPOSAL

Proper pesticide storage and disposal are essential to protect against exposure to people and the environment due to leaks and spills, excess product or waste, and vandalism. Do not allow this product to contaminate water, foodstuffs, feed or seed by storage and disposal.

PESTICIDE STORAGE: STORE ABOVE 5°F (-15°C) TO KEEP PRODUCT FROM CRYSTALLIZING. Crystals will settle to the bottom. If allowed to crystallize, place in a warm room 68°F (20°C) for several days to redissolve and roll or shake container or recirculate in mini-bulk containers to mix well before using. Store pesticides away from food, pet food, feed, seed, fertilizers, and veterinary supplies. Keep container closed to prevent spills and contamination.

PESTICIDE DISPOSAL: To avoid wastes, use all material in this container, including rinsate, by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program. Such programs are often run by state or local governments or by industry. All disposal must be in accordance with applicable Federal, state and local regulations and procedures.

CONTAINER HANDLING AND DISPOSAL: See container label for container handling and disposal instructions and refilling limitations.

5.0 GENERAL INFORMATION (How This Product Works)

Product Description: This product is a postemergence, systemic herbicide with no residual soil activity. It gives broad-spectrum control of many annual weeds, perennial weeds, woody brush and trees. It is formulated as a water-soluble liquid and may be applied through standard equipment after dilution and mixing with water or other carriers according to label instructions.

Time to Symptoms: This product moves through the plant from the point of foliage contact to and into the root system. Visible effects are a gradual wilting and yellowing of the plant which advances to complete browning of above-ground growth and deterioration of underground plant parts. Effects are visible on most annual weeds within 2 to 4 days, but on most perennial weeds may not occur for 7 days or more. Extremely cool or cloudy weather following treatment may slow activity of this product and delay development of visual symptoms.

Stage of Weeds: Annual weeds are easiest to control when they are small. Best control of most perennial weeds is obtained when treatment is made at late growth stages approaching maturity. Refer to the "WEEDS CONTROLLED" sections for specific weed instructions. Always use the higher product application rate in the labeled range

when weed growth is heavy or dense, or when weeds are growing in an undisturbed (non-cultivated) area. Reduced weed control may result from treating weeds with disease or insect damage, weeds heavily covered with dust, or weeds under poor growing conditions.

Cultural Considerations: Reduced control may result when applications are made to annual or perennial weeds that have been mowed, grazed or cut, and have not been allowed to regrow to the specified stage for treatment.

Rainfastness: Heavy rainfall soon after application may wash this product off of the foliage and a repeat application may be required for adequate control.

Mode of Action in Plants: The active ingredient in this product inhibits production of an enzyme in plants and microorganisms that is essential to formation of specific amino acids.

No Soil Activity: Weeds must be emerged at the time of application to be controlled by this product. Weeds germinating from seed after application will not be controlled. Unemerged plants arising from unattached underground rhizomes or rootstocks of perennials will not be affected by the herbicide and will continue to grow.

Maximum Application Rates: The maximum application or use rates stated throughout this label are given in units of volume (fluid ounces or quarts) of this product per acre. However, the maximum allowed application rates apply to this product combined with the use of any and all other herbicides containing the active ingredient glyphosate, whether applied separately or as tank mixtures, on a basis of total pounds of glyphosate (acid equivalents) per acre. If more than one glyphosate-containing product is applied to the same site within the same year, you must ensure that the total use of glyphosate (pounds acid equivalents) does not exceed the maximum allowed. The combined total of all treatments must not exceed 8 quarts of this product (8 pounds of glyphosate acid) per acre per year. See the "INGREDIENTS" section of this label for necessary product information.

ATTENTION

AVOID CONTACT OF HERBICIDE WITH FOLIAGE, STEMS, EXPOSED NON-WOODY ROOTS OR FRUIT OF CROPS, DESIRABLE PLANTS AND TREES, BECAUSE SEVERE INJURY OR DESTRUCTION MAY RESULT.

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended. The likelihood of injury occurring from the use of this product increases when winds are gusty, as wind velocity increases, when wind direction is constantly changing or when there are other meteorological conditions that favor spray drift. When spraying, avoid combinations of pressure and nozzle type that will result in splatter or fine particles (mist) that are likely to drift. AVOID APPLYING AT EXCESSIVE SPEED OR PRESSURE.

NOTE: Use of this product in any manner not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences.

5.1 Weed Resistance Management

GROUP	9	HERBICIDE
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Glyphosate, the active ingredient in this product, is a Group 9 herbicide based on the mode of action classification system of the Weed Science Society of America. Any weed population may contain plants naturally resistant to Group 9 herbicides. Weed species resistant to Group 9 herbicides may be effectively managed utilizing another herbicide from a different Group or using other cultural or mechanical practices.

To minimize the occurrence of glyphosate-resistant biotypes observe the following general weed management recommendations:

- Scout your application site before and after herbicide applications.
- Control weeds early when they are relatively small.
- Incorporate other herbicides and cultural or mechanical practices as part of your weed control system where appropriate.
- Use the labeled rate for the most difficult weed in the site. Avoid tank mixtures with other herbicides that reduce this product's efficacy (through antagonism) or with tank mixtures that encourage rates of this product below those specified on this label.
- Control weed escapes and prevent weeds from setting seeds.
- Clean equipment before moving from site to site to minimize spread of weed seed.
- Use new commercial seed as free of weed seed as possible.
- Report any incidence of repeated non-performance of this product on a particular weed to your Monsanto representative, local retailer, or county extension agent.

5.2 Management Recommendations for Glyphosate-Resistant Weed Biotypes

NOTE: Appropriate testing is critical in order to confirm weed resistance to glyphosate. Contact your Monsanto representative to determine if resistance in any particular weed biotype in your area has been confirmed. Control recommendations for biotypes confirmed as resistant to glyphosate are made available on separately published supplemental

labeling or Fact Sheets for this product and may be obtained from your local retailer or Monsanto representative.

Since the occurrence of new glyphosate-resistant weeds cannot be determined until after product use and scientific confirmation, Monsanto Company is not responsible for any losses that may result from the failure of this product to control glyphosate-resistant weed biotypes.

The following good weed management practices are recommended to reduce the spread of confirmed glyphosate-resistant biotypes:

- If a naturally occurring resistant biotype is present at your site, this product may be tank mixed or applied sequentially with an appropriately labeled herbicide with a different mode of action to achieve control.
- Cultural and mechanical control practices may also be used as appropriate.
- Scout treated sites after herbicide applications and control weed escapes of resistant biotypes before they set seed.
- Thoroughly clean equipment before leaving sites known to contain resistant biotypes.

6.0 MIXING

Clean sprayer parts immediately after using this product by thoroughly flushing with water.

NOTE: REDUCED RESULTS MAY OCCUR IF WATER CONTAINING SOIL IS USED, SUCH AS VISIBLY MUDDY WATER OR WATER FROM PONDS AND DITCHES THAT IS NOT CLEAR.

6.1 Mixing with Water

This product mixes readily with water. Mix spray solutions of this product as follows: Fill the mixing or spray tank with the required amount of water. Add the labeled amount of this product near the end of the filling process and mix well. Use caution to avoid siphoning back into the carrier source. Use approved anti-back-siphoning devices where required by state or local regulations. During mixing and application, foaming of the spray solution may occur. To prevent or minimize foam, avoid the use of mechanical agitators, terminate by-pass and return lines at the bottom of the tank and, if needed, use an approved anti-foam or defoaming agent.

6.2 Tank Mixtures

When this product is tank mixed with other products, refer to the tank-mix product labels for approved non-crop sites and application rates. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive precautionary statements for each product in the mixture. Any labeled rate of this product may be used in a tank mix.

When this label lists a tank mixture with a generic active ingredient such as diuron, 2,4-D, or dicamba, the user is responsible for ensuring the mixture product label allows the specific application.

Buyer and all users are responsible for all loss or damage in connection with the use or handling of mixtures of this product with herbicides or other materials that are not expressly listed in this label. Mixing this product with herbicides or other materials not specified on this label may result in reduced performance.

6.3 Tank Mixing Procedure

When tank mixing, read and carefully observe label directions, cautionary statements and all information on the labels of all products used. Add the tank-mix product to the tank as directed by the label. Maintain agitation and add the labeled amount of this product.

Maintain good agitation at all times until the contents of the tank are sprayed. If the spray mixture is allowed to settle, thorough agitation is required to resuspend the mixture before spraying is resumed.

Keep by-pass line on or near the bottom of the tank to minimize foaming. Screen size in nozzle or line strainers should be no finer than 50-mesh.

Always predetermine the compatibility of labeled tank mixtures of this product with water carrier by mixing small proportional quantities in advance. Ensure that the specific tank mixture product is registered for application at the desired site.

Refer to the "Tank Mixtures" section for additional precautions.

6.4 Mixing Percent Solutions

Prepare the desired volume of spray solution by mixing the amount of this product in water as shown in the following table:

Spray Solution

Desired Volume	Amount of AquaMaster herbicide					
	0.5%	0.75%	1%	1.5%	4%	8%
1 gal	2/3 oz	1 oz	1.3 oz	2 oz	5 oz	10 oz
25 gal	1 pt	1.5 pt	1 qt	1.5 qt	4 qt	2 gal
100 gal	2 qt	3 qt	1 gal	1.5 gal	4 gal	8 gal

2 tablespoons = 1 fluid ounce

For use in backpack, knapsack or pump-up sprayers, it is suggested that the amount of this product be mixed with water in a larger container. Fill sprayer with the mixed solution.

6.5 Surfactant

This product requires the use of a nonionic surfactant unless otherwise specified. When using this product, unless otherwise specified, mix 2 or more quarts of a nonionic surfactant per 100 gallons of spray solution. Increasing the rate of surfactant may enhance performance. Examples of when to use the higher surfactant rate include, but are not limited to: hard to control woody brush, trees and vines, high water volumes, adverse environmental conditions, tough to control weeds, weeds under stress, surfactants with less than 70 percent active ingredient, tank mixes, etc. These surfactants should not be used in excess of 1 quart per acre when making broadcast applications. Always read and follow the manufacturer's surfactant label for best results. Carefully observe all cautionary statements and other information appearing in the surfactant label.

6.6 Colorants or Dyes

Approved colorants or marking dyes may be added to this product. Colorants or dyes used in spray solutions of this product may reduce performance, especially at lower rates or dilution. Use colorants or dyes according to the manufacturer's instructions.

6.7 Drift Reduction Additives

Drift reduction additives may be used with all equipment types, except wiper applicators, and sponge bars. When a drift reduction additive is used, read and carefully observe the precautionary statements and all other information appearing on the additive label. The use of drift reduction additives can affect spray coverage which may result in reduced performance.

7.0 APPLICATION EQUIPMENT AND TECHNIQUES

Do not apply this product through any type of irrigation system.

APPLY THESE SPRAY SOLUTIONS IN PROPERLY MAINTAINED AND CALIBRATED EQUIPMENT CAPABLE OF DELIVERING DESIRED VOLUMES.

SPRAY DRIFT MANAGEMENT

AVOID DRIFT. EXTREME CARE MUST BE USED WHEN APPLYING THIS PRODUCT TO PREVENT INJURY TO DESIRABLE PLANTS AND CROPS.

Do not allow the herbicide solution to mist, drip, drift or splash onto desirable vegetation since minute quantities of this product can cause severe damage or destruction to the crop, plants or other areas on which treatment was not intended.

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment- and weather-related factors determines the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

7.1 Aerial Equipment

DO NOT APPLY THIS PRODUCT USING AERIAL SPRAY EQUIPMENT EXCEPT UNDER CONDITIONS AS SPECIFIED WITHIN THIS LABEL.

FOR AERIAL APPLICATION IN CALIFORNIA, REFER TO THE FEDERAL SUPPLEMENTAL LABELING FOR AERIAL APPLICATIONS IN THAT STATE OR COUNTY FOR SPECIFIC INSTRUCTIONS, RESTRICTIONS AND REQUIREMENTS.

This product, when tank mixed with dicamba, may not be applied by air in California. Only 2,4-D amine formulations may be applied by air in California.

TO PREVENT INJURY TO ADJACENT DESIRABLE VEGETATION, APPROPRIATE BUFFER ZONES MUST BE MAINTAINED.

Avoid direct application to any body of water.

Use the labeled rates of this herbicide in 3 to 25 gallons of water per acre.

Ensure uniform application. To avoid streaked, uneven or overlapped application, use appropriate marking devices.

AERIAL SPRAY DRIFT MANAGEMENT

The following drift management requirements must be followed to avoid off-target drift movement from aerial applications to agricultural field crops. These requirements do not apply to public health uses.

1. The distance of the outermost nozzles on the boom must not exceed 3/4 the length of the wingspan or rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees. Where states have more stringent regulations, they should be observed.

Importance of Droplet Size

The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see

the "Wind", "Temperature and Humidity", and "Temperature Inversions" sections of this label).

Controlling Droplet Size

- **Volume:** Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with the higher rated flows produce larger droplets.
- **Pressure:** Use the lower spray pressures recommended for the nozzle. Higher pressure reduces droplet size and does not improve canopy penetration. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of nozzles:** Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle orientation:** Orienting nozzles so that the spray is released backwards, parallel to the air stream, will produce larger droplets than other orientations. Significant deflection from the horizontal will reduce droplet size and increase drift potential.
- **Nozzle type:** Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce larger droplets than other nozzle types.
- **Boom length:** For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.
- **Application height:** Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces the exposure of the droplets to evaporation and wind.

Swath Adjustment

When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller droplets, etc.).

Wind

Drift potential is lowest between wind speeds of 2 to 10 miles per hour. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Application should be avoided below 2 miles per hour due to variable wind direction and high inversion potential. **NOTE:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect drift.

Temperature and Humidity

Set up equipment to produce larger droplets when making applications in low relative humidity to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions

Applications should not occur during a temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

Sensitive Areas

This product should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, bodies of water, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

Aircraft Maintenance

PROLONGED EXPOSURE OF THIS PRODUCT TO UNCOATED STEEL SURFACES MAY RESULT IN CORROSION AND POSSIBLE FAILURE OF THE PART. The maintenance of an organic coating (paint) which meets aerospace specification MIL-C-38413 may prevent corrosion. To prevent corrosion of exposed parts, thoroughly wash aircraft after each day of spraying to remove residues of this product accumulated during spraying or from spills. Landing gear is most susceptible.

7.2 Ground Broadcast Equipment

For broadcast ground applications, unless otherwise specified in this label or in separate supplemental labeling or Fact Sheets published by Monsanto, use this product at the rate of 1.5 to 3 pints per acre for annual weeds, 3 to 7.5 pints per acre for perennial weeds and 3 to 7.5 pints per acre for woody brush and trees. When used according to label directions this product will give control or partial control of herbaceous weeds, woody brush and trees listed in the "WEEDS CONTROLLED" section of this label.

Use the labeled rates of this product in 3 to 40 gallons of water per acre as a broadcast spray unless otherwise specified. As density of weeds increases, spray volume should be increased within the labeled range to ensure complete coverage. Carefully select proper nozzles to avoid spraying a fine mist. For best results with ground application equipment, use flat-fan nozzles. Check spray pattern for even distribution of spray droplets.

7.3 Hand-Held Equipment

Apply to foliage of vegetation to be controlled. For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff. Use coarse sprays only.

For control of weeds listed in the "Annual Weeds" section of "WEEDS CONTROLLED", apply a 0.5-percent solution of this product to weeds less than 6 inches in height or runner length. For annual weeds over 6 inches tall, or unless otherwise specified, use a 1-percent solution. Apply prior to seedhead formation in grass or bud formation in broadleaf weeds.

For best results, use a 1.5-percent solution on harder-to-control perennials, woody vines, brush and trees. Make applications to perennials after seedhead emergence in grasses or bud formation in broadleaf weeds, woody brush and trees for best results.

For low-volume directed spray applications, use a 4- to 8-percent solution of this product for control or partial control of annual weeds, perennial weeds, or woody brush and trees. Spray coverage should be uniform with at least 50 to 75 percent of the foliage contacted. Coverage of the top one half of the plant is important for best results. If a straight stream nozzle is used, start the application at the top of the targeted vegetation and spray from top to bottom in a lateral zigzag motion. For flat-fan and cone nozzles and with hand-directed mist blowers, mist the application over the foliage of the targeted vegetation. To ensure adequate spray coverage, spray both sides of large or tall woody brush and trees, when foliage is thick and dense, or where there are multiple sprouts. For best results, apply to actively growing woody brush and trees after full leaf expansion and before fall color and leaf drop.

Unless otherwise specified, use the rates listed in the following "Application Rates" table for various methods of foliar application using high-volume, backpack, knapsack and similar types of hand-held equipment. When used according to label directions this product will give control or partial control of herbaceous weeds, woody brush and trees listed in the "WEEDS CONTROLLED" section of this label.

Application Rates

APPLICATION	AQUAMASTER HERBICIDE	SPRAY VOLUME GALLONS/ACRE
SPRAY-TO-WET		
Handgun or Backpack	0.5 to 1.5% by volume	spray-to-wet*
LOW-VOLUME DIRECTED SPRAY		
Backpack	4 to 8% by volume	15 to 25**
Modified High-Volume	1.5 to 3% by volume	40 to 60**

*For applications made on a spray-to-wet basis, spray coverage should be uniform and complete. Do not spray to the point of runoff.

**Low-volume directed applications with backpacks work best when treating weeds and brush less than 10 feet tall. For taller weeds and brush, high-volume handguns can be modified by reducing nozzle size and spray pressure to produce a low-volume directed spray.

7.4 Selective Equipment

This product may be applied through shielded applicators, hooded sprayers, wiper applicators or sponge bars, after dilution and thorough mixing with water, to listed weeds growing in any aquatic or non-crop site specified on this label.

AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION, AS SERIOUS INJURY OR DEATH IS LIKELY TO OCCUR:

Applicators used above desired vegetation should be adjusted so that the lowest spray stream or wiper contact point is at least 2 inches above the desirable vegetation. Droplets, mist, foam or splatter of the herbicide solution settling on desirable vegetation is likely to result in discoloration, stunting or destruction.

Better results may be obtained when more of the weed is exposed to the herbicide solution. Weeds not contacted by the herbicide solution will not be affected. This may occur in dense clumps, severe infestations or when the height of the weeds varies so that not all weeds are contacted. In these instances, repeat treatment may be necessary.

Shielded and Hooded Applicators

A shielded or hooded applicator directs the herbicide solution onto weeds, while shielding desirable vegetation from the herbicide. Use nozzles that provide uniform coverage within the treated area. Keep shields on these sprayers adjusted to protect desirable vegetation. **EXTREME CARE MUST BE EXERCISED TO AVOID CONTACT OF HERBICIDE WITH DESIRABLE VEGETATION.**

Wiper Applicators and Sponge Bars

Wiper applicators are devices that physically wipe appropriate amounts of this product directly onto the weed.

Equipment must be designed, maintained and operated to prevent the herbicide solution from contacting desirable vegetation. Operate this equipment at ground speeds no greater than 5 miles per hour. Performance may be improved by reducing speed in areas of heavy weed infestations to ensure adequate wiper saturation. Better results may be obtained if 2 applications are made in opposite directions.

Avoid leakage or dripping onto desirable vegetation. Adjust height of applicator to ensure adequate contact with weeds. Keep wiping surfaces clean. Be aware that, on sloping ground, the herbicide solution may migrate, causing dripping on the lower end and drying of the wicks on the upper end of a wiper applicator.

Do not use wiper equipment when weeds are wet.

Mix only the amount of solution to be used during a 1-day period, as reduced activity may result from the use of leftover solutions. Clean wiper parts immediately after using this product by thoroughly flushing with water.

Nonionic surfactant at a rate of 10 percent by volume of total herbicide solution is recommended with all wiper applications.

For Rope or Sponge Wick Applicators—Solutions ranging from 33 to 75 percent of this product in water may be used.

For Panel Applicators—Solutions ranging from 33 to 100 percent of this product in water may be used in panel wiper applicators.

8.0 SITE AND USE INSTRUCTIONS

Unless otherwise specified, applications may be made to control any weeds listed in the "Annual Weeds", "Perennial Weeds" and "Woody Brush and Trees" rate tables. Refer also to the "Selective Equipment" section.

8.1 Aquatic Sites

This product may be applied to emerged weeds in all bodies of fresh and brackish water which may be flowing, nonflowing or transient. This includes lakes, rivers, streams, ponds, estuaries, rice levees, seeps, irrigation and drainage ditches, canals, reservoirs, wastewater treatment facilities, wildlife habitat restoration and management areas.

This product may also be used to control the labeled weeds, woody brush and trees growing in other terrestrial non-crop sites listed on this label or in aquatic sites within these areas.

If aquatic sites are present in a non-crop area and are part of the intended treatment, read and observe the following directions:

This product does not control plants which are completely submerged or have a majority of their foliage under water.

There is no restriction on the use of treated water for irrigation, recreation or domestic purposes.

Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.

NOTE: Do not apply this product **directly to water** within 0.5 mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 0.5 mile of an active potable water intake in a standing body of water such as lake, pond or reservoir. To make aquatic applications around and within 0.5 mile of active potable water intakes, the water intake must be turned off for a minimum period of 48 hours after the application. The water intake may be turned on prior to 48 hours if the glyphosate level in the intake water is below 0.7 parts per million as determined by laboratory analysis. These aquatic applications may be made **ONLY** in those cases where there are alternative water sources or holding ponds which would permit the turning off of an active potable water intake for a minimum period of 48 hours after the applications. This restriction does **NOT** apply to intermittent inadvertent overspray of water in terrestrial use sites.

For treatments after drawdown of water or in dry ditches, allow 7 or more days after treatment before reintroduction of water to achieve maximum weed control. Apply this product within 1 day after drawdown to ensure application to actively growing weeds.

Floating mats of vegetation may require retreatment. Avoid wash-off of sprayed foliage by spray boat or recreational boat backwash or by rainfall within 6 hours of application. Do not retreat within 24 hours following the initial treatment.

Applications made to moving bodies of water must be made while traveling upstream to prevent concentration of this herbicide in water. When making any bankside applications, do not overlap more than 1 foot into open water. Do not spray in bodies of water where weeds do not exist. The maximum application rate of 7.5 pints per acre must not be exceeded in any single broadcast application that is being made over water except as follows, where any labeled rate may be applied:

- Stream crossings in utility rights-of-way.
- Where applications will result in less than 20 percent of the total water area being treated.

When emerged infestations require treatment of the total surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in fish kill.

Tank Mixtures

Tank mixtures of this product plus 2,4-D amine may be used to increase the spectrum of vegetation controlled in aquatic sites. Use 1.5 to 2 pints of this product plus 1 to 2 quarts of 2,4-D amine (4 pounds active ingredient per gallon, labeled for aquatic sites) for control of annual weeds. Use 3 to 7.5 pints of this product plus 2 to 4 quarts of 2,4-D amine (4 pounds active ingredient per gallon, labeled for aquatic sites) for control or partial control of perennial weeds, woody brush and trees.

When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of all products used. Use according to the most restrictive precautionary statements for each product in the mixture. Mix in the following sequence: Fill sprayer tank one-half full with water, add AquaMaster herbicide, then 2,4-D amine and finally surfactant. Fill sprayer tank to final volume of water.

NOTE: DO NOT MIX AQUAMASTER HERBICIDE AND 2,4-D AMINE CONCENTRATES WITHOUT WATER CARRIER. DO NOT MIX AQUAMASTER HERBICIDE AND 2,4-D AMINE IN BYPASS INJECTOR-TYPE SPRAY EQUIPMENT.

For Control of Cordgrass (*Spartina spp.*)

The presence of debris and silt on the surface of cordgrass plants will reduce product performance. It may be necessary to wash targeted plants prior to application to improve herbicide uptake. Where cordgrass has been cut or mowed prior to application, allow significant regrowth before application to ensure adequate interception and uptake of the herbicide solution. Rainfall within 2 hours or immersion within 4 hours after application may reduce effectiveness.

Prior to application, survey the areas to be treated to determine if shellfish beds exist within the intended treatment area. Wait either until shellfish have been harvested before application is made or do not harvest shellfish for 14 days following treatment.

Add 1 to 2 quarts or more of nonionic surfactant or other adjuvant approved for use on aquatic sites and compatible with this product per 100 gallons of spray solution for broadcast applications (ground or air) and when using optical sensing application equipment.

Do not apply this product through any type of irrigation system.

APPLICATION: Under ideal application conditions, that is, where silt and debris are not present on plant surfaces, good spray coverage is achievable, target plants are actively growing and labeled rates and application volumes are used, allow at least 4 hours drying time before plants are covered by tidewater. Where one or more of these conditions are not met, schedule applications to allow at least 5 hours drying time before plants are covered by tidewater. Do not apply when wind speed at the application site exceed 10 miles per hour.

Broadcast Application (Ground): Apply 2 to 8 quarts of this herbicide in 5 to 100 gallons of spray solution per acre. For best results, complete coverage of cordgrass clumps is required.

Broadcast Application (Ground/Optical Sensing Application Equipment): Apply 2 to 8 quarts of this product in 5 to 100 gallons of spray solution per acre using equipment designed and calibrated to deliver spray solution only when cordgrass plants are present and detected by optical sensors. For best results, complete coverage of cordgrass clumps is required.

Hand-Held Backpack or High-Volume Equipment: Apply a 5 to 8 percent solution of this product. Ensure that complete coverage of cordgrass clumps is achieved. Do not spray to the point of runoff.

Broadcast Application (Air): Apply 2 to 8 quarts of this product in 5 to 10 gallons of spray solution per acre. Maintain at least a 50-foot buffer between commercial shellfish beds and treated areas. The potential for spray drift is dependent upon weather- and equipment-related factors. The applicator must be familiar with local wind patterns and monitor and record temperature and wind speed prior to and periodically during application. Schedule application in order to allow at least 5 hours before treated plants are covered by tidewater.

For Control of Giant Salvinia

For control of Giant Salvinia, this product may be applied as a 2.0% v/v spray-to-wet solution with 0.5 to 2.0% v/v of a nonionic surfactant containing at least 70 percent active ingredient. Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment.

For broadcast applications, apply 3 to 3.75 quarts of this product with an aquatic approved surfactant system containing 0.1% v/v nonionic organosilicone and 0.25% v/v nonionic spreader sticker surfactant in 3 to 40 gallons per acre as a broadcast treatment.

Allow at least 3 days after application before disturbing treated vegetation. This product does not control plants which are completely submerged or have a majority of their foliage under water.

8.2 Hollow Stem Injection

This product may be applied through hand-held injection devices that deliver labeled amounts of this product into targeted hollow stem plants growing in any aquatic or non-crop site specified on this label. For control of the following hollow stem plants, follow the use instructions below:

Castorbean (*Ricinus communis*)

Inject 4 mL/plant of this product into the lower portion of the main stem.

Hemlock, Poison (*Conium maculatum*)

Inject one leaf cane per plant 10 to 12 inches above root crown with 5 mL of a 5% v/v solution of this product.

Hogweed, Giant (*Heracleum mantegazzianum*)

Inject one leaf cane per plant 12 inches above root crown with 5 mL of a 5% v/v solution of this product.

Horsetail, Field (*Equisetum arvense*)

Inject one segment above the root crown with 0.5 mL/stem of this product. Use a small syringe that calibrates to this rate.

Iris, Yellow Flag (*Iris pseudocorus*)

Cut flower stems with clippers 8 to 9 inches above the root crown. Use a cavity needle that is pushed into the stem center and then slowly removed as 0.5 mL/stem of this product is injected into the stem.

Knotweed, Bohemian (*Polygonum bohemicum*),

Knotweed, Giant (*Polygonum sachalinense*), and

Knotweed, Japanese (*Polygonum cuspidatum*)

Inject 5 mL/stem of this product between second and third internode.

Reed, Giant (*Arundo donax*)

Inject 6 mL/stem of this product between second and third internode.

Thistle, Canada (*Cirsium arvense*)

Cut 8 to 9 of the tallest plants at bud stage in a clump with clippers. Use a cavity needle that is pushed into the stem center and then slowly removed as 0.5 mL/stem of this product is injected into the stem.

NOTE: Based on the maximum annual use rate of glyphosate for these non-crop sites, the combined total for all treatments must not exceed 8 quarts of this product per acre. At 5 mL per stem, 8 quarts should treat approximately 1500 stems.

8.3 Cut Stump

Cut stump treatments may be made on any site listed on this label. This product will control many types of woody brush and tree species. Apply this product using suitable equipment to ensure coverage of the entire cambium. Cut trees or resprouts close to the soil surface. Apply a 50- to 100-percent solution of this product to the freshly-cut surface immediately after cutting. Delays in application may result in reduced performance. For best results, applications should be made during periods of active growth and full leaf expansion.

For control of *Ailanthus altissima* (Tree-of-heaven) make a cut stump treatment according to the directions in this section using a spray mixture of 50 percent AquaMaster herbicide and 10 percent Arsenal.

DO NOT MAKE CUT STUMP APPLICATIONS WHEN THE ROOTS OF DESIRABLE WOODY BRUSH OR TREES MAY BE GRAFTED TO THE ROOTS OF THE CUT STUMP. Some sprouts, stems, or trees may share the same root system. Adjacent trees having a similar age, height and spacing may signal shared roots. Whether grafted or shared, injury is likely to occur to non-treated stems/trees when one or more trees sharing common roots are treated.

8.4 General Non-crop Areas and Industrial Sites

Use in areas such as airports, apartment complexes, commercial sites, ditch banks, driveways, dry ditches, dry canals, fencerows, forestry sites, golf courses, greenhouses, industrial sites, lumber yards, manufacturing sites, municipal sites, natural areas, office complexes, ornamentals, parks, parking areas, pastures, petroleum tank farms and pumping installations, railroads, rangeland, recreational areas, residential areas, rights-of-way, roadsides, schools, sod or turf seed farms, sports complexes, storage areas, substations, utility sites, warehouse areas, and wildlife management areas.

General Weed Control, Trim-and-Edge and Bare Ground

This product may be used in general non-crop areas. It may be applied with any application equipment described in this label. This product may be used to trim-and-edge around objects in non-crop sites, for spot treatment of unwanted vegetation and to eliminate unwanted weeds growing in established shrub beds or ornamental plantings. This product may be used prior to planting an area to ornamentals, flowers, turfgrass (sod or seed), or prior to laying asphalt or beginning construction projects.

Repeated applications of this product may be used, as weeds emerge, to maintain bare ground.

TANK MIXTURES: This product may be tank mixed with the following products. Refer to these product labels for approved non-crop sites and application rates. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive precautionary statements for each product in the mixture.

Arsenal	Outrider®
Barricade 65WG	Pendulum 3.3 EC
Certainty®	Pendulum WDG
diuron*	Plateau
Endurance	Princep DF
Escort XP	Princep Liquid
Garlon 3A	Ronstar 50 WP
Garlon 4	Sahara
Hyvar X	simazine*
Karmex	Surflan
Krovar I DF	Telar
Oust XP	2,4-D*

*User is responsible for ensuring that tank mixtures with products containing this generic active ingredient may be made provided the specific product is registered for this use.

This product plus dicamba tank mixtures may not be applied by air in California.

Brush Control Tank Mixtures

TANK MIXTURES: Tank mixtures of this product may be used to increase the spectrum of control for herbaceous weeds, woody brush and trees. When tank mixing, read and carefully observe the label claims, cautionary statements and all information on the labels of all products used. Use according to the most restrictive precautionary statements for each product in the mixture. Any labeled rate of this product may be used in a tank mix.

For control of herbaceous weeds, use the lower tank mixture rates. For control of dense stands or tough-to-control woody brush and trees, use the higher rates.

NOTE: For side trimming treatments, this product may be used alone or in tank mixture with Garlon 4.

PRODUCT

Arsenal
Escort XP
Garlon 3A*
Garlon 4

*Ensure that Garlon 3A is thoroughly mixed with water according to label directions before adding this product. Have spray mixture agitating at the time this product is added to avoid spray compatibility problems.

8.5 Habitat Management

Habitat Restoration and Management

This product may be used to control exotic and other undesirable vegetation in habitat management and natural areas, including riparian and estuarine areas, rangeland and wildlife refuges. Applications can be made to allow recovery of native plant species, prior to planting desirable native species, and for similar broad-spectrum vegetation control requirements. Spot treatments can be made to selectively remove unwanted plants for habitat management and enhancement.

Wildlife Food Plots

This product may be used as a site preparation treatment prior to planting wildlife food plots. Any wildlife food species may be planted after applying this product, or native species may be allowed to repopulate the area. If tillage is needed to prepare a seedbed, wait 7 days after application before tillage to allow translocation into underground plant parts.

8.6 Injection and Frill (Woody Brush and Trees)

This product may be used to control woody brush and trees by injection or frill applications. Apply this product using suitable equipment that must penetrate into the living tissue. Apply 1 mL of this product per each 2 to 3 inches of trunk diameter at breast height (DBH). This is best achieved by applying a 50- to 100-percent concentration of this product either to a continuous frill around the tree or as cuts evenly spaced around the tree below all branches. As tree diameter increases in size, better results are achieved by applying diluted material to a continuous frill or more closely spaced cuttings. Avoid application techniques that allow runoff to occur from frilled or cut areas in species that exude sap freely. In species such as this, make the frill or cuts at an oblique angle to produce a cupping effect and use a 100-percent concentration of this product. For best results, application should be made during periods of active growth and after full leaf expansion.

8.7 Roadsides

All of the instructions in the "General Non-Crop Areas and Industrial Sites" section apply to roadsides.

Shoulder Treatments

This product may be used on road shoulders. It may be applied with boom sprayers, shielded boom sprayers, high-volume off-center nozzles, hand-held equipment, and similar equipment.

Guardrails and Other Obstacles to Mowing

This product may be used to control weeds growing under guardrails and around signposts and other objects along the roadside.

Spot Treatment

This product may be used as a spot treatment to control unwanted vegetation growing along roadsides.

TANK MIXTURES: This product may be tank mixed with the following products for shoulder, guardrail, spot and bare ground treatments, provided that the specific tank mixture product is registered for use on such sites. Refer to these product labels for approved non-crop sites and application rates. Read and carefully observe the cautionary statements and all other information appearing on the labels of all herbicides used. Use according to the most restrictive precautionary statements for each product in the mixture.

atrazine*	Landmark MP	Sahara DG
Crossbow L	Landmark XP	simazine*
dicamba*	Oust XP	Surflan AS
diuron*	Outrider	Surflan WDG
Endurance	pendimethalin*	Telar DF
Escort XP	Plateau	Velpar DF
Gallery 75 DF	Plateau DG	Velpar L
Krovar I DF	Poast	2,4-D*
Landmark II MP	Ronstar 50 WSP	

*User is responsible for ensuring that tank mixtures with products containing this generic active ingredient may be made provided the specific product is registered for this use.

See the "MIXING" section of this label for general instructions for tank mixing.

Release of Bermudagrass or Bahiagrass

Dormant Applications

This product may be used to control or partially control many winter annual weeds and tall fescue for effective release of dormant bermudagrass or bahiagrass. Treat only when turf is dormant and prior to spring greenup. This product may also be tank mixed with Outrider herbicide or Oust XP for residual control. Tank mixtures of this product with Oust XP may delay greenup.

For best results on winter annuals, treat when plants are in an early growth stage (below 6 inches in height) after most have germinated. For best results on tall fescue, treat when fescue is at or beyond the 4- to 6-leaf stage.

Apply 6 to 48 ounces of this product in a tank mixture with 0.75 to 1.33 ounces Outrider herbicide per acre. Read and follow all label directions for Outrider herbicide.

TANK MIXTURES: Apply 6 to 48 fluid ounces of this product per acre alone or in a tank mixture with 0.25 to 1 ounce per acre of Oust XP. Apply the labeled rates in 10 to 40 gallons of water per acre. Use only in areas where bermudagrass or bahiagrass are desirable ground covers and where some temporary injury or discoloration can be tolerated. To avoid delays in greenup and minimize injury, add no more than 1 ounce of Oust XP per acre on bermudagrass and no more than 0.5 ounce of Oust XP per acre on bahiagrass and avoid treatments when these grasses are in a semi-dormant condition.

Actively Growing Bermudagrass

This product may be used to control or partially control many annual and perennial weeds for effective release of actively growing bermudagrass. Apply 12 to 36 fluid ounces of this product in 10 to 40 gallons of spray solution per acre. Use the lower rate when treating annual weeds below 6 inches in height (or runner length). Use the higher rate as weeds increase in size or as they approach flower or seedhead formation. These rates will also provide partial control of the following perennial species:

Bahiagrass	Johnsongrass
Bluestem, silver	Trumpetcreeper
Fescue, tall	Vaseygrass

This product may be tank mixed with Outrider herbicide for control or partial control of Johnsongrass and other weeds listed in the Outrider herbicide label. Use 6 to 24 ounces of this product with 0.75 to 1.33 ounces of Outrider herbicide. Use the higher rates of both products for control of perennial weeds or annual weeds greater than 6 inches in height.

TANK MIXTURES: This product may be tank mixed with Oust XP. If tank mixed, use no more than 12 to 24 fluid ounces of this product with 1 to 2 ounces of Oust XP per acre. Use the lower rates of each product to control annual weeds less than 6 inches in height (or runner length) that are listed in this label and the Oust XP label. Use the higher rates as annual weeds increase in size and approach the flower or seedhead stages. These rates will also provide partial control of the following perennial weeds:

Bahiagrass	Fescue, tall
Bluestem, silver	Johnsongrass
Broomsedge	Poorjoe
Dallisgrass	Trumpetcreeper
Dock, curly	Vaseygrass
Dogfennel	Vervain, blue

Use only on well-established bermudagrass. Bermudagrass injury may result from the treatment, but regrowth will occur under moist conditions. Repeat applications of the tank mix in the same season are not recommended, since severe injury may occur.

Actively Growing Bahiagrass

For suppression of vegetative growth and seedhead inhibition of bahiagrass for approximately 45 days, apply 4 fluid ounces of this product in 10 to 40 gallons of water per acre. Apply 1 to 2 weeks after full greenup or after mowing to a uniform height of 3 to 4 inches. This application must be made prior to seedhead emergence.

For suppression up to 120 days, apply 3 fluid ounces of this product per acre, followed by an application of 2 to 3 fluid ounces per acre about 45 days later. Make no more than 2 applications per year.

This product may be used for control or partial control of Johnsongrass and other weeds listed on the Outrider herbicide label in actively growing bahiagrass. Apply 1.5 to 3.5 fluid ounces of this product with 0.75 to 1.33 ounces of Outrider herbicide per acre. Use the higher rates for control of perennial weeds or annual weeds greater than 6 inches in height. Use only on well established bahiagrass.

TANK MIXTURES: A tank mixture of this product plus Oust XP may be used. Apply 4 fluid ounces of this product plus 0.25 ounce of Oust XP per acre 1 to 2 weeks following an initial spring mowing. Make only one application per year.

9.0 WEEDS CONTROLLED

Always use the higher rate of this product per acre within the labeled range when weed growth is heavy or dense or weeds are growing in an undisturbed (non-cultivated) area.

Reduced results may occur when treating weeds heavily covered with dust. For weeds that have been mowed, grazed or cut, allow regrowth to occur prior to treatment.

Refer to the following label sections for application rates for the control of annual and perennial weeds and woody brush and trees. For difficult to control perennial weeds and woody brush and trees, where plants are growing under stressed conditions, or where infestations are dense, this product may be used at 4.5 to 8 quarts per acre for enhanced results.

9.1 Annual Weeds

Apply to actively growing annual grasses and broadleaf weeds.

Allow at least 3 days after application before disturbing treated vegetation. After this period the weeds may be mowed, tilled or burned. See the "GENERAL INFORMATION" and "MIXING" and "APPLICATION EQUIPMENT AND TECHNIQUES" sections for labeled uses and specific application instructions.

Use 1.5 pints per acre if weeds are less than 6 inches in height or runner length and 1 to 4 quarts per acre if weeds are over 6 inches in height or runner length or when weeds are growing under stressed conditions.

For spray-to-wet applications, apply a 0.5-percent solution of this product to weeds less than 6 inches in height or runner length. Apply prior to seedhead formation in grass or bud formation in broadleaf weeds. For annual weeds over 6 inches tall, or for smaller weeds growing under stressed conditions, use a 0.75- to 1.5-percent solution. Use the higher rate for tough-to-control species or for weeds over 24 inches tall.

WEED SPECIES

Anoda, spurred	Lamb's-quarters*
Balsamapple**	Lettuce, prickly*
Barley*	Mannagrass, eastern*
Barley, little*	Mayweed
Barnyardgrass*	Medusahead*
Bassia, fivehook	Morningglory (<i>Ipomoea spp</i>)
Bittercress*	Mustard, blue*
Bluegrass, annual*	Mustard, tansy*
Bluegrass, bulbous*	Mustard, tumble*
Brome, downy*	Mustard, wild*
Brome, Japanese*	Nightshade, black*
Broomsedge	Oats
Buttercup*	Panicum, browntop*
Castorbean	Panicum, fall*
Cheatgrass*	Panicum, Texas*
Cheeseweed (<i>Malva parviflora</i>)	Pennycress, field*
Chervil*	Pepperweed, Virginia*
Chickweed*	Pigweed*
Cocklebur*	Puncturevine
Copperleaf, hophornbeam	Purslane, common
Copperleaf, Virginia	Pusley, Florida
Coreopsis, plains/tickseed*	Ragweed, common*
Corn*	Ragweed, giant
Crabgrass*	Rice, red
Cupgrass, woolly*	Rocket, London*
Dwarfdandelion*	Rocket, yellow
Eclipta*	Rye*
Falsedandelion*	Ryegrass*
Falseflax, smallseed*	Sandbur, field*
Fiddleneck	Sesbania, hemp
Filaree	Shattercane*
Fleabane, annual*	Shepherd's-purse*
Fleabane, hairy (<i>Conyza bonariensis</i>)*	Sicklepod
Fleabane, rough*	Signalgrass, broadleaf*
Foxtail*	Smartweed, ladysthumb*
Foxtail, Carolina*	Smartweed, Pennsylvania*
Geranium, Carolina	Sorghum, grain (milo)*
Goatgrass, jointed*	Sowthistle, annual
Goosegrass	Spanishneedles***
Groundsel, common*	Speedwell, corn*
Henbit	Speedwell, purslane*
Horseweed/Marestail (<i>Conyza canadensis</i>)	Sprangletop*
Itchgrass*	Spurge, annual
Johnsongrass, seedling	Spurge, prostrate*
Junglerice	Spurge, spotted*
Knotweed	Spurry, umbrella*
Kochia	Starthistle, yellow
	Stinkgrass*
	Sunflower*
	Teaweed/prickly sida

Thistle, Russian	Wild oats*
Velvetleaf	Witchgrass
Wheat*	

*When using field broadcast equipment (aerial applications or boom sprayers using flat-fan nozzles) these species will be controlled or partially controlled using 12 fluid ounces of this product per acre. Applications must be made using 3 to 10 gallons of carrier volume per acre. Use nozzles that ensure thorough coverage of foliage and treat when weeds are in an early growth stage.

**Apply with hand-held equipment only.

***Apply 3 pints of this product per acre.

9.2 Perennial Weeds

Best results are obtained when perennial weeds are treated after they reach the reproductive stage of growth (seedhead initiation in grasses and bud formation in broadleaves). For non-flowering plants, best results are obtained when the plants reach a mature stage of growth. In many situations, treatments are required prior to these growth stages. Under these conditions, use the higher application rate within the labeled range.

Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment. When using hand-held equipment for low-volume directed spot treatments, apply a 4- to 8-percent solution of this product.

Allow 7 or more days after application before tillage. If weeds have been mowed or tilled, do not treat until regrowth has reached the specified stages. Fall treatments must be applied before a killing frost.

Repeat treatments may be necessary to control weeds regenerating from underground parts or seed.

WEED SPECIES	RATE (QT/A)	HAND-HELD % SOLUTION
Alfalfa*	0.7	1.5
Alligatorweed*	3.0	1.3
Anise (fennel)	1.5 - 3.0	1.0 - 1.5
Bahiagrass	2.3 - 3.75	1.5
Beachgrass, European (<i>Ammophila arenaria</i>)	-	3.5
Bentgrass*	1.0	1.5
Bermudagrass	4.0	1.5
Bermudagrass, water (knotgrass)	1.0	1.5
Bindweed, field	3.0 - 3.75	1.5
Bluegrass, Kentucky	1.5 - 2.3	0.75
Blueweed, Texas	3.0 - 3.75	1.5
Brackenfern	2.3 - 3.0	0.75 - 1.0
Bromegrass, smooth	1.5 - 2.3	0.75
Bursage, woolly-leaf	-	1.5
Canarygrass, reed	1.5 - 2.3	0.75
Cattail	2.3 - 3.75	0.75
Clover, red, white	2.3 - 3.75	1.5
Cogongrass	2.3 - 3.75	1.5
Cordgrass	2.3 - 3.75	1.0 - 2.0
Cutgrass, giant	3.0	1.0
Dallisgrass	2.3 - 3.75	1.5
Dandelion	2.3 - 3.75	1.5
Dock, curly	2.3 - 3.75	1.5
Dogbane, hemp	3.0	1.5
Fescue (except tall)	2.3 - 3.75	1.5
Fescue, tall	2.3	1.0
Guineagrass	2.3	0.75
Hemlock, poison	1.5 - 3.0	0.75 - 1.5
Horsenettle	2.3 - 3.75	1.5
Horseradish	3.0	1.5
Iceplant	1.5	1.5
Ivy; German, cape	1.5 - 3.0	0.75 - 1.5
Jerusalem artichoke	2.3 - 3.75	1.5
Johnsongrass	1.5 - 2.3	0.75
Kikuyugrass	1.5 - 2.3	0.75
Knapweed	3.0	1.5
Lantana	-	0.75 - 1.0
Lespedeza	2.3 - 3.75	1.5
Loosestrife, purple	2.0	1.0 - 1.5
Lotus, American	2.0	0.75
Maidencane	3.0	0.75
Milkweed, common	2.3	1.5
Muhly, wirestem	1.5 - 2.3	0.75
Mullein, common	2.3 - 3.75	1.5
Napiergrass	2.3 - 3.75	1.5
Nightshade, silverleaf	3.0 - 3.75	1.5
Nutsedge; purple, yellow	2.3	0.75
Orchardgrass	1.5 - 2.3	0.75
Pampasgrass	2.3 - 3.75	1.5

WEED SPECIES	RATE (QT/A)	HAND-HELD % SOLUTION
Paragrass	3.0	0.75
Pepperweed, perennial	3.0	1.5
Phragmites*	2.0 - 3.75	0.75 - 1.5
Quackgrass	1.5 - 2.3	0.75
Redvine*	1.5	1.5
Reed, giant (<i>Arundo donax</i>)	3.0 - 3.75	1.5
Ryegrass, perennial	1.5 - 2.3	0.75
Salvinia, giant	3.0 - 3.75	2.0
Smartweed, swamp	2.3 - 3.75	1.5
Spatterdock	3.0	0.75
Spurge, leafy*	-	1.5
Starthistle, yellow	-	1.5
Sweet potato, wild*	-	1.5
Thistle, artichoke	1.5 - 2.3	2.0
Thistle, Canada	1.5 - 2.3	1.5
Timothy	1.5 - 2.3	1.5
Torpedograss*	3.0 - 3.75	0.75 - 1.5
Trumpet creeper*	1.5 - 2.3	1.5
Tules, common	-	1.5
Vaseygrass	2.3 - 3.75	1.5
Velvetgrass	2.3 - 3.75	1.5
Waterhyacinth	2.5 - 3.0	0.75 - 1.0
Waterlettuce	-	0.75 - 1.0
Waterprimrose	-	0.75
Wheatgrass, western	1.5 - 2.3	0.75

*Partial control

Alligatorweed—Apply 3 quarts of this product per acre as a broadcast spray or as a 1.3-percent solution with hand-held equipment to provide partial control of alligatorweed. Apply when most of the target plants are in bloom. Repeat applications will be required to maintain such control.

Beachgrass, European—Apply an 8-percent solution of this products plus 0.5- to 1.5-percent nonionic surfactant on a low-volume spray-to-wet basis. Best results are obtained when applications are made when European beachgrass is actively growing through the boot to the full heading stages of growth. Make applications prior to the loss of more than 50 percent green leaf color in the fall. Do not treat when weeds are under drought stress. Repeat applications may be necessary.

Bermudagrass—Apply 4 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and when seed heads appear.

Bindweed, field / Silverleaf Nightshade / Texas Blueweed—Apply 3 to 3.75 quarts of this product per acre as a broadcast spray west of the Mississippi River and 2.3 to 3 quarts of this product per acre east of the Mississippi River. With hand-held equipment, use a 1.5-percent solution. Apply when target plants are actively growing and are at or beyond full bloom. For silverleaf nightshade, best results can be obtained when application is made after berries are formed. Do not treat when weeds are under drought stress. New leaf development indicates active growth. For best results apply in late summer or fall.

Brackenfern—Apply 2.3 to 3 quarts of this product per acre as a broadcast spray or as a 0.75- to 1-percent solution with hand-held equipment. Apply to fully expanded fronds which are at least 18 inches long.

Cattail—Apply 2.3 to 3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and are at or beyond the early-to-full bloom stage of growth. Best results are achieved when application is made during the summer or fall months.

Cogongrass—Apply 2.3 to 3.75 quarts of this product per acre as a broadcast spray. Apply when cogongrass is at least 18 inches tall and actively growing in late summer or fall. Allow 7 or more days after application before tillage or mowing. Due to uneven stages of growth and the dense nature of vegetation preventing good spray coverage, repeat treatments may be necessary to maintain control.

Cordgrass—Apply 2.3 to 3.75 quarts of this product per acre as a broadcast spray or as a 1- to 2-percent solution with hand-held equipment. Schedule applications in order to allow 6 hours before treated plants are covered by tidewater. The presence of debris and silt on the cordgrass plants will reduce performance. It may be necessary to wash targeted plants prior to application to improve uptake of this product into the plant.

Cutgrass, giant—Apply 3 quarts of this product per acre as a broadcast spray or as a 1-percent solution with hand-held equipment to provide partial control of giant cutgrass. Repeat applications will be required to maintain such control, especially where vegetation is partially submerged in water. Allow for substantial regrowth to the 7- to 10-leaf stage prior to retreatment.

Dogbane, hemp / Knapweed / Horseradish—Apply 3 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth. For best results, apply in late summer or fall.

Fescue, tall—Apply 2.3 quarts of this product per acre as a broadcast spray or as a 1-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained.

Guineagrass—Apply 2.3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and when most have reached at least the 7-leaf stage of growth.

Johnsongrass / Bluegrass, Kentucky / Bromegrass, smooth / Canarygrass, reed / Orchardgrass / Ryegrass, perennial / Timothy / Wheatgrass, western—Apply 1.5 to 2.3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the boot-to-head stage of growth. When applied prior to the boot stage, less desirable control may be obtained. In the fall, apply before plants have turned brown.

Lantana—Apply this product as a 0.75- to 1-percent solution with hand-held equipment. Apply to actively growing lantana at or beyond the bloom stage of growth. Use the higher application rate for plants that have reached the woody stage of growth.

Loosestrife, purple—Apply 2 quarts of this product per acre as a broadcast spray or as a 1- to 1.5-percent solution using hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost.

Lotus, American—Apply 2 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Treat when plants are actively growing at or beyond the bloom stage of growth. Best results are achieved when application is made during summer or fall months. Fall treatments must be applied before a killing frost. Repeat treatment may be necessary to control regrowth from underground parts and seeds.

Maidencane / Paragrass—Apply 3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Repeat treatments will be required, especially to vegetation partially submerged in water. Under these conditions, allow for regrowth to the 7- to 10-leaf stage prior to retreatment.

Milkweed, common—Apply 2.3 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached the late bud-to-flower stage of growth.

Nutsedge, purple, yellow—Apply 2.3 quarts of this product per acre as a broadcast spray, or as a 0.75-percent solution with hand-held equipment to control existing nutsedge plants and immature outlets attached to treated plants. Apply when target plants are in flower or when new outlets can be found at rhizome tips. Outlets which have not germinated will not be controlled and may germinate following treatment. Repeat treatments will be required for long-term control.

Pampasgrass—Apply a 1.5-percent solution of this product with hand-held equipment when plants are actively growing.

Phragmites—For partial control of phragmites in Florida and the counties of other states bordering the Gulf of Mexico, apply 3.75 quarts per acre as a broadcast spray or apply a 1.5-percent solution with hand-held equipment. In other areas of the U.S., apply 2 to 3 quarts per acre as a broadcast spray or apply a 0.75-percent solution with hand-held equipment for partial control. For best results, treat during late summer or fall months when plants are actively growing and in full bloom. Due to the dense nature of the vegetation, which may prevent good spray coverage and uneven stages of growth, repeat treatments may be necessary to maintain control. Visual control symptoms will be slow to develop.

Quackgrass / Kikuyugrass / Muhly, wirestem—Apply 1.5 to 2.3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment when most quackgrass or wirestem muhly is at least 8 inches in height (3- to 4-leaf stage of growth) and actively growing. Allow 3 or more days after application before tillage.

Reed, giant / Ice Plant—For control of giant reed and ice plant, apply a 1.5-percent solution of this product with hand-held equipment when plants are actively growing. For giant reed, best results are obtained when applications are made in late summer to fall.

Salvinia, giant—Apply as a 2.0% v/v spray-to-wet solution with 0.5 to 2.0% v/v of a nonionic surfactant containing at least 70% active ingredient. For broadcast applications, apply 3 to 3.75 quarts of this product with an aquatic approved surfactant system containing 0.1% v/v nonionic organosilicone and 0.25% v/v nonionic spreader sticker surfactant in 3 to 40 gallons per acre as a broadcast treatment.

Spatterdock—Apply 3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Apply when most plants are in full bloom. For best results, apply during the summer or fall months.

Sweet potato, wild—Apply this product as a 1.5-percent solution using hand-held equipment. Apply to actively growing weeds that are at or beyond the bloom stage of growth. Repeat applications will be required. Allow the plant to reach the specified stage of growth before retreatment.

Thistle, Canada, artichoke—Apply 1.5 to 2.3 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment for Canada thistle. To control artichoke thistle, apply a 2-percent solution as a spray-to-wet application. Apply when target plants are actively growing and are at or beyond the bud stage of growth.

Torpedograss—Apply 3 to 3.75 quarts of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment to provide partial control of torpedograss. Use the lower rates under terrestrial conditions, and the higher rates under partially submerged or a floating mat condition. Repeat treatments will be required to maintain such control.

Tules, common—Apply this product as a 1.5-percent solution with hand-held equipment. Apply to actively growing plants at or beyond the seedhead stage of growth.

After application, visual symptoms will be slow to appear and may not occur for 3 or more weeks.

Waterhyacinth—Apply 2.5 to 3 quarts of this product per acre as a broadcast spray or apply a 0.75- to 1-percent solution with hand-held equipment. Apply when target plants are actively growing and at or beyond the early bloom stage of growth. After application, visual symptoms may require 3 or more weeks to appear with complete necrosis and decomposition usually occurring within 60 to 90 days. Use the higher rates when more rapid visual effects are desired.

Waterlettuce—For control, apply a 0.75- to 1-percent solution of this product with hand-held equipment to actively growing plants. Use higher rates where infestations are heavy. Best results are obtained from mid-summer through winter applications. Spring applications may require retreatment.

Waterprimrose—Apply this product as a 0.75-percent solution using hand-held equipment. Apply to plants that are actively growing at or beyond the bloom stage of growth, but before fall color changes occur. Thorough coverage is necessary for best control.

Other perennials listed on this label—Apply 2.3 to 3.75 quarts of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment. Apply when target plants are actively growing and most have reached early head or early bud stage of growth.

9.3 Woody Brush and Trees

Apply this product after full leaf expansion, unless otherwise directed. Use the higher rate for larger plants and/or dense areas of growth. On vines, use the higher rate for plants that have reached the woody stage of growth. Best results are obtained when application is made in late summer or fall after fruit formation.

In arid areas, best results are obtained when applications are made in the spring to early summer when brush species are at high moisture content and are flowering.

Ensure thorough coverage when using spray-to-wet treatments using hand-held equipment. When using hand-held equipment for low-volume directed-spray spot treatments, apply a 4- to 8-percent solution of this product.

Symptoms may not appear prior to frost or senescence with fall treatments.

Allow 7 or more days after application before tillage, mowing or removal. Repeat treatments may be necessary to control plants regenerating from underground parts or seed. Some autumn colors on undesirable deciduous species are acceptable provided no major leaf drop has occurred. Reduced performance may result if fall treatments are made following a frost.

WEED SPECIES	BROADCAST RATE (QT/A)	HAND-HELD SPRAY-TO-WET % SOLUTION
Alder	2.3-3.0	0.75-1.2
Ash*	1.5-3.75	0.75-1.5
Aspen, quaking	1.5-2.3	0.75-1.2
Bearclover (Bearnat)*	1.5-3.75	0.75-1.5
Beech*	1.5-3.75	0.75-1.5
Birch	1.5	0.75
Blackberry	2.3-3.0	0.75-1.2
Blackgum	1.5-3.75	0.75-1.5
Bracken	1.5-3.75	0.75-1.5
Broom; French, Scotch	1.5-3.75	1.2-1.5
Buckwheat, California*	1.5-3.0	0.75-1.5
Cascara*	1.5-3.75	0.75-1.5
Castorbean	-	1.5
Catsclaw*	-	1.2-1.5
Ceanothus*	1.5-3.75	0.75-1.5
Chamise*	1.5-3.75	0.75
Cherry; bitter, black, pin	1.5-3.75	1.0-1.5
Cottonwood, eastern	1.5-3.75	0.75-1.5
Coyote brush	2.3-3.0	1.2-1.5
Cypress; swamp, bald	1.5-3.75	0.75-1.5
Deerweed	1.5-3.75	0.75-1.5
Dewberry	2.3-3.0	0.75-1.2
Dogwood*	3.0-3.75	1.0-2.0
Elderberry	1.5	0.75
Elm*	1.5-3.75	0.75-1.5
Eucalyptus	-	1.5
Gallberry	1.5-3.75	0.75-1.5
Gorse*	1.5-3.75	0.75-1.5
Hackberry, western	1.5-3.75	0.75-1.5
Hasardia*	1.5-3.0	0.75-1.5
Hawthorn	1.5-2.3	0.75-1.2
Hazel	1.5	0.75
Hickory*	3.0-3.75	1.0-2.0
Honeysuckle	2.3-3.0	0.75-1.2
Hornbeam, American*	1.5-3.75	0.75-1.5
Huckleberry	1.5-3.75	0.75-1.5
Ivy, poison	3.0-3.75	1.5

Knotweed; Bohemian, Giant, Japanese**	-	-
Kudzu	3.0	1.5
Locust, black*	1.5-3.0	0.75-1.5
Madrone resprouts*	-	1.5
Magnolia, sweetbay	1.5-3.75	0.75-1.5
Manzanita*	1.5-3.75	0.75-1.5
Maple, red	1.0-3.75	0.75-1.2
Maple, sugar	-	0.75-1.2
Maple, vine*	1.5-3.75	0.75-1.5
Monkey flower*	1.5-3.0	0.75-1.5
Oak; black, white*	1.5-3.0	0.75-1.5
Oak; northern, pin	1.5-3.0	0.75-1.2
Oak, poison	3.0-3.75	1.5
Oak, post	2.3-3.0	0.75-1.2
Oak, red	-	0.75-1.2
Oak, scrub*	1.5-3.0	0.75-1.5
Oak, southern red	1.5-3.75	1.0-1.5
Orange, Osage	1.5-3.75	0.75-1.5
Peppertree, Brazilian (Florida holly)*	1.5-3.75	1.5
Persimmon*	1.5-3.75	0.75-1.5
Pine	1.5-3.75	0.75-1.5
Poplar, yellow*	1.5-3.75	0.75-1.5
Prunus	1.5-3.75	1.0-1.5
Raspberry	2.3-3.0	0.75-1.2
Redbud, eastern	1.5-3.75	0.75-1.5
Redcedar, eastern	1.5-3.75	0.75-1.5
Rose, multiflora	1.5	0.75
Russian olive*	1.5-3.75	0.75-1.5
Sage, black	1.5-3.0	0.75
Sage, white*	1.5-3.0	0.75-1.5
Sage brush, California	1.5-3.0	0.75
Salmonberry	1.5	0.75
Saltbush	-	1.0
Saltcedar**	1.5-3.75	0.75-1.5
Sassafras*	1.5-3.75	0.75-1.5
Sea Myrtle	-	1.0
Sourwood*	1.5-3.75	0.75-1.5
Sumac; laurel, poison, smooth, sugarbush, winged*	1.5-3.0	0.75-1.5
Sweetgum	1.5-2.3	0.75-1.5
Swordfern*	1.5-3.75	0.75-1.5
Tallowtree, Chinese	-	0.75
Tan oak resprouts*	-	1.5
Thimbleberry	1.5	0.75
Tobacco, tree*	1.5-3.0	0.75-1.5
Toyon*	-	1.5
Trumpetcreeper	1.5-2.3	0.75-1.2
Vine maple*	1.5-3.75	0.75-1.5
Virginia creeper	1.5-3.75	0.75-1.5
Waxmyrtle, southern*	1.5-3.75	1.5
Willow	2.3	0.75
Yerba Santa, California*	-	1.5

*Partial control

**Refer to specific instructions below

Alder / Blackberry / Dewberry / Honeysuckle / Oak, Post / Raspberry—For control, apply 2.3 to 3 quarts per acre as a broadcast spray or as a 0.75- to 1.2-percent solution with hand-held equipment.

Aspen, Quaking / Hawthorn / Trumpetcreeper—For control, apply 1.5 to 2.3 quarts of this product per acre as a broadcast spray or as a 0.75- to 1.2-percent solution with hand-held equipment.

Birch / Elderberry / Hazel / Salmonberry / Thimbleberry—For control, apply 1.5 quarts per acre of this product as a broadcast spray or as a 0.75-percent solution with hand-held equipment.

Broom: French, Scotch—For control, apply a 1.2- to 1.5-percent solution with hand-held equipment.

Buckwheat, California / Hasardia / Monkey Flower / Tobacco, Tree—For partial control of these species, apply a 0.75- to 1.5-percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Castorbean—For control, apply a 1.5-percent solution of this product with hand-held equipment.

Catsclaw—For partial control, apply a 1.2- to 1.5-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Cherry: Bitter, Black, Pin / Oak, Southern Red / Sweet Gum / Prunus—For control, apply 1.5 to 3.75 quarts of this product per acre as a broadcast spray or as a 1- to 1.5-percent solution with hand-held equipment.

Coyote brush—For control, apply a 1.2- to 1.5-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Dogwood / Hickory—For partial control, apply a 1- to 2-percent solution of this product with hand-held equipment or 3 to 3.75 quarts per acre as a broadcast spray.

Eucalyptus, Bluegum—For control of eucalyptus resprouts, apply a 1.5-percent solution of this product with hand-held equipment when resprouts are 6- to 12-feet tall. Ensure complete coverage. Apply when plants are actively growing. Avoid application to drought-stressed plants.

Knottweed: Bohemian, Giant, Japanese (*Polygonum bohemicum*, *P. sachalinense* and *P. cuspidatum*)

Stem Injection. See the "Hollow Stem Injection" section of this label.

Cut Stem. Cut stems cleanly just below the 2nd or 3rd node above the ground. Immediately apply 0.36 fluid ounce (10 mLs) of a 50-percent solution of this product into the 'well' or remaining internode. Ensure that removed upper plant material is carefully gathered and discarded so that it will not contact soil and regenerate plants from sprouting buds. Use of a bio-barrier such as cardboard, plywood or plastic sheeting is recommended.

The combined total for all treatments must not exceed 8 quarts per acre. At 10 mL of a 50-percent solution, approximately 1500 stems per acre may be treated.

Kudzu—For control, apply 3 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Repeat applications will be required to maintain control.

Maple, Red—For control, apply as a 0.75- to 1.2-percent solution with hand-held equipment when leaves are fully developed. For partial control, apply 1 to 3.75 quarts of this product per acre as a broadcast spray.

Maple, Sugar / Oak: Northern, Pin, Red—For control, apply as a 0.75- to 1.2-percent solution with hand-held equipment when at least 50 percent of the new leaves are fully developed.

Peppertree, Brazilian (Holly, Florida) / Waxmyrtle, Southern—For partial control, apply this product as a 1.5-percent solution with hand-held equipment.

Poison Ivy / Poison Oak—For control, apply 3 to 3.75 quarts of this product per acre as a broadcast spray or as a 1.5-percent solution with hand-held equipment. Repeat applications may be required to maintain control. Fall treatments must be applied before leaves lose green color.

Rose, Multiflora—For control, apply 1.5 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment. Treatments should be made prior to leaf deterioration by leaf-feeding insects.

Sage, Black / Sagebrush, California / Chamise / Tallowtree, Chinese—For control of these species, apply a 0.75-percent solution of this product as a foliar spray with hand-held equipment. Thorough coverage of foliage is necessary for best results.

Saltbush, Sea myrtle—For control, apply this product as a 1-percent solution with hand-held equipment.

Saltcedar—For partial control, apply a 1- to 2-percent solution of this product with hand-held equipment or 3 to 3.75 quarts per acre as a broadcast spray. For control, apply a 1- to 2-percent solution of this product mixed with 0.25 percent Arsenal with hand-held equipment. For control using broadcast applications, apply 1.5 quarts of this product in a tank-mix with 1 pint of Arsenal to plants less than 6 feet tall. To control saltcedar greater than 6 feet tall using broadcast applications, apply 3 quarts of this product in a tank-mix with 2 pints of Arsenal.

Willow—For control, apply 2.3 quarts of this product per acre as a broadcast spray or as a 0.75-percent solution with hand-held equipment.

Other woody brush and trees listed in this label—For partial control, apply 1.5 to 3.75 quarts of this product per acre as a broadcast spray or as a 0.75- to 1.5-percent solution with hand-held equipment.

10.0 LIMIT OF WARRANTY AND LIABILITY

Monsanto Company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes set forth in the Complete Directions for Use label booklet ("Directions") when used in accordance with those Directions under the conditions described therein. NO OTHER EXPRESS WARRANTY OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. This warranty is also subject to the conditions and limitations stated herein.

Buyer and all users shall promptly notify this Company of any claims whether based in contract, negligence, strict liability, other tort or otherwise.

To the fullest extent permitted by law, buyer and all users are responsible for all loss or damage from use or handling which results from conditions beyond the control of this Company, including, but not limited to, incompatibility with products other than those set forth in the Directions, application to or contact with desirable vegetation, unusual weather, weather conditions which are outside the range considered normal at the application site and for the time period when the product is applied, as well as weather conditions which are outside the application ranges set forth in the Directions, application in any manner not explicitly set forth in the Directions, moisture conditions outside the moisture range specified in the Directions, or the presence of products other than those set forth in the Directions in or on the soil, crop or treated vegetation.

This Company does not warrant any product reformulated or repackaged from this product except in accordance with this Company's stewardship requirements and with express written permission from this Company.

THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF THE LIABILITY OF THIS COMPANY OR ANY OTHER SELLER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT (INCLUDING CLAIMS BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE) SHALL BE THE PURCHASE PRICE PAID BY THE USER OR BUYER FOR THE QUANTITY OF THIS PRODUCT INVOLVED, OR, AT THE ELECTION OF THIS COMPANY OR ANY OTHER SELLER, THE REPLACEMENT OF SUCH QUANTITY, OR, IF NOT ACQUIRED BY PURCHASE, REPLACEMENT OF SUCH QUANTITY, TO THE FULLEST EXTENT PERMITTED BY LAW, IN NO EVENT SHALL THIS COMPANY OR ANY OTHER SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES.

Upon opening and using this product, buyer and all users are deemed to have accepted the terms of this LIMIT OF WARRANTY AND LIABILITY which may not be varied by any verbal or written agreement. If terms are not acceptable, return at once unopened.

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All other trademarks are the property of their respective owners.

EPA Reg No. 524-343

Packed For:
MONSANTO COMPANY
800 N. LINDBERGH BLVD.
ST. LOUIS, MISSOURI, 63167 U.S.A.
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061709



Habitat®

Herbicide

SPECIMEN



For the control of undesirable vegetation growing within specified aquatic sites and nonirrigation ditchbanks.

Active Ingredient

isopropylamine salt of imazapyr: (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid) 27.77%

Other Ingredients 72.23%

TOTAL 100.0%

¹ Equivalent to 22.6% 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid or 2 pounds acid per gallon.

Keep Out of Reach of Children

CAUTION / PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Refer to inside of label booklet for additional precautionary information and directions for use, including first aid and storage and disposal.

NOTICE: Read the entire label before using. Use only according to label directions. Before buying or using this product, read *Terms and Conditions of Use, Warranty Disclaimer, Inherent Risks of Use* and *Limitation of Remedies* inside label booklet.

Habitat is a registered trademark of BASF Corporation.

Manufactured for: SePRO Corporation 11550 N. Meridian St. EPA Reg. No. 241-426-67690
Suite 600, Carmel, IN 46032 U.S.A. FPL20120613

KEEP OUT OF REACH OF CHILDREN CAUTION/PRECAUCIÓN

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

FIRST AID

If swallowed	<ul style="list-style-type: none"> • Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • DO NOT induce vomiting unless told to do so by a poison control center or doctor. • DO NOT give anything by mouth to an unconscious person.
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HOTLINE NUMBER

Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact INFOTRAC for emergency medical treatment information: 1-800-535-5053.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

CAUTION. Harmful if swallowed

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Some materials that are chemically resistant to this product are listed below. If you want more options, follow the instructions for Category A on an EPA chemical-resistance category selection chart.

Mixers, loaders, applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (except for pilots)
- Shoes plus socks.

Follow manufacturer's instructions for cleaning and maintaining PPE. If no such instructions are given for washables, use detergent and hot water. Keep and wash PPE separately from other laundry. Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. **DO NOT** reuse them.

ENGINEERING CONTROLS

Pilots must use an enclosed cockpit that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240 (d)(6)].

USER SAFETY RECOMMENDATIONS

Users should:

- Wash hands with plenty of soap and water before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

PHYSICAL AND CHEMICAL HAZARDS

Spray solutions of Habitat® herbicide should be mixed, stored and applied only in stainless steel, fiberglass, plastic and plastic-lined steel containers.

Thoroughly clean application equipment, including landing gear, immediately after use of this product. Prolonged exposure of this product to uncoated steel (except stainless steel) surfaces may result in corrosion and failure of the exposed part. The maintenance of an organic coating (paint) may prevent corrosion.

ENVIRONMENTAL HAZARDS

This product is toxic to plants. Drift and runoff may be hazardous to plants in water adjacent to treated areas. **DO NOT** apply to water except as specified in this label. Treatment of aquatic weeds may result in oxygen depletion or loss due to decomposition of dead plants. This oxygen loss may cause the suffocation of some aquatic organisms. **DO NOT** treat more than 1/2 of the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas. **DO NOT** contaminate water when disposing of equipment washwaters or rinsate. See Directions for Use for additional precautions and requirements.

This pesticide is toxic to vascular plants and must be used strictly in accordance with the drift precautions on the label.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Habitat must be used only in accordance with the instructions on the leaflet label attached to the container. Keep containers closed to avoid spills and contamination.

DO NOT apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

NONAGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are **NOT** within the scope of the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Noncrop weed control is not within the scope of the Worker Protection Standard. See the Product Information section of this label for a description of noncrop sites.

DO NOT enter or allow others to enter treated areas until sprays have dried.

STORAGE AND DISPOSAL

DO NOT contaminate water, food or feed by storage or disposal.

Pesticide Storage

DO NOT store below 10° F.

Pesticide Disposal

Wastes resulting from the use of this product must be disposed of on-site or at an approved waste disposal facility.

Container Handling

Nonrefillable Container. DO NOT reuse or refill this container. Triple rinse or pressure rinse container (or equivalent) promptly after emptying; then offer for recycling, if available, or reconditioning, if appropriate, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures approved by state and local authorities.

Triple rinse containers small enough to shake (capacity ≤ 5 gallons) as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank, or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times.

Triple rinse containers too large to shake (capacity >5 gallons) as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank, or store rinsate for later use or disposal. Repeat this procedure two more times.

Pressure rinse as follows: Empty the remaining contents into application equipment or mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank, or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container and rinse at about 40 PSI for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

Refillable Container. Refill this container with pesticide only. **DO NOT** reuse this container for any other purpose. Triple rinsing the container before final disposal is the responsibility of the person disposing of the container. Cleaning before refilling is the responsibility of the refiller.

Triple rinse as follows: To clean the container before final disposal, empty the remaining contents from this container into application equipment or mix tank. Fill the container about 10% full with water. Agitate vigorously or recirculate water with the pump for 2 minutes. Pour or pump rinsate into application equipment or rinsate collection system. Repeat this rinsing procedure two more times.

When this container is empty, replace the cap and seal all openings that have been opened during use; return the container to the point of purchase or to a designated location. This container must only be refilled with a pesticide product. Prior to refilling, inspect carefully for damage such as cracks, punctures, abrasions, worn-out threads and closure devices. Check for leaks after refilling and before transport. **DO NOT** transport if this container is damaged or leaking. If the container is damaged, or leaking, or obsolete and not returned to the point of purchase or to a designated location, triple rinse emptied container and offer for recycling, if available, or dispose of container in compliance with state and local regulations.

IN CASE OF EMERGENCY

In case of large-scale spillage regarding this product, call:

- INFOTRAC 1-800-535-5053

In case of medical emergency regarding this product, call:

- Your local doctor for immediate treatment
- Your local poison control center (hospital)
- INFOTRAC 1-800-535-5053.

Steps to be taken in case material is released or spilled:

- Dike and contain the spill with inert material (sand, earth, etc.) and transfer liquid and solid diking material to separate containers for disposal.
- Remove contaminated clothing and wash affected skin areas with soap and water.
- Wash clothing before reuse.
- Keep the spill out of all sewers and open bodies of water.

PRODUCT USE PRECAUTIONS AND RESTRICTIONS

Applications may be made for the control of undesirable vegetation growing within specified aquatic sites. Aquatic sites consist of standing and flowing water, estuarine/marine, wetland and riparian areas and nonirrigation ditchbanks.

Restrictions

- **DO NOT** use on food crops.
- **DO NOT** apply this product within 1/2 mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 mile of an active potable water intake in a standing body of water, such as a lake, pond or reservoir.
- **DO NOT** apply to water used for irrigation except as described in Product Use Precautions and Restrictions section of this label.
- Keep from contact with fertilizers, insecticides, fungicides and seeds.
- **DO NOT** drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the treated soil may be washed or moved into contact with their roots.
- **DO NOT** side trim desirable vegetation with this product unless severe injury and plant death can be tolerated. Prevent drift of spray to desirable plants.
- Clean application equipment after using this product by thoroughly flushing with water.

Aquatic Sites

- **DO NOT** apply more than 1.5 lbs ae imazapyr (equivalent to 96 fl oz of Habitat® herbicide) per acre per year.
- **Public waters.** Application of Habitat to water can only be made by federal or state agencies, such as Water Management District personnel, municipal officials, and the U.S. Army Corps of Engineers, or those applicators who are licensed or certified as aquatic pest control applicators and are authorized by the state or local government. Treatment to other than non-native invasive species is limited to only those plants that have been determined to be a nuisance by a federal or state government entity.
- **Permitting.** Consult local state fish and game agency and water control authorities before applying this product to public water. Permits may be required to treat such water.
- **Private waters.** Applications may be made to private waters that are still, such as ponds, lakes and drainage ditches where there is minimal or no outflow to public waters.
- **Aerial application.** Aerial application to aquatic sites is restricted to helicopter only.
- **Irrigation water.** Application to water used for irrigation that results in Habitat residues > 1.0 ppb **MUST NOT** be used for irrigation purposes for 120 days after application or until Habitat residue levels are determined by laboratory analysis or other appropriate means of analysis to be 1.0 ppb or less. When applications are made within 500 feet of an active irrigation intake, **DO NOT** irrigate for at least 24 hours following application to allow for dissipation.

Recreational use of water in treatment area. There are no restrictions on the use of water in the treatment area for recreational purposes, including swimming and fishing.

Livestock use of water in/from treatment area. There are no restrictions on livestock consumption of water from the treatment area.

Precautions for potable water intakes. DO NOT apply Habitat directly to water within 1/2 mile upstream of an active potable water intake in flowing water (i.e., river, stream, etc.) or within 1/2 mile of an active potable water intake in a standing body of water such as a lake, pond or reservoir. To make aquatic applications around and within 1/2 mile of active potable water intakes, the water intake must be turned off during application and for a minimum of 48 hours after the application. These aquatic applications may be made only in the cases where there are alternative water sources or holding ponds that would permit the turning off of an active potable water intake for a minimum period of 48 hours after the applications.

NOTE: Existing potable water intakes that are no longer in use, such as those replaced by connections to wells or a municipal water system, are not considered to be active potable water intakes.

Quiescent or Slow-moving Waters. In lakes and reservoirs, **DO NOT** apply Habitat within one (1) mile of an active irrigation water intake during the irrigation season. Applications less than one (1) mile from an active irrigation water intake may be made during the off-season, provided that the irrigation intake will remain inactive for a minimum of 120 days after application or until Habitat residue levels are determined by laboratory analysis or other appropriate means of analysis to be 1.0 ppb or less.

PRODUCT INFORMATION

Habitat® herbicide is an aqueous solution to be mixed with water and a surfactant and applied as a spray solution to control undesirable vegetation growing within specified aquatic sites. Aquatic sites consist of standing and flowing water, estuarine/marine, wetland, riparian areas and nonirrigation ditchbanks.

Herbicidal Activity. Habitat will control most annual and perennial grasses and broadleaf weeds in addition to many brush and vine species with some residual control of undesirable species that germinate above the waterline. Habitat is readily absorbed through emergent leaves and stems and is translocated rapidly throughout the plant with accumulation in the meristematic regions. For maximum activity, weeds should be growing vigorously at the time of application, and the spray solution should include a surfactant (see Adjuvants section for specific use directions). Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into, and kills, underground or submerged storage organs, which prevents regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species until 2 or more weeks after application. Complete kill of plants may not occur for several weeks. Applications of Habitat are rainfast 1 hour after treatment.

Application Methods. Habitat may be selectively applied by using low-volume directed application techniques or may be broadcast applied by using ground equipment, watercraft, or aircraft (aerial applications to aquatic sites must be made by helicopter). In addition, Habitat may also be applied using cut stump, cut stem, and frill and girdle treatment techniques within aquatic sites (see Aerial Application and Ground Application sections for additional details).

PRECAUTIONS FOR AVOIDING INJURY TO NONTARGET PLANTS

Untreated desirable plants can be affected by root uptake of Habitat from treated soil. Injury or loss of desirable plants may result if Habitat is applied on or near desirable plants, on areas where their roots extend, or in locations where the treated soil may be washed or moved into contact with their roots. When making applications along shorelines where desirable plants may be present, caution should be exercised to avoid spray contact with their foliage or spray application to the soil in which they are rooted. Shoreline plants that have roots which extend into the water in an area where Habitat has been applied generally will not be adversely affected by uptake of the herbicide from the water. If treated vegetation is to be removed from the application site, DO NOT use the vegetative matter as mulch or compost on or around desirable species.

Wind Erosion

Avoid treating powdery, dry or light sandy soils when conditions are favorable for wind erosion. Under these conditions, the soil surface should first be settled by rainfall or irrigation.

Spray Drift Requirements

Aerial Application

- Applicators are required to use a coarse or coarser droplet size (ASABE S572) or, if specifically using a spinning atomizer nozzle, applicators are required to use a volume mean diameter (VMD) of 385 microns or greater for release heights below 10 feet. Applicators are required to use a very coarse or coarser droplet size or, if specifically using a spinning atomizer nozzle, applicators are required to use a VMD of 475 microns or greater for release heights above 10 feet. Applicators must consider the effects of nozzle orientation and flight speed when determining droplet size.
- Applicators are required to use upwind swath displacement.
- The boom length must not exceed 60% of the wingspan or 90% of the rotor blade diameter to reduce spray drift.
- Applications with wind speeds less than 3 mph and with wind speeds greater than 10 mph are prohibited.
- Applications into temperature inversions are prohibited.

Ground Boom Application

- Applicators are required to use a nozzle height below 4 feet above the ground or plant canopy and coarse or coarser droplet size (ASABE S572) or, if specifically using a spinning atomizer nozzle, applicators are required to use a volume mean diameter (VMD) of 385 microns or greater.
- Applications with wind speeds greater than 10 mph are prohibited.
- Applications into temperature inversions are prohibited.

ADJUVANTS

Postemergence applications of Habitat require the addition of a spray adjuvant. When making aquatic applications, only spray adjuvants that are approved or appropriate for aquatic use must be utilized.

Nonionic Surfactants. Use a nonionic surfactant (NIS) at the rate of 0.25% volume/volume (v/v) or higher (see manufacturer's label) of the spray solution (0.25% v/v is equivalent to 1 quart in 100 gallons). For best results, select a nonionic surfactant with an HLB (hydrophilic to lipophilic balance) ratio between 12 and 17 with at least 70% surfactant in the formulated product (alcohols, fatty acids, oils, ethylene glycol or diethylene glycol should not be considered as surfactants to meet the above requirements).

Methylated Seed Oils or Vegetable Oil Concentrates. Instead of a surfactant, a methylated seed oil (MSO) or vegetable-based seed oil concentrate may be used at the rate of 1.5 to 2 pints per acre. When using spray volumes greater than 30 gallons per acre, methylated seed oil or vegetable-based seed oil concentrates should be mixed at a rate of 1% of the total spray volume, or alternatively use a nonionic surfactant as described above. Research indicates that these oils may aid in Habitat deposition and uptake by plants under moisture or temperature stress.

Silicone-based Surfactants. See manufacturer's label for specific rates. Silicone-based surfactants may reduce the surface tension of the spray droplet allowing greater spreading on the leaf surface as compared to conventional nonionic surfactants. However, some silicone-based surfactants may dry too quickly, limiting herbicide uptake.

Invert Emulsions. Habitat can be applied as an invert emulsion. The spray solution results in an invert (water-in-oil) spray emulsion designed to minimize spray drift and spray runoff, resulting in more herbicide on the target foliage. The spray emulsion may be formed in a single tank (batch mixing) or injected (in-line mixing). Consult the invert chemical label for proper mixing directions.

Other. An antifoaming agent, spray pattern indicator, or drift-reducing agent may be applied at the product labeled rate if necessary or desired.

TANK MIXES

Habitat may be tank mixed with other herbicides.

Consult manufacturer's labels for specific rate restrictions and weeds controlled. Always follow the more restrictive label restrictions and precautions for all products used when making an application involving tank mixes.

AERIAL APPLICATION

All precautions must be taken to minimize or eliminate spray drift. Only helicopters can be used for aquatic applications. DO NOT make applications by helicopter unless appropriate buffer zones can be maintained to prevent spray drift out of the target area. Aerial equipment designed to minimize spray drift, such as a helicopter equipped with a Microfoil™ boom, Thru-Valve™ boom, or raindrop nozzles, must be used and calibrated. Except when applying with a Microfoil boom, a drift control agent may be added at the specified label rate. DO NOT side trim with Habitat unless death of treated tree can be tolerated.

Uniformly apply the specified amount of Habitat in 2 to 30 gallons of water per acre. A foam-reducing agent may be added at the specified label rate, if needed.

IMPORTANT: Thoroughly clean application equipment, including landing gear, immediately after use of this product. Prolonged exposure of this product to uncoated steel (except stainless steel) surfaces may result in corrosion and failure of the exposed part. The maintenance of an organic coating (paint) may prevent corrosion.

GROUND APPLICATION

FOLIAR APPLICATIONS

Low-volume Foliar Application

Use equipment calibrated to deliver 5 to 20 gallons of spray solution per acre. To prepare the spray solution, thoroughly mix in water 0.5% to 5% Habitat plus surfactant (see the Adjuvants section of this label for specific use directions). A foam-reducing agent may be applied at the specified label rate, if needed. For control of difficult species (see Aquatic Weeds Controlled section for relative susceptibility of weed species), use the higher concentrations of herbicide and/or spray volumes, but DO NOT apply more than 6 pints of Habitat per acre in aquatic sites. Excessive wetting of foliage is not necessary. See Spray Solution Mixing Guide for Low-volume Foliar Applications following for specified volumes of Habitat and water.

For low-volume foliar application, select proper nozzles to avoid overapplication. Proper application is critical to ensure desirable results. Best results are achieved when the spray covers the crown and approximately 70 percent of the plant. The use of an even, flat-fan tip with a spray angle of 40 degrees or less will aid in proper deposition.

Appropriate tip sizes include 4004E or 1504E. For a straight-stream and cone pattern, adjustable cone nozzles, such as 5500 X3 or 5500 X4, may be used. Attaching a rolover valve onto a Spraying Systems Model 30 gunjet or other similar spray gun allows for the use of both flat-fan and cone tips on the same gun.

Moisten, but **DO NOT** drench target vegetation causing spray solution to run off.

Low-volume Follar Application with Backpacks

For low-growing species, spray down on the crown, covering crown and penetrating approximately 70% of the plant.

For target species 4 to 8 feet tall, swipe the sides of target vegetation by directing spray to at least 2 sides of the plant in smooth vertical motions from the crown to the bottom. Make sure to cover the crown whenever possible.

For target species over 8 feet tall, lace sides of the target vegetation by directing spray to at least 2 sides of the target in smooth zigzag motions from crown to bottom.

Low-volume Follar Application with Hydraulic Handgun Application Equipment

Use the same technique as described above for Low-volume Follar Application with Backpacks.

For broadcast applications, simulate a gentle rain near the top of target vegetation allowing spray to contact the crown and penetrate the target foliage without falling to the understory. Herbicide spray solution that contacts the understory may result in severe injury or death of plants in the understory.

Spray Solution Mixing Guide for Low-volume Follar Applications

Spray Solution Prepared (gallons)	Desired Concentration (% v/v)				
	0.5%	0.75%	1%	1.5%	5%
	(amount of Habitat® herbicide to use)				
1	0.6 fl oz	0.9 fl oz	1.3 fl ozs	1.9 fl ozs	6.5 fl ozs
3	1.9 fl ozs	2.8 fl ozs	3.8 fl ozs	5.8 fl ozs	1.2 pints
4	2.5 fl ozs	3.8 fl ozs	5.1 fl ozs	7.7 fl ozs	1.6 pints
5	3.2 fl ozs	4.8 fl ozs	6.5 fl ozs	9.6 fl ozs	2 pints
50	2 pints	3 pints	4 pints	6 pints	10 quarts
100	4 pints	6 pints	8 pints	6 quarts	5 gallons

2 tablespoons = 1 fluid ounce

High-volume Follar Application

For optimum performance when spraying medium-density to high-density vegetation, use equipment calibrated to deliver up to 100 gallons of spray solution per acre (GPA). Spray solutions exceeding 100 GPA may result in excessive spray runoff, causing increased ground cover injury, and injury to desirable species. To prepare the spray solution, thoroughly mix Habitat in water and add a surfactant (see Adjuvants section for specific use directions and rates for surfactants). A foam-reducing agent may be added at the specified label rate, if needed. For control of difficult species (see Aquatic Weeds Controlled chart for relative susceptibility of weed species), use the higher concentrations of herbicide and/or spray volumes, but **DO NOT** apply more than 6 pints of Habitat per acre in aquatic sites. Uniformly cover the foliage of the vegetation to be controlled, but **DO NOT** apply to runoff. Excessive wetting of foliage is not necessary.

Side Trimming

DO NOT side trim with Habitat unless severe injury or death of the treated tree can be tolerated. Habitat is readily translocated and can result in death of the entire tree.

CUT-SURFACE TREATMENT

Habitat may be used to control undesirable woody vegetation by applying the Habitat solution to the cambium area of freshly cut stump surfaces or to fresh cuts on the stem of the target woody vegetation. Applications can be made at any time of the year except during periods of heavy sap flow in the spring. **DO NOT** overapply solution causing runoff from the cut surface.

Injury may occur to desirable woody plants if the shoots extend from the same root system or their root systems are grafted to those of the treated tree.

Cut-surface Application with Dilute and Concentrate Solutions

Habitat may be mixed as either a concentrated or dilute solution. The dilute solution may be used for applications to the cut surface of the stump or to cuts on the stem of the target woody vegetation. Concentrated solutions may be used for applications to cuts on the stem. Use of the concentrated solution permits application to fewer cuts on the stem, especially for large-diameter trees. Follow the application instructions to determine proper application techniques for each type of solution.

- To prepare a dilute solution, mix 8 to 12 fluid ounces of Habitat with 1 gallon of water. The use of a surfactant or penetrating agent may improve uptake through partially callused cambiums.
- To prepare a concentrated solution, mix 2 quarts of Habitat with no more than 1 quart of water.

Cut-stump Treatment

- **Dilute Solution.** Spray or brush the solution onto the cambium area of the freshly cut stump surface. Ensure that the solution thoroughly wets the entire cambium area (the wood next to the bark of the stump).

Cut-stem (Injection, hack and squirt) Treatment

- **Dilute Solution.** Using standard injection equipment, apply 1 milliliter of solution at each injection site around the tree with no more than 1-inch intervals between cut edges. Ensure that the injector completely penetrates the bark at each injection site.
- **Concentrate Solution.** Using standard injection equipment, apply 1 milliliter of solution at each injection site. Make at least 1 injection cut for every 3 inches of Diameter at Breast Height (DBH) on the target tree. For example, a 3-inch DBH tree will receive 1 injection cut, and a 6-inch DBH tree will receive 2 injection cuts. On trees requiring more than 1 injection site, place the injection cuts at approximately equal intervals around the tree.

Frill or Girdle Treatment

- Using a hatchet, machete, or chainsaw, make cuts through the bark and completely around the tree to expose the cambium. The cut should angle downward extending into the cambium enough to expose at least 2 growth rings. Using a spray applicator or brush, apply a 25% to 100% solution of Habitat into each cut until thoroughly wet. Avoid applying so much herbicide that runoff to the ground or water occurs.

AQUATIC WEED CONTROL

Habitat may be applied for the control of floating and emergent undesirable vegetation (see the Aquatic Weeds Controlled section) in or near bodies of water that may be flowing, nonflowing, or transient. Habitat may be applied to aquatic sites that include lakes, rivers, streams, ponds, seeps, drainage ditches, canals, reservoirs, swamps, bogs, marshes, estuaries, bays, brackish water, transitional areas between terrestrial and aquatic sites, riparian sites, and seasonal wet areas. See Product Use Precautions and Restrictions section of this label for precautions, restrictions, and instructions on aquatic uses.

Habitat must be applied to the emergent foliage of the target vegetation and has little-to-no activity on submerged aquatic vegetation. Habitat concentrations resulting from direct application to water are not expected to be of sufficient concentration nor duration to provide control of target vegetation. Application should be made in such a way as to maximize spray interception by the target vegetation while minimizing the amount of overspray that enters the water.

Habitat does not control plants that are completely submerged or have a majority of their foliage under water.

Habitat should be applied with surface or helicopter application equipment in a minimum of 2 gallons of water per acre. When applying by helicopter, follow directions under the Aerial Application section of this label; otherwise, refer to the Ground Application section when using surface equipment.

Applications made to moving bodies of water should be made while traveling upstream to prevent concentration of this herbicide in water. **DO NOT** apply to bodies of water or portions of bodies of water where emergent and/or floating weeds do not exist.

When application is to be made to target vegetation that covers a large percentage of the surface area of impounded water, treating the area in strips may avoid oxygen depletion due to decaying vegetation. Oxygen depletion may result in the suffocation of some sensitive aquatic organisms. If oxygen depletion is a concern, treat no more than 1/2 of the surface area of the water in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outward in bands to allow aquatic organisms to move into untreated areas.

Avoid washoff of sprayed foliage by spray boat or recreational boat backwash for 1 hour after application.

Apply Habitat® herbicide at 2 to 6 pints per acre depending on species present and weed density. DO NOT exceed the maximum label rate of 6 pints per acre (1.5 lbs ae/A) per year. Use the higher labeled rates for heavy weed pressure. Consult the Aquatic Weeds Controlled section of this label for specific rates.

Habitat may be applied as a draw-down treatment in areas described above. Apply Habitat to weeds after water has been drained and allow 14 days before reintroduction of water.

WEEDS CONTROLLED

Aquatic Weeds Controlled

Habitat will control the following target species as specified in the Use Rates and Application Directions column of the table. Rates are expressed in terms of product volume for broadcast applications and as a % solution for directed applications including spot treatments. For % solution applications, DO NOT apply more than the equivalent of 6 pints of Habitat per acre.

Common Name	Scientific Name	Use Rates and Application Directions
Floating		
*Floating heart	<i>Nymphodes</i> spp.	2 to 4 pints/A (0.5 to 1.0% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Frogbit	<i>Limnobium spongia</i>	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Spatterdock	<i>Nuphar luteum</i>	Apply a tank mix of 2 to 4 pints/A Habitat + 4 to 6 pints/A glyphosate (0.5% Habitat + 1.5% glyphosate) in 100 GPA water for best control. Ensure 100% coverage of actively growing emergent foliage.
*Water hyacinth	<i>Eichhornia crassipes</i>	1 to 2 pints/A (0.5% solution) applied in 100 GPA water to actively growing foliage.
*Water lettuce	<i>Pistia stratiotes</i>	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
Emerg		
*Alligatorweed	<i>Alternanthera philoxeroides</i>	1 to 4 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Arrowhead, duck-potato	<i>Sagittaria</i> spp.	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Bacopa, lemon	<i>Bacopa</i> spp.	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Parrot feather	<i>Myriophyllum aquaticum</i>	Must be foliage above water for sufficient Habitat uptake. Apply 2 to 4 pints/A to actively growing emergent foliage.
*Pennywort	<i>Hydrocotyle</i> spp.	1 to 2 pints/A (0.5% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Pickerelweed	<i>Pontederia cordata</i>	2 to 3 pints/A (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.

* Use not permitted in California unless otherwise directed by supplemental labeling.

(continued)

Aquatic Weeds Controlled (continued)

Common Name	Scientific Name	Use Rates and Application Directions
Emerg (continued)		
*Taro, wild Dasheen Elephant's ear Coco yam	<i>Colocasia esculentum</i>	4 to 6 pints/A (1.5% solution) applied in 100 GPA with a high quality "sticker" adjuvant. Ensure good coverage of actively growing emergent foliage.
*Water chestnut	<i>Trappa natans</i>	4 to 6 pints/A (1.5% solution) applied in 100 GPA with a high quality "sticker" adjuvant. Ensure good coverage of actively growing emergent foliage.
*Water lily	<i>Nymphaea odorata</i>	2 to 3 pints/A (1% solution) applied in 100 GPA water mix. Ensure 100% coverage of actively growing emergent foliage.
*Water primrose	<i>Ludwigia uruguayensis</i>	4 to 6 pints/A (1.5% solution). Ensure 100% coverage of actively growing emergent foliage.
Terrestrial/Marginal		
*Soda apple Aquatic nightshade	<i>Solanum tampicense</i>	2 pints/A applied to foliage
*Bamboo, Japanese	<i>Phyllostachys</i> spp.	3 to 4 pints/A applied to the foliage when plant is actively growing; before setting seed head. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Beach, vitex	<i>Vitex rotundifolia</i>	5% solution + 1% MSO foliar spray. 17% solution stem injection (hack and squirt)
Brazilian pepper Christmasberry	<i>Schinus terebinthifolius</i>	2 to 4 pints/A applied to foliage
Cattail	<i>Typha</i> spp.	2 to 4 pints/A (1% solution) applied to actively growing green foliage after full leaf elongation. Lower rates will control cattail in the North; higher rates are needed in the South.
Chinese tallow tree	<i>Sapium sebiferum</i>	16 to 24 fl ozs/A applied to foliage
Cogon grass	<i>Imperata cylindrica</i>	Burn foliage, till area; then fall-spray 2 quarts/A Habitat + MSO applied to new growth.
Cordgrass, prairie	<i>Spartina</i> spp.	4 to 6 pints/A applied to actively growing foliage
*Cutgrass	<i>Zizaniopsis miliacea</i>	4 to 6 pints/A applied to actively growing foliage
*Elephant grass Napier grass	<i>Pennisetum purpureum</i>	3 pints/A applied to actively growing foliage
*Flowering rush	<i>Butomus umbellatus</i> L.	2 to 3 pints/A applied to actively growing foliage
Giant reed Wild cane	<i>Arundo donax</i>	4 to 6 pints/A applied in spring to actively growing foliage
*Golden bamboo	<i>Phyllostachys aurea</i>	3 to 4 pints/A applied to foliage when plant is actively growing; before setting seed head. More foliage will result in greater herbicide uptake, resulting in greater root kill.
Junglerice	<i>Echinochloa colonum</i>	3 to 4 pints/A applied to actively growing foliage
Knapweed	<i>Centaurea</i> spp.	Russian knapweed: 2 to 3 pints + 1 quart/A MSO fall-applied after senescence begins

* Use not permitted in California unless otherwise directed by supplemental labeling.

(continued)

Aquatic Weeds Controlled (continued)

Common Name	Scientific Name	Use Rates and Application Directions
Terrestrial/Marginal (continued)		
Knotweed, Japanese	<i>Polygonum cuspidatum</i> <i>Fallopia japonica</i>	3 to 4 pints/A applied post-emergence to actively growing foliage
Melaleuca Paperbark tree	<i>Melaleuca quinquenervia</i>	For established stands, apply 6 pints/A Habitat® herbicide + 6 pints/A glyphosate + spray adjuvant. For best results, use 4 quarts/A methylated seed oil as an adjuvant. For ground foliar application, uniformly apply to ensure 100% coverage. For broadcast foliar control, apply aerially in a minimum of 2 passes at 10 gallons/A applied cross treatment. For spot treatment, use a 25% Habitat + 25% solution of glyphosate + 1.25% MSO in water applied as a frill or stump treatment.
*Nutsedge	<i>Cyperus rotundus</i>	2 pints Habitat + 1 quart/A MSO applied early post-emergence
*Nutsedge	<i>Cyperus</i> spp.	2 to 3 pints post-emergence to foliage or pre-emergence incorporated, nonincorporated, pre-emergence applications will not control.
Phragmites Common reed	<i>Phragmites australis</i>	4 to 6 pints/A applied to actively growing green foliage after full leaf elongation. Ensure 100% coverage. If stand has a substantial amount of old stem tissue, mow or burn, allow to regrow to approximately 5 feet tall before treatment. Lower rates will control phragmites in the North; higher rates are needed in the South.
*Poison hemlock	<i>Conium maculatum</i>	2 pints Habitat + 1 quart/A MSO applied pre-emergence to early post-emergence to rosette prior to flowering
Purple loosestrife	<i>Lythrum salicaria</i>	1 pint/A applied to actively growing foliage
Reed canarygrass	<i>Phalaris arundinacea</i>	3 to 4 pints/A applied to actively growing foliage
Rose, swamp	<i>Rosa palustris</i>	2 to 3 pints/A applied to actively growing foliage
Russian olive	<i>Elaeagnus angustifolia</i>	2 to 4 pints/A or a 1% solution applied to foliage
Saltcedar Tamarisk	<i>Tamarix</i> spp.	Aerial apply 2 quarts Habitat + 0.25% v/v NIS applied to actively growing foliage during flowering. For spot spraying, use 1% solution of Habitat + 0.25% v/v NIS and spray to wet foliage. After application, wait at least 2 years before disturbing treated saltcedar. Earlier disturbance can reduce overall control.
Smartweed	<i>Polygonum</i> spp.	2 pints/A applied early post-emergence
Sumac	<i>Rhus</i> spp.	2 to 3 pints/A applied to foliage
Swamp morningglory Water spinach Kangkong	<i>Ipomoea aquatica</i>	1 to 2 pints/A Habitat + 1 quart/A MSO applied early post-emergence
Torpedo grass	<i>Panicum repens</i>	4 pints/A (1 to 1.5% solution); ensure good coverage to actively growing foliage.
*White top Hoary cress	<i>Cardaria draba</i>	1 to 2 pints/A applied in spring to foliage during flowering
Willow	<i>Salix</i> spp.	2 to 3 pints/A Habitat applied to actively growing foliage. Ensure good coverage.

* Use not permitted in California unless otherwise directed by supplemental labeling.

TERMS AND CONDITIONS OF USE

If terms of the following *Warranty Disclaimer, Inherent Risks of Use and Limitation of Remedies* are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, to the extent consistent with applicable law, use by the buyer or any other user constitutes acceptance of the terms under *Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies*.

WARRANTY DISCLAIMER

SePRO Corporation warrants that the product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, SEPRO CORPORATION MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

INHERENT RISKS OF USE

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of SePRO Corporation or the seller. To the extent consistent with applicable law, all such risks shall be assumed by buyer.

LIMITATION OF REMEDIES

To the extent consistent with applicable law, the exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories) shall be limited to, at SePRO Corporation's election, one of the following:

- (1) Refund of purchase price paid by buyer or user for product bought, or
- (2) Replacement of amount of product used.

To the extent consistent with applicable law, SePRO Corporation shall not be liable for losses or damages resulting from handling or use of this product unless SePRO Corporation is promptly notified of such losses or damages in writing. In no case shall SePRO Corporation be liable for consequential or incidental damages or losses.

The terms of the *Warranty Disclaimer, Inherent Risks of Use* and this *Limitation of Remedies* cannot be varied by any written or verbal statements or agreements. No employee or sales agent of SePRO Corporation or the seller is authorized to vary or exceed the terms of the *Warranty Disclaimer* or this *Limitation of Remedies* in any manner.

Habitat is a registered trademark of BASF Corporation.
Microfoil is a trademark of Rhone Poulenc Ag Company.
Thru-Valve is a trademark of Waldrum Specialties.

NVA 2011-04-246-0167
FPL20120613
SePRO Corporation
11550 N. Meridian St., Ste. 600
Carmel, IN 46032

Specimen Label



Herbicide

Aquatic Sites: For control of emersed, submersed and floating aquatic plants in aquatic sites such as ponds, lakes, reservoirs, non-irrigation canals and ditches which have little or no continuous outflow, marshes and wetlands, including broadleaf and woody vegetation on banks and shores within or adjacent to these and other aquatic sites.

Active Ingredient:

triclopyr: 3,5,6-trichloro-
2-pyridinyloxyacetic acid,
triethylamine salt.....

.....44.4%
Inert Ingredients.....55.6%
Total.....100.0%

Acid equivalent: triclopyr - 31.8% - 3 lb/gal

Keep Out of Reach of Children

DANGER PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

Precautionary Statements

Hazards to Humans and Domestic Animals

Corrosive • Causes irreversible eye damage • Harmful if swallowed or absorbed through skin • Prolonged or frequently repeated skin contact may cause allergic reaction in some individuals

Do not get in eyes or on skin or clothing.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Shoes plus socks • Protective eyewear
- Chemical resistant gloves (≥ 14 mils) such as butyl rubber, natural rubber, neoprene rubber or nitrile rubber

Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

FIRST AID

In the eyes

- Hold eye open and rinse slowly and gently with water for 15 - 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.
- Call poison control center or doctor for treatment advice.

If on skin or clothing

- Take off contaminated clothing.
- Rinse skin immediately with plenty of water for 15 - 20 minutes.
- Call a poison control center or doctor for treatment advice.

If swallowed

- Call a poison control center or doctor for treatment advice.
- Have person sip a glass of water if able to swallow.
- Do not induce vomiting unless told to do so by a poison control center or doctor.
- Do not give anything by mouth to a unconscious person.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment.

Note to Applicator: Allergic skin reaction is not expected from exposure to spray mixtures of Renovate 3 herbicide when used as directed.

Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage.

Refer to inside of label booklet for additional precautionary information including Personal Protective Equipment (PPE), User Safety Recommendations and Directions for Use including Storage and Disposal.

Notice: Read the entire label. Use only according to label directions. **Before using this product, read Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies at end of label booklet. If terms are unacceptable, return at once unopened.**

In case of emergency endangering health or the environment involving this product, call **INFOTRAC at 1-800-535-5053**. If you wish to obtain additional product information, visit our web site at www.sepro.com.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

EPA Reg. No. 62719-37-67690
FPL 012203

EPA Est. No. 464-MI-1
SPC - 381116

*Trademark of Dow AgroSciences LLC manufactured for:
SePRO Corporation Carmel, IN 46032, U.S.A.

Renovate³ Herbicide

Engineering Controls

When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets the requirements listed in the WPS (40 CFR 170.240(d)(4-6)), the handler PPE requirements may be reduced or modified as specified in the WPS.

USER SAFETY RECOMMENDATIONS

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Environmental Hazards

Under certain conditions, treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants, which may contribute to fish suffocation. This loss can cause fish suffocation. Therefore, to minimize this hazard, do not treat more than one-third to one-half of the water area in a single operation and wait at least 10 to 14 days between treatments. Begin treatment along the shore and proceed outwards in bands to allow fish to move into untreated areas. Consult with the State agency for fish and game before applying to public water to determine if a permit is needed.

Physical or Chemical Hazards

Combustible. Do not use or store the product near heat or open flame.

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. Read all **Directions for Use** carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 48 hours.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Shoes plus socks
- Protective eyewear
- Chemical-resistant gloves (≥ 14 mils) such as butyl rubber, natural rubber, neoprene rubber or nitrile rubber

NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for Agricultural Pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, or greenhouses.

Entry Restrictions for Non-WPS Uses: For applications to non-cropland areas, do not allow entry into areas until sprays have dried, unless applicator and other handler PPE is worn.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal. Open dumping is prohibited.

Pesticide Storage: Store above 28° F or agitate before use.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal for Refillable Containers: Seal all openings which have been opened during use. Return the empty container to a collection site designated by SePRO Corporation. If the container has been damaged and cannot be returned according to the recommended procedures, contact SePRO Corporation at 1-800-419-7779 to obtain proper handling instructions.

Container Disposal (Metal): Do not reuse container. Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by other procedures approved by state and local authorities.

Container Disposal (Plastic): Do not reuse container. Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

General: Consult federal, state, or local disposal authorities for approved alternative procedures.

General Information

For Aquatic and Wetland Sites

Renovate⁺ 3 herbicide is recommended for control of emerged, submersed and floating aquatic plants in aquatic sites such as ponds, lakes, reservoirs, non-irrigation canals, and ditches which have little or no continuous outflow, marshes and wetlands, including broadleaf and woody vegetation on banks and shores within or adjacent to these and other aquatic sites.

Obtain Required Permits: Consult with appropriate state or local water authorities before applying this product to public waters. State or local public agencies may require permits.

General Use Precautions and Restrictions

In Arizona: The state of Arizona has not approved Renovate^{*} 3 for use on plants grown for commercial production, specifically forests grown for commercial timber production, or on designated grazing areas.

When applying this product in tank mix combination, follow all applicable use directions, precautions and limitations on each manufacturer's label.

Chemigation: Do not apply this product through any type of irrigation system.

Irrigation: Do not use treated water for irrigation for 120 days following application. As an alternative to waiting 120 days, treated water may be used for irrigation once the triclopyr level in the intake water is determined to be non-detectable by laboratory analysis (immunoassay). There is no restriction on use of water from the treatment area to irrigate established grasses.

Do not apply Renovate 3 directly to, or otherwise permit it to come into direct contact with grapes, tobacco, vegetable crops, flowers, or other desirable broadleaf plants, and do not permit spray mists containing it to drift into them.

- **Do not** apply to salt water bays or estuaries.
- **Do not** apply directly to un-impounded rivers or streams.
- **Do not** apply on ditches or canals used to transport irrigation water. It is permissible to treat non-irrigation ditch banks.
- **Do not** apply where runoff water may flow onto agricultural land as injury to crops may result.
- When making applications to control unwanted plants on banks or shorelines of moving water sites, minimize overspray to open water.
- The use of a mistblower is not recommended.

Grazing and Haying Restrictions

Except for lactating dairy animals, there are no grazing restrictions following application of this product.

- **Grazing Lactating Dairy Animals:** Do not allow lactating dairy animals to graze treated areas until the next growing season following application of this product.
- **Do not** harvest hay for 14 days after application.
- Grazed areas of non-cropland and forestry sites may be spot treated if they comprise no more than 10% of the total grazable area.

Slaughter Restrictions: During the season of application, withdraw livestock from grazing treated grass at least 3 days before slaughter.

Avoiding Injurious Spray Drift

Applications should be made only when there is little or no hazard from spray drift. Very small quantities of spray, which may not be visible, may seriously injure susceptible plants. Do not spray when wind is blowing toward susceptible crops or ornamental plants near enough to be injured. It is suggested that a continuous smoke column at or near the spray site or a smoke generator on the spray equipment be used to detect air movement, lapse conditions, or temperature inversions (stable air). If the smoke layers or indicates a potential of hazardous spray drift, do not spray.

Aerial Application: For aerial application near susceptible crops, apply through a Microfoil[®] or Thru-Valve boom¹, or use a drift control additive labeled for aquatic use. Other drift reducing systems or thickened sprays prepared by using high viscosity inverting systems may be used if they are made as drift-free as mixtures containing thickening agents labeled for use in aquatics or applications made with the Microfoil or Thru-Valve boom. Keep spray pressures low enough to provide coarse spray droplets. Spray boom should be no longer than 3/4 of the rotor length. Do not use a thickening agent with the Microfoil or Thru-Valve booms, or other systems that cannot accommodate thick sprays. Spray only when the wind velocity is low (follow state regulations). Avoid application during air inversions. If a spray thickening agent is used, follow all use recommendations and precautions on the product label.

†Reference within this label to a particular piece of equipment produced by or available from other parties is provided without consideration for use by the reader at its discretion and subject to the reader's independent circumstances, evaluation, and expertise. Such reference by SePRO Corporation is not intended as an endorsement of such equipment, shall not constitute a warranty (express or implied) of such equipment, and is not intended to imply that other equipment is not available and equally suitable. Any discussion of methods of use of such equipment does not imply that the reader should use the equipment other than as advised in directions available from the equipment's manufacturer. The reader is responsible for exercising its own judgment and expertise, or consulting with sources other than SePRO Corporation, in selecting and determining how to use its equipment.

Spray Drift Management

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential for spray drift. The applicator and the grower are responsible for considering all these factors when making decisions.

The following drift management requirements must be followed to avoid off-target drift movement from aerial applications:

1. The distance of the outer most operating nozzles on the boom must not exceed 3/4 the length of the rotor.
2. Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees.

Where states have more stringent regulations, they should be observed.

The applicator should be familiar with and take into account the information covered in the following Aerial Drift Reduction Advisory. [This information is advisory in nature and does not supersede mandatory label requirements.]

Aerial Drift Reduction Advisory

Information on Droplet Size: The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see Wind, Temperature and Humidity, and Temperature Inversions).

Controlling Droplet Size:

- **Volume** - Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.
- **Pressure** - Do not exceed the nozzle manufacturer's recommended pressures. For many nozzle types lower pressure produces larger droplets. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of Nozzles** - Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle Orientation** - Orienting nozzles so that the spray is released parallel to the airstream produces larger droplets than other orientations and is the recommended practice. Significant deflection from horizontal will reduce droplet size and increase drift potential.
- **Nozzle Type** - Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce the largest droplets and the lowest drift.

Boom Length: For some use patterns, reducing the effective boom length to less than 3/4 of the wingspan or rotor length may further reduce drift without reducing swath width.

Application Height: Applications should not be made at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces exposure of droplets to evaporation and wind.

Swath Adjustment: When applications are made with a cross-wind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase, with increasing drift potential (higher wind, smaller drops, etc.).

Wind: Drift potential is lowest between wind speeds of 2-10 mph. However, many factors, including droplet size and equipment type determine drift potential at any given speed. Application should be avoided below 2 mph due to variable wind direction and high inversion potential. **Note:** Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect spray drift.

Temperature and Humidity: When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions: Applications should not occur during a local, low level temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of the smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

Sensitive Areas: The pesticide should only be applied when the potential for drift to adjacent sensitive areas (e.g., residential areas, known habitat for threatened or endangered species, non-target crops) is minimal (e.g., when wind is blowing away from the sensitive areas).

Ground Equipment: To aid in reducing spray drift, Renovate 3 should be used in thickened (high viscosity) spray mixtures using a labeled drift control additive, high viscosity invert system, or equivalent as directed by the manufacturer. With ground equipment, spray drift can be reduced by keeping the spray boom as low as possible; by applying 20 gallons or more of spray per acre; by keeping the operating spray pressures at the lower end of the manufacturer's recommended pressures for the specific nozzle type used (low pressure nozzles are available from spray equipment manufacturers); and by spraying when wind velocity is low (follow state regulations). In hand-gun applications, select the minimum spray pressure that will provide adequate plant

coverage (without forming a mist). Do not apply with nozzles that produce a fine-droplet spray.

High Volume Leaf-Stem Treatment: To minimize spray drift, do not use pressure exceeding 50 psi at the spray nozzle and keep sprays no higher than brush tops. A labeled thickening agent may be used to reduce drift.

Plants Controlled by Renovate 3

Woody Plant Species

alder	casara	maples
arrowwood	ceanothus	mulberry
ash	cherry	oaks
aspen	Chinese Tallow	poison ivy
bear clover (bearmat)	chinquapin	poison oak
beech	choke cherry	poplar
birch	cottonwood	salt-bush (<i>Baccharis</i> spp.)
blackberry	crataegus (hawthorn)	sweetgum
blackgum	locust	waxmyrtle
Brazilian pepper	Maleleuca (seedlings)	willow

Annual and Perennial Broadleaf Weeds

burdock	ligodium	tropical sodaapple
Canada thistle	plantain	vetch
curly dock	smartweed	wild lettuce
elephant ear	tansy ragwort	

Aquatic Weeds

alligatorweed	milfoil species	purple loosestrife
American lotus	nuphar (spatterdock)	waterhyacinth
American frogbit	parrotfeather*	waterlily
Aquatic sodaapple	pickerelweed	waterprimose
Eurasian watermilfoil	pennywort	

*Retreatment may be needed to achieve desired level of control.

Application Methods

Floating and Emerged Weeds

For control of waterhyacinth, alligatorweed (see specific directions below), and other susceptible emerged and floating herbaceous weeds and woody plants, apply 1 1/2 to 6 lb ae triclopyr (2 to 8 quarts of Renovate 3) per acre as a foliar application using surface or aerial equipment. Use higher rates in the rate range when plants are mature, when the weed mass is dense, or for difficult to control species. Repeat as necessary to control regrowth and plants missed in the previous operation, but do not exceed a total of 6 lb ae triclopyr (8 quarts of Renovate 3) per acre per annual growing season.

Use of a non-ionic surfactant in the spray mixture is recommended to improve control. Follow all directions and use precautions on the aquatic surfactant label.

Apply when plants are actively growing.

Surface Application

Use a spray boom, handgun or other similar suitable equipment mounted on a boat or vehicle. Thorough wetting of foliage is essential for maximum effectiveness. Use 20 to 200 gallons per acre of spray mixture. Special precautions such as the use of low spray pressure, large droplet producing nozzles or addition of a labeled thickening agent may minimize spray drift in areas near sensitive crops.

Aerial Application

Apply with a helicopter using a Microfoil or Thru-Valve boom, or a drift control additive in the spray solution. Apply in a minimum of 10 gallons of total spray mix per acre. Do not apply when weather conditions favor drift to sensitive areas. See label section on aerial application directions and precautions.

Waterhyacinth (*Eichhornia crassipes*)

Apply Renovate 3 at 1 1/2 to 6 lb ae triclopyr (2 to 8 quarts of Renovate 3) per acre to control waterhyacinth. Apply when plants are actively growing. Use the higher rate in the rate range when the weed mass is dense. It is important to thoroughly wet all foliage with the spray mixture. Use of a non-ionic surfactant in the spray mixture is recommended. A repeat treatment may be needed to control regrowth or plants missed in the previous treatment.

Alligatorweed (*Alternanthera philoxeroides*)

Apply Renovate 3 at 2 to 6 lb ae triclopyr (3 to 8 quarts of Renovate 3) per acre to control alligatorweed. It is important to thoroughly wet all foliage with the spray mixture. For best results, it is recommended that an approved non-ionic aquatic surfactant be added to the spray mixture. Alligatorweed growing outside the margins of a body of water can be controlled with this treatment. However, alligatorweed growing in water will only be partially controlled. Top growth above the water will be controlled, but the plant will likely regrow from tissue below the water surface.

Precautions for Potable Water Intakes - Lakes, Reservoirs, Ponds:

For applications of Renovate 3 to control floating and emerged weeds in lakes, reservoirs or ponds that contain a functioning potable water intake for human consumption, see chart below to determine the minimum setback distances of the application from the functioning potable water intakes.

Renovate 3 Application Rate (quart/acre)				
Area Treated (acres)	Setback Distance (ft)			
	2 qt/acre	4 qt/acre	6 qt/acre	8 qt/acre
< 4	0	200	400	500
> 4 - 8	0	200	700	900
> 8 - 16	0	200	700	1000
> 16	0	200	900	1300

Note: Existing potable water intakes which are no longer in use, such as those replaced by potable water wells or connections to a municipal water system, are not considered to be functioning potable water intakes. These setback restrictions do not apply to terrestrial applications made adjacent to potable water intakes.

To apply Renovate 3 around and within the distances noted above from a functioning potable water intake, the intake must be turned off until the triclopyr level in the intake water is determined to be 0.4 parts per million (ppm) or less by laboratory analysis or immunoassay.

• **Recreational Use of Water in Treatment Area:** There are no restrictions on use of water in the treatment area for recreational purposes, including swimming and fishing.

• **Livestock Use of Water from Treatment Area:** There are no restrictions on livestock consumption of water from the treatment area.

Submerged Weeds

For control of Eurasian watermilfoil (*Myriophyllum spicatum*) and other susceptible submerged weeds in ponds, lakes, reservoirs, and in non-irrigation canals or ditches that have little or no continuous outflow, apply Renovate 3 as either a surface or subsurface application. Rates should be selected according to the rate chart below to provide a triclopyr concentration of 0.75 to 2.5 ppm ae in treated water. Higher rates in the rate range are recommended in areas of greater water exchange. These areas may require a repeat application. However, total application of Renovate 3 must not exceed an application rate of 2.5 ppm triclopyr for the treatment area per annual growing season.

Apply in spring or early summer when Eurasian watermilfoil or other submerged weeds are actively growing.

Areas near susceptible crops or other desirable broadleaf plants may be treated by subsurface injection applied by boat to avoid spray drift.

Subsurface Application

Apply desired amount of Renovate 3 per acre directly into the water through boat-mounted distribution systems.

Surface Application

Apply the desired amount of Renovate 3 as either a concentrate or a spray mixture in water. However, use a minimum spray volume of 5 gallons per acre. Do not apply when weather conditions favor drift to sensitive areas.

Concentration of Triclopyr Acid in Water (ppm ae)					
Water Depth (feet)	Gallons of Renovate 3 per surface acre at specified depth				
	0.75 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm
1	0.7	0.9	1.4	1.8	2.3
2	1.4	1.8	3.3	3.6	4.6
3	2.1	2.9	4.1	5.4	6.8
4	2.7	3.6	5.4	7.2	9.1
5	3.4	4.5	6.8	9.0	11.3
6	4.1	5.4	8.1	10.9	13.6
7	4.8	6.3	9.5	12.7	15.8
8	5.5	7.2	10.9	14.5	18.1
9	6.1	8.1	12.2	16.3	20.4
10	6.8	9.0	13.6	18.1	22.6
15	10.2	13.6	20.4	27.2	33.9
20	13.6	18.1	27.2	36.2	45.3

Precautions for Potable Water Intakes - Lakes, Reservoirs, Ponds:

For applications of Renovate 3 to control submerged weeds in lakes, reservoirs or ponds that contain a functioning potable water intake for human consumption, see the chart below to determine the minimum setback distances of the application from the functioning potable water intakes.

Concentration of Triclopyr Acid in Water (ppm ae)					
	Required setback distance (ft) from potable water intake				
Area Treated (acres)	0.75 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm
< 4	300	400	600	800	1000
> 4 - 8	420	560	840	1120	1400
> 8 - 16	600	800	1200	1600	2000
> 16 - 32	780	1040	1560	2080	2600
32 acres, calculate a setback using the formula for the appropriate rate	Setback (ft) = $(800 \times \ln(\text{acres}) - 160) / 3.33$	Setback (ft) = $(800 \times \ln(\text{acres}) - 160) / 2.50$	Setback (ft) = $(800 \times \ln(\text{acres}) - 160) / 1.67$	Setback (ft) = $(800 \times \ln(\text{acres}) - 160) / 1.25$	Setback (ft) = $(800 \times \ln(\text{acres}) - 160)$

Example Calculation 1: to apply 2.5 ppm Renovate 3 to 50 acres:

$$\begin{aligned} \text{Setback in feet} &= (800 \times \ln(50 \text{ acres}) - 160) \\ &= (800 \times 3.912) - 160 \\ &= 2970 \text{ feet} \end{aligned}$$

Example Calculation 2: to apply 0.75 ppm Renovate 3 to 50 acres:

$$\begin{aligned} \text{Setback in feet} &= \frac{(800 \times \ln(50 \text{ acres}) - 160)}{3.33} \\ &= \frac{(800 \times 3.912) - 160}{3.33} \\ &= 892 \text{ feet} \end{aligned}$$

Note: Existing potable water intakes which are no longer in use, such as those replaced by potable water wells or connections to a municipal water system, are not considered to be functioning potable water intakes. These setback restrictions do not apply to terrestrial applications made adjacent to potable water intakes.

To apply Renovate 3 around and within the distances noted above from a functioning potable water intake, the intake must be turned off until the triclopyr level in the intake water is determined to be 0.4 parts per million (ppm) or less by laboratory analysis or immunoassay.

- **Recreational Use of Water in Treatment Area:** There are no restrictions on use of water in the treatment area for recreational purposes, including swimming and fishing.
- **Livestock Use of Water from Treatment Area:** There are no restrictions on livestock consumption of water from the treatment area.

Wetland Sites

Wetlands include flood plains, deltas, marshes, swamps, bogs, and transitional areas between upland and lowland sites. Wetlands may occur within forests, wildlife habitat restoration and management areas and similar sites as well as areas adjacent to or surrounding domestic water supply reservoirs, lakes and ponds.

For control of woody plants and broadleaf weeds in these sites, follow use directions and application methods on this label for terrestrial sites associated with wetland areas.

Use Precautions

Minimize overspray to open water when treating target vegetation in and around non-flowing, quiescent or transient water. When making applications to control unwanted plants on banks or shorelines of flowing water, minimize overspray to open water.

Note: Consult local public water control authorities before applying this product in and around public water. Permits may be required to treat such areas.

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife can be controlled with foliar applications of Renovate 3. For broadcast applications, a minimum of 4 1/2 to 6 lb ae triclopyr (6 to 8 quarts of Renovate 3) per acre is recommended. Apply Renovate 3 when purple loosestrife is at the bud to mid-flowering stage of growth. Follow-up applications for control of regrowth should be made the following year in order to achieve increased control of this weed species. For all applications, a non-ionic surfactant labeled for aquatics should be added to the spray mixture. Follow all directions and use precautions on the label of the surfactant. Thorough wetting of the foliage and stems is necessary to achieve satisfactory control. A minimum spray volume of 50 gallons per acre is recommended for ground broadcast applications.

If using a backpack sprayer, a spray mixture containing 1% to 1.5% Renovate 3 or 5 to 7.6 fl oz of Renovate 3 per 4 gallons of water should be used. All purple loosestrife plants should be thoroughly wetted.

Aerial application by helicopter may be needed when treating restoration sites that are inaccessible, remote, difficult to traverse, isolated, or otherwise unsuited to ground application, or in circumstances where invasive exotic weeds dominate native plant populations over extensive areas and efforts to restore native plant diversity are being conducted. By air, apply in a minimum spray volume of 30 gallons per acre using Thru-Valve or Microfoil boom only.

- **Recreational Use of Water in Treatment Area:** There are no restrictions on use of water in the treatment area for recreational purposes, including swimming and fishing.

- **Livestock Use of Water from Treatment Area:** There are no restrictions on livestock consumption of water from the treatment area.

Terrestrial Sites Associated with Wetland Areas

- Apply no more than 2 lb ae triclopyr (2/3 gallon of Renovate 3) per acre per growing season on range and pasture sites, including rights-of-way, fence rows or any area where grazing or harvesting is allowed.
- On forestry sites, Renovate 3 may be used at rates up to 6 lb ae of triclopyr (2 gallons of Renovate 3) per acre per year.

Use Renovate 3 at rates of 3/4 to 6 lb ae triclopyr (1/4 to 2 gallons of Renovate 3) per acre to control broadleaf weeds and woody plants. In all cases use the amount specified in enough water to give uniform and complete coverage of the plants to be controlled. Use only water suitable for spraying. Use of a labeled non-ionic surfactant is recommended for all foliar applications. When using surfactants, follow the use directions and precautions listed on

the surfactant manufacturer's label. Use the higher recommended concentrations of surfactant in the spray mixture when applying lower spray volumes per acre. The recommended order of addition to the spray tank is water, spray thickening agent (if used), additional herbicide (if used), and Renovate 3. A labeled aquatic surfactant should be added to the spray tank last or as recommended on the product label. If combined with emulsifiable concentrate herbicides, moderate continuous adequate agitation is required.

Before using any recommended tank mixtures, read the directions and all use precautions on both labels.

For best results, applications should be made when woody plants and weeds are actively growing. When hard to control species such as ash, blackgum, choke cherry, maples, or oaks are prevalent and during applications made in late summer when the plants are mature and during drought conditions, use the higher rates of Renovate 3.

When using Renovate 3 in combination with a 2,4-D herbicide approved for aquatic use, such as DMA 4 IVM, generally the higher rates should be used for satisfactory brush control.

Use the higher dosage rates when brush approaches an average of 15 feet in height or when the brush covers more than 60% of the area to be treated. If lower rates are used on hard to control species, resprouting may occur the year following treatment.

High Volume Foliage Treatment

For control of woody plants, use Renovate 3 at the rate of 3 to 6 lb ae triclopyr (1 to 2 gallons of Renovate 3) per 100 gallons of spray solution, or Renovate 3 at 3/4 to 3 lb ae triclopyr (1 to 4 quarts of Renovate 3) may be tank mixed with 1/4 to 1/2 gallons of 2,4-D 3.8 lb amine, like DMA 4 IVM, diluted to make 100 gallons of spray solution. Apply at a volume of 100 to 400 gallons of total spray per acre depending on size and density of woody plants. Coverage should be thorough to wet all leaves, stems, and root collars. (See General Use Precautions and Restrictions.) Do not exceed the maximum allowable use rate of 6 lb ae of triclopyr (2 gallons of Renovate 3) per acre per growing season.

Low Volume Foliage Treatment

To control susceptible woody plants, apply up to 15 lb ae triclopyr (5 gallons of Renovate 3) in 10 to 100 gallons of finished spray. The spray concentration of Renovate 3 and total spray volume per acre may be adjusted according to the size and density of target woody plants and kind of spray equipment used. With low volume sprays, use sufficient spray volume to obtain uniform coverage of target plants including the surfaces of all foliage, stems, and root collars (see General Use Precautions and Restrictions). For best results, a labeled aquatic surfactant should be added to all spray mixtures. Match equipment and delivery rate of spray nozzles to height and density of woody plants. When treating tall, dense brush, a truck mounted spray gun with spray tips that deliver up to 2 gallons per minute at 40 to 60 psi may be required. Backpack or other types of specialized spray equipment with spray tips that deliver less than 1 gallon of spray per minute may be appropriate for short, low to moderate density brush.

Cut Surface Treatments (Woody Plants)

To control unwanted trees and other listed woody plants, apply Renovate 3, either undiluted or diluted in a 1 to 1 ratio with water as directed below.

With Tree Injector Method

Applications should be made by injecting 1/2 milliliter of undiluted Renovate 3 or 1 milliliter of the diluted solution through the bark at intervals of 3 to 4 inches between centers of the injector wound. The injections should completely surround the tree at any convenient height. **Note: No Worker Protection Standard worker entry restrictions or worker notification requirements apply when this product is injected directly into plants.**

With Hack and Squirt Method

Make cuts with a hatchet or similar equipment at intervals of 3 to 4 inches between centers at a convenient height around the tree trunk. Spray 1/2 milliliter of undiluted Renovate 3 or 1 milliliter of the diluted solution into each cut.

With Frill or Girdle Method

Make a single girdle through the bark completely around the tree at a convenient height. Wet the cut surface with undiluted or diluted solution.

Both of the above methods may be used successfully at any season except during periods of heavy sap flow of certain species—for example, maples.

Stump Treatment

Spray or paint the cut surfaces of freshly cut stumps and stubs with undiluted Renovate 3. The cambium area next to the bark is the most vital area to wet.

Terms and Conditions of Use

If terms of the following Warranty Disclaimer, Inherent Risks of Use, and Limitation of Remedies are not acceptable, return unopened package at once to the seller for a full refund of purchase price paid. Otherwise, use by the buyer or any other user constitutes acceptance of the terms under Warranty Disclaimer, Inherent Risks of Use and Limitations of Remedies.

Warranty Disclaimer

SePRO Corporation warrants that the product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. SEPRO CORPORATION MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label such as unfavorable temperatures, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner or application, or other factors, all of which are beyond the control of SePRO Corporation as the seller. All such risks shall be assumed by buyer.

Limitation of Remedies

The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories) shall be limited to, at SePRO Corporation's election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

SePRO Corporation shall not be liable for losses or damages resulting from handling or use of this product unless SePRO Corporation is promptly notified of such losses or damages in writing. In no case shall SePRO Corporation be liable for consequential or incidental damages or losses.

The terms of the Warranty Disclaimer above and this Limitation of Remedies can not be varied by any written or verbal statements or agreements. No employee or sales agent of SePRO Corporation or the seller is authorized to vary or exceed the terms of the Warranty Disclaimer or Limitations of Remedies in any manner.

APPENDIX C:

Guidance Documents

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Washington State Department of Ecology 2008 Water Quality Assessments

Listing Detail	Category	WRIA	Water Body Name	Parameter	Medium	Map Link
4805	5	8	SAMMAMISH RIVER	Temperature	Water	4805
7028	5	8	SAMMAMISH RIVER	Temperature	Water	7028
10644	1	8	SAMMAMISH RIVER	pH	Water	10644
10645	1	8	SAMMAMISH RIVER	Ammonia-N	Water	10645
10646	5	8	SAMMAMISH RIVER	Dissolved Oxygen	Water	10646
10647	2	8	SAMMAMISH RIVER	Temperature	Water	10647
10735	1	8	SAMMAMISH RIVER	pH	Water	10735
12561	5	8	SAMMAMISH RIVER	Fecal Coliform	Water	12561
12562	5	8	SAMMAMISH RIVER	Fecal Coliform	Water	12562
12621	1	8	SAMMAMISH RIVER	pH	Water	12621
12670	5	8	SAMMAMISH RIVER	Dissolved Oxygen	Water	12670
12676	5	8	SAMMAMISH RIVER	Dissolved Oxygen	Water	12676
13128	5	8	SAMMAMISH RIVER	Fecal Coliform	Water	13128
41131	2	8	SAMMAMISH RIVER	Temperature	Water	41131
41134	2	8	SAMMAMISH RIVER	Temperature	Water	41134
41135	2	8	SAMMAMISH RIVER	Temperature	Water	41135
41148	2	8	SAMMAMISH RIVER	Temperature	Water	41148
41149	2	8	SAMMAMISH RIVER	Temperature	Water	41149
42085	5	8	SAMMAMISH RIVER	Dissolved Oxygen	Water	42085
46943	5	8	SAMMAMISH RIVER	Fecal Coliform	Water	46943
46974	5	8	SAMMAMISH RIVER	Fecal Coliform	Water	46974
47695	5	8	SAMMAMISH RIVER	Dissolved Oxygen	Water	47695
48012	5	8	SAMMAMISH RIVER	Dissolved Oxygen	Water	48012
48013	5	8	SAMMAMISH RIVER	Dissolved Oxygen	Water	48013
50928	1	8	SAMMAMISH RIVER	pH	Water	50928
51308	1	8	SAMMAMISH RIVER	pH	Water	51308
51309	1	8	SAMMAMISH RIVER	pH	Water	51309

Number of Listings 27

**Bird list for Marymoor Park, 1990-01-01 through 2011-12-31
(plus known historical records of rare species)
220 species + 7 hypotheticals (marked with '?')**

(Species in *italics* have been seen fewer than 10 times, with year of most recent sighting in parentheses)

Status code Key: ("State Status Code", "Federal Status Code ")	Frequency codes:
State:	A --Seen on at least 90% of visits for the month - "always"
SE: State Endangered	C -- Seen on at least 50% but less than 90% of visits - "common"
ST: State Threatened	u -- Seen on at least 20% but less than 50% of visits - "uncommon" or less common
SC: State Candidate	o -- Seen more than twice, but less than 20% of visits - "occasional"
SS: State Sensitive	r -- Seen only once or twice - "rare"
SM: State Monitored	
	Note that the frequency data is constantly being refined through additional visits. Note also that frequencies can change over time. For example, American Bittern occurrence may be correlated with mowing near the slough, which only happens once a every few years. Also, this bird list covers the areas of my weekly walks, and not the park as a whole.
Federal:	
	Understand also that these codes do not imply quantities. One resident individual of one species will result in that species getting an "A" rating if the individual is always noted, whereas a roaming flock of 200 birds of another species may result in a "u" rating if they only visit about a quarter of the time.
FE: Federal Endangered	
FT: Federal Threatened	
FC: Federal Candidate	
Fco: Federal Species of Concern	<i>PLEASE report any unusual sightings of birds at Marymoor Park to Michael Hobbs. Use the table below as a guide to the "unusual" -- I'm interested in sightings in the "o" or "r" category, or anything not previously recorded for that month.</i>

WDFW species of concern status	Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	oddities?
	American Bittern	r	r	o	o	o	o	o	o	o	o	r		
	American Coot	A	A	A	C	u	o	o	o	C	C	A	A	
	American Crow	A	A	A	A	A	A	A	A	A	A	A	A	
	American Dipper (2011)										r			
	American Goldfinch	u	u	u	C	A	A	A	A	A	C	C	C	
	American Kestrel	o		o	o	o	o	r	o	o	o	?	r	
	American Pipit	r		r	o	o				u	u	o	o	
	<i>American Redstart (2002)</i>								r					
	American Robin	A	A	A	A	A	A	A	A	A	A	A	A	
	American Tree Sparrow (2009)	o	o	r	r						r	r		
	American Wigeon	u	u	u	o	r			?	o	u	u	u	

	Anna's Hummingbird	o	u	u	u	u	u	u	u	u	u	u	u	
	Anna's x Rufous Hummingbird hybrid (2010)			r	o									oddities
SM, none	Ash-throated Flycatcher (2010)							o						
	<i>Baird's Sandpiper (2007)</i>									r				
SS, Fco	Bald Eagle	C	C	C	C	C	C	C	C	u	u	u	C	C
	Baltimore Oriole (2006)							r						
	Band-tailed Pigeon	r	r	o	o	C	C	C	u	u	o	r		
	<i>Bank Swallow (2009)</i>							?	r					
	Barn Owl	u	u	u	u	u	u	u	u	u	u	u	u	
	Barn Swallow			o	C	A	A	A	A	A	o	r		
	Barred Owl (2010)				r			r			r			
	<i>Barrow's Goldeneye (2011)</i>	?	o	r	r	r						r		
	Belted Kingfisher	u	u	u	u	C	C	C	A	A	A	C	C	
	Bewick's Wren	A	A	A	C	A	A	A	A	A	A	A	A	
SM, FCo	Black Swift					o	u	o	o	o	r			
SM, none	<i>Black Tern (2004)</i>									r				
	Black-capped Chickadee	A	A	A	A	A	A	A	A	A	A	A	A	
	Black-headed Grosbeak				o	C	A	A	C	u	r			
	Black-throated Gray Warbler				o	o		o	u	u		r		
	<i>Blue-gray Gnatcatcher (1999)</i>											r		
	Blue-winged Teal				r	o	o	r	o	r				
	Blue-winged x Cinnamon Teal hybrid (1999)					r								oddities
	Bohemian Waxwing (2012)		r	r									?	
	Bonaparte's Gull					o	o	o		r	?	o		
	Brant (2009)											r	o	
	Brewer's Blackbird			r	o		o	o	r	o	o		r	
	Brewer's Sparrow (2011)				r		r							
	Brown Creeper	C	u	u	u	u	u	u	u	u	u	u	u	
SE, FCo	Brown Pelican (2008)							r						
	Brown-headed Cowbird			o	C	A	A	A	C	r		r	r	
	Buff-breasted Sandpiper (2005)								r	r				
	Bufflehead	A	A	A	A	u	r				u	A	A	
	Bullock's Oriole					u	u	u						
SC, FCo	Burrowing Owl (2008)				r									
	Bushtit	C	C	A	A	A	A	C	C	C	C	C	C	
	Cackling Goose	u	o	o	r	r			o	o	u	u	u	
	California Gull	o	o	o	o	o	o	o	u	u	C	u	o	
	California Quail	r	o	o	u	o	o	o	o	r	o	r	o	
	Canada Goose	A	A	A	A	A	C	C	A	A	A	A	C	
	Canvasback	u	o	o	o						r	o	o	
SM, none	Caspian Tern				o	o	u	o	o					

	Cassin's Vireo				r	o	o		r	r			
	<i>Cattle Egret (1994)</i>											r	
	Cedar Waxwing	o	o	o	o	C	A	A	A	A	C	u	o
	Chestnut-backed Chickadee	u	C	C	C	C	C	C	C	C	C	C	u
	Chipping Sparrow				o	o	r		r	?			
	Cinnamon Teal			r	o	o							
	Clay-colored Sparrow (2011)									r	o		
	Cliff Swallow				u	C	A	C	u	o			
	Common Canary (escapee) (2007)										r		oddities
	Common Goldeneye	C	C	C	u	r					u	C	
SS, none	Common Loon	o	r	o	u	o	r		?		r	o	o
	Common Merganser	C	C	C	C	C	u	o	o	u	u	u	C
	<i>Common Nighthawk (2010)</i>									o			
	Common Poorwill (2010)									r			
	Common Raven	r		r				r	r	o	o	o	o
	Common Redpoll (2008)	r									r		
	<i>Common Tern (2004)</i>								r				
	Common Yellowthroat			o	C	A	A	A	A	A	o		
	Cooper's Hawk	u	C	u	u	u	u	u	u	u	C	u	u
	<i>Crested Caracara ? (2009)</i>						?						
	Dark-eyed Junco	C	C	C	C	C	C	C	u	C	C	C	C
	Double-crested Cormorant	A	A	A	C	o	o	r	r	o	u	C	A
	Downy Woodpecker	C	C	C	C	C	C	C	C	A	C	C	C
	Dunlin (2009)	o	o									r	r
	<i>Dusky Flycatcher ? (1998)</i>								?				
	Eastern Kingbird (2010)						o		r				
	Eurasian Collared-Dove (2009)				r								
	Eurasian Wigeon (2007)	r											
	European Starling	A	A	A	A	A	A	A	C	A	A	A	A
	Evening Grosbeak	r			r	u	o	r	o	u	o	r	r
	Fox Sparrow	C	C	A	u	r			?	u	C	A	A
	<i>Franklin's Gull (2010)</i>					r						r	
	Gadwall	A	A	A	C	C	C	u	u	u	C	C	C
	Glaucous Gull (2007)		r	r									
	Glaucous-winged Gull	A	A	A	C	C	u	u	u	C	A	A	A
SC, none	<i>Golden Eagle ? (2008)</i>				?								
	Golden-crowned Kinglet	C	C	C	C	C	u	C	u	C	C	C	C
	Golden-crowned Sparrow	A	A	C	C	u				C	C	A	A
SM, none	Great Blue Heron	A	A	C	C	A	A	A	A	A	A	A	A
SM, none	<i>Great Egret (2005)</i>				r								
	Great Horned Owl	o	o	o	o	r		r	r	r	o	r	o

	Greater Scaup	u	u	u	o						o	o	u	
	Greater White-fronted Goose	o	o	o		r			r	o	o	o	u	
	Greater Yellowlegs (2011)				r			r		r		r		
SM, none	Green Heron	u	o	u	u	C	C	C	A	C	u	u	u	
	Green-winged Teal	C	C	C	C	o			o	o	u	u	C	
	Hairy Woodpecker	o	u	u	u	u	u	o	u	u	u	u	u	
	Hammond's Flycatcher (2011)				o	r								
	Hermit Thrush	r		r	u	o				o	o	o	r	
	<i>Herring Gull (2007)</i>		r		?						?			
	Hooded Merganser	A	C	C	u	u	u	C	C	C	C	C	C	
	Horned Grebe	o	o	o	o					o	o	o	o	
	Horned Lark		r		r					o	r	o		
	House Finch	C	C	A	C	C	C	A	A	A	C	A	A	
	House Sparrow	C	C	C	u	u	u	u	u	u	C	u	u	
	<i>House Wren (2007)</i>				r			r	r					
	Hutton's Vireo (2011)			r	r	r	?	r	r			r		
	<i>Jaeger sp. (Parasitic or Long-tailed) (2008)</i>									r				
	Killdeer	u	u	C	C	C	C	C	C	A	C	C	u	
	<i>Lapland Longspur (2005)</i>									o				
	Lark Sparrow (2011)					r								
	Lazuli Bunting					u	u	o	r					
	Least Flycatcher (2010)						o	o						
	Least Sandpiper (2011)					o		r	r					
	Lesser Scaup	u	u	o	o	?					o	o	u	
	<i>Lesser Yellowlegs (2011)</i>					r		r	r	r				
SC, none	Lewis's Woodpecker (2011)					r	r			r				
	Lincoln's Sparrow	u	u	u	u	u		r	o	C	C	C	C	
SC, FCo	Loggerhead Shrike (2011)			r	r									
	Long-billed Dowitcher (2008)							r	?	r				
	Long-eared Owl (2011)	r		o										
	MacGillivray's Warbler					o	r		r	o				
	Mallard	A	A	A	A	A	A	A	A	A	A	A	A	
	Mandarin Duck (escapee) (2006)	r												oddities
	Marsh Wren	C	C	A	A	A	A	A	C	A	C	C	C	
	Merlin	o	o	o	o	r		o	o	o	u	o	o	
	Mew Gull	C	C	C	u	?		?		o	C	C	C	
	Mountain Bluebird			o	o							r		
	Mountain Chickadee (2004)									r				
	Mourning Dove			r	o	u	o	r	o	o	o	o	o	
	Nashville Warbler				o	o			r	o	r			
	Northern Flicker	C	C	A	C	C	C	C	C	A	A	A	A	

SC, FCo	<i>Northern Goshawk ? (2000)</i>			?										
	Northern Harrier	o	o	o	u	o	r	r	o	u	u	u	o	
	Northern Pintail	o	o		o					r	o	o	u	
	Northern Rough-winged Swallow		r	r	o	u	o	r	o					
	<i>Northern Saw-whet Owl (2009)</i>	r												
	Northern Shoveler	u	o	o	o	o			?	o	o	u	u	
	Northern Shrike	u	u	C	o						u	u	u	
	Northern Mockingbird (2006)									r				
	Olive-sided Flycatcher					o	r	r	o	r				
	Orange-crowned Warbler	r		o	C	C	o	o	u	C	u	o	r	
SM, none	Osprey			o	C	C	C	C	C	u	o	r	r	
	<i>Pacific Loon (2009)</i>										r			
	Pacific Wren	u	C	u	o	o				o	u	u	u	
	Pacific-slope Flycatcher				o	o	o	o	u	o	?			
	Pectoral Sandpiper (2011)									r	r			
SS, Fco	Peregrine Falcon	o	o	o	o	o	r	o	r	o	o	o	o	
	Pied-billed Grebe	A	A	A	C	C	C	C	C	A	A	A	A	
SC, none	Pileated Woodpecker	o	o	o	o	o	o	o	o	o	o	o	o	
	Pine Siskin	u	u	C	C	u	u	o	o	o	u	C	C	
	Purple Finch	u	C	C	u	u	u	u	u	C	C	u	u	
SC, none	Purple Martin				o	o	o	u	u	o				
	Red Crossbill (2011)				r	r	r		r	r				
	<i>Red-breasted Merganser ? (2009)</i>				?									
	Red-breasted Nuthatch	u	u	u	u	u	u	u	u	u	u	u	u	
	Red-breasted Sapsucker	o	u	u	u	u	u	u	u	u	u	o	o	
	Red-eyed Vireo					o	C	C	u	o				
	Redhead (2002)		r			r		r				r		
	Red-naped Sapsucker (2011)				r				r			r		
SM, none	Red-necked Grebe	r		r	o	r			r	o	r	r	r	
	Red-tailed Hawk	A	A	A	A	C	C	C	C	C	C	A	A	
	Red-winged Blackbird	A	A	A	A	A	A	A	C	A	A	C	C	
	Ring-Billed Gull	C	C	C	o	o	o	o	o	u	C	A	C	
	Ringed Turtle-Dove (escapee) (2006)						r							oddities
	Ring-necked Duck	C	C	C	u	o				r	u	u	C	
	Ring-necked Pheasant	o	r	o	o	o	o	o	o	o	o	o	o	
	Rock Pigeon	C	A	A	C	A	C	C	A	A	A	A	C	
	<i>Rough-legged Hawk (2006)</i>										r			
	Ruby-crowned Kinglet	A	A	A	C	o			?	u	A	A	A	
	Ruddy Duck	o	r		r						o	o	o	
	<i>Ruffed Grouse (2001)</i>	r				?						?		
	Rufous Hummingbird			u	C	A	C	C	u		r			

SC, none	Sage Sparrow (2007)			r	r								
SC, none	Sage Thrasher (2007)				r	r							
SE, none	Sandhill Crane (2010)				r								
	Savannah Sparrow	o	r	u	A	A	A	A	A	C	C	o	o
	Say's Phoebe			o	o					r			
	<i>Semipalmated Sandpiper (2002)</i>								r				
	Sharp-shinned Hawk	u	o	o	o	o	o	o	o	u	u	u	u
	Short-eared Owl	o	r	o	o	o				r	o	o	r
	Smith's Longspur (2006)								r				
	Snow Bunting (2002)										r		
	Snow Goose	o	r								o	o	o
	Solitary Sandpiper (2011)					o			r				
	Song Sparrow	A	A	A	A	A	A	A	A	A	A	A	A
	Sora				r	r		o	r	r	o		
	Spotted Sandpiper					u	o	u	u	o	r		
	Spotted Towhee	A	A	A	A	A	A	A	A	A	A	A	A
	Steller's Jay	C	C	C	C	C	u	C	C	A	C	C	C
	<i>Surf Scoter (2000)</i>				r								
SM, none	Swainson's Hawk (2008)					r				r			
	Swainson's Thrush				o	C	A	A	C	C	o		
	Swamp Sparrow	r	r								r	o	r
	<i>Thayer's Gull (2004)</i>	?	r									r	
	Townsend's Solitaire (2011)			r	r	r							
	Townsend's Warbler	o	o	o	o	o	r		r	o	u	u	o
	Tree Swallow		o	C	C	A	A	C	o				
	Tropical Kingbird (2007)										r		
	Trumpeter Swan	o		o							r	o	o
	Tundra Swan (2011)	r				?						o	r
SM, none	Turkey Vulture		r	o	r	o		r		o	o		
	Varied Thrush	o	o	o	o	r				o	u	o	o
SC, none	Vaux's Swift				o	C	C	C	C	C	r	r	
	<i>Vesper Sparrow (2009)</i>					r		?	r	r			
	Violet-green Swallow		r	C	A	A	A	A	C	u	o		
	Virginia Rail	u	u	C	u	u	o	u	u	u	u	u	u
	Warbling Vireo				o	C	C	C	u	u			
	<i>Western Bluebird (2001)</i>					r							
SC, none	Western Grebe	o	o	o	r	r	o	r	r	o	C	u	o
	Western Gull	o	o	o	o	r	r				o	o	o
	Western Kingbird				o	u	o	r		r			
	Western Meadowlark	u	u	C	u	o			r	o	u	u	o
	Western Sandpiper (2011)				?	r		?					

Friends of Marymoor Park

Marymoor Park Plant List

Marymoor Park plant inventory conducted on 10/15/00 and 5/31/02 on Washington Native Plant Society field trips led by Fred Weinmann.. The list combines observations from both dates. Very few species were seen in October that were not seen in May. No attempt has been made by Fred to catalog the planted species around the Clise Mansion, nor the area north of the through access road, nor west of the Sammamish Slough.

Nomenclature has been updated and will, therefore, not be the same as found in Hitchcock and Cronquist (1973). Nomenclature is from the book by Arthur Lee Jacobson, Wild Plants of Greater Seattle (2001). 151 species; 64 native, 87 introduced, 12 listed as noxious. N=Native to King County; I=Introduced species; f=flower or fruit of current year; nox.= listed as category A, B, C, or Weed of Concern on 2012 King County Noxious Weed List. Vascular plants by Fred Weinmann; Bryophytes by Denise Liguori.

A couple of additions have been made to the list based on additional visits by Michael Hobbs.

Scientific name	Common name	Origin
Coniferous Evergreen Trees		
<i>Pinus contorta</i> v. <i>latifolia</i>	Shore pine	N, planted
<i>Thuja plicata</i>	Western red cedar	N, planted
<i>Tsuga heterophylla</i>	Western hemlock	N
<i>Pseudotsuga menziesii</i>	Douglas fir	N
Deciduous Trees		
<i>Acer circinatum</i>	Vine maple	N, f
<i>Acer macrophyllum</i>	Bigleaf maple	N, f
<i>Alnus rubra</i>	Red alder	N
<i>Betula pendula</i>	European white birch	I, f
<i>Cornus nuttallii</i>	Pacific dogwood	N
<i>Crataegus monogyna</i>	Common hawthorn	I, f, nox
<i>Crataegus phaenopyrum</i>	Washington hawthorn	I, f
<i>Malus x domestica</i>	Domestic apple	I, f
<i>Fraxinus latifolia</i>	Oregon ash	N, f
<i>Populus balsamifera</i>	Black cottonwood	N, f
<i>Populus tremuloides</i>	Quaking aspen	N
<i>Prunus avium</i>	Mazzard cherry	I, f
<i>Prunus cerasifera</i>	Cherry plum	I
<i>Prunus domestica</i>	European plum	I
<i>Prunus emarginata</i>	Bitter cherry	N, f

Rhamnus purshiana	Cascara	N, f
Salix geyeriana	Geyer's willow	N, f
Salix lucida s. lasiandra	Pacific willow	N, f
Salix piperi	Piper's willow	N
Salix scouleriana	Scouler's willow	N, f
Salix sitchensis	Sitka willow	N, f
Sorbus aucuparia	European Mountain As	l, f, nox
Broadleaf Evergreen Trees		
Arbutus menziesii	Madrone	N, f
Ilex aquifolium	English holly	l, nox
Prunus laurocerasus	English laurel	l, nox
Deciduous Shrubs		
Corylus avellana	Cultivated hazelnut	l
Corylus cornuta v. californica	Western beaked hazelnut	N
Cornus sericea s. occidentalis	Red osier dogwood	N, f
Lonicera involucrata	Black twinberry	N, f
Oemleria cerasiformis	Indian plum	N, f
Physocarpus capitatus	Pacific ninebark	N, planted
Ribes lacustre	Swamp black gooseberry	N, planted
Ribes sanguineum	Redflower gooseberry	N, planted
Rosa nutkana	Nootka rose	N, planted
Rosa pisocarpa	Peafruit rose (Swamp rose)	N
Sambucus racemosa	Red elderberry	N, f
Spiraea douglasii	Hardhack	N
Symphoricarpos albus	Snowberry	N
Vaccinium corymbosum	Common blueberry	l
Viburnum opulis	Highbush cranberry	l, f
Broadleaf Evergreen Shrubs		
Berberis aquifolium	Tall Oregon grape	N, f
Cytisus scoparius	Scotch broom	l, f, nox
Woody Vines		
Hedera helix	English ivy	l, nox
Lonicera ciliosa	Orange honeysuckle	N
Lonicera periclymenum	European honeysuckle	l
Brambles		
Rubus armeniacus	Himalaya blackberry	l, nox
Rubus laciniatus	Evergreen blackberry	l, nox
Rubus parviflorus	Thimbleberry	N, f
Rubus spectabilis	Salmonberry	N, f

Rubus ursinus	Trailing blackberry	N, f
Wildflowers and Weeds		
Achillea millefolium	Yarrow	N/I
Aphanes australis	Slender parsley piert	l, f
Arabidopsis thaliana	Mouse-ear cress	l, f
Bellis perennis	English lawn daisy	l, f
Bidens frondosa	Leafy beggar-tick	N
Brassica campestris	Field mustard	l, f
Callitriche stagnalis	Common water starwort	l
Capsella bursa-pastoris	Shepherd's purse	l, f
Cardamine hirsuta	Hairy shotweed	l, f
Cerastium glomeratum	Sticky mouse-ear	l, f
Cerastium vulgatum	Common mouse-ear	l, f
Cirsium arvense	Canada thistle	l, nox
Cirsium vulgare	Bull thistle	l, nox
Convolvulus arvensis	Field bindweed	l, nox
Crepis capillaris	Smooth hawk's beard	l
Epilobium ciliate ssp. watsonii	Watson's willowherb	l
Filago minima?	Small cudweed	l
Fragaria vesca	Woodland strawberry	N, f
Galium aparine	Common bedstraw	N, f
Galium trifidum	Marsh cleavers	N, f
Geranium dissectum	Cut-leaf geranium	l, f
Geranium molle	Dovefoot geranium	l, f
Geranium robertianum	Herb-robert	l, f
Geum macrophyllum	Big-leaf avens	N, f
Glechoma hederacea	Creeping charlie	l
Hypochaeris radicata	Hairy cats-ear	l, f
Iris pseudacorus	Yellow flag iris	l, f, nox
Lactuca muralis	Wall lettuce	l
Lamium purpureum	Purple dead nettle	l, f
Lapsana communis	Nipplewort	l, f
Lemna minor	Common duckweed	N
Lotus corniculatus	Birdsfoot trefoil	l
Lotus micranthus	Small-flowered lotus	N, f
Ludwigia palustris	Water purslane	N
Lycopus americanus	Water horehound	N
Lysimachia vulgaris	Garden loosestrife	l, nox
Lythrum salicaria	Purple loosestrife	l, nox
Matricaria discoidea	Pineapple weed	l, f
Mycelis muralis	Wall lettuce	l
Myriophyllum spicatum	Eurasian water milfoil	l, nox
Najas flexilis	Wavy water-nymph	N

<i>Nuphar polysepalum</i>	Yellow water lily	N, f
<i>Nymphaea odorata</i>	White water lily	l, f, nox
<i>Oenanthe sarmentosa</i>	Water parsley	N
<i>Plantago lanceolata</i>	English plantain	l, f
<i>Plantago major</i>	Common plantain	l, f
<i>Polygonum amphibium</i>	Water smartweed	N
<i>Polygonum aviculare</i>	Doorweed	l
<i>Polygonum hydropiperoides</i>	Waterpepper	N
<i>Polygonum persicaria</i>	Spotted smartweed	l
<i>Potentilla palustris</i>	Swamp cinquefoil	N
<i>Prunella vulgaris</i> var. <i>vulgaris</i>	Self heal	l
<i>Ranunculus acris</i>	Meadow buttercup	l, f
<i>Ranunculus repens</i>	Creeping buttercup	l, f
<i>Rorippa curvisiliqua</i>	Western yellow-cress	N
<i>Rumex acetocella</i>	Sheep sorrel	l, f
<i>Rumex crispus</i>	Curly dock	l
<i>Sagina occidentalis</i>	Western pearlwort	N, f
<i>Scutellaria lateriflora</i>	Mad dog skullcap	N
<i>Solanum dulcamera</i>	Bittersweet nightshade	l
<i>Sonchus arvensis</i>	Field sow thistle	l
<i>Spergularia rubra</i>	Red sand spurry	l, f
<i>Stellaria media</i>	Garden chickweed	l, f
<i>Tanacetum vulgare</i>	Common tansy	l, nox.
<i>Taraxacum officinale</i>	Dandelion	l, f
<i>Trifolium pratense</i>	Red clover	l, f
<i>Trifolium repens</i>	White clover	l, f
<i>Urtica dioica</i>	Stinging nettle	N, f
<i>Utricularia vulgaris</i>	Common bladderwort	N, f
<i>Veronica arvensis</i>	Wall speedwell	l, f
<i>Veronica scutellata</i>	Marsh speedwell	N
<i>Vicia sativa</i>	Common vetch	l, f

Rushes, Sedges, and Grasses

<i>Agrostis capillaris</i>	Colonial bentgrass	l
<i>Aira caryophyllea</i>	Silvery hairgrass	l, f
<i>Aira praecox</i>	Little hair grass	l, f
<i>Anthoxanthum odoratum</i>	Sweet-vernal grass	l, f
<i>Bromus diandrus</i>	Ripgut brome	l, f
<i>Bromus mollis</i>	Smooth brome	l, f
<i>Bromus sitchensis</i>	Sitka brome	N
<i>Carex deweyana</i>	Dewey's sedge	N, f
<i>Carex lenticularis</i>	Lens-fruited sedge	N, f
<i>Carex obnupta</i>	Slough sedge	N, f
<i>Dactylus glomerata</i>	Orchard grass	l, f

<i>Festuca arundinacea</i>	Tall fescue	l, f
<i>Festuca rubra</i> v. <i>rubra</i>	Red fescue	l, f
<i>Holcus lanatus</i>	Velvet grass	l, f
<i>Hordeum marinum</i>	Farmer's foxtail	l, f
<i>Juncus articulatus</i>	Jointed rush	N
<i>Juncus bufonius</i>	Toadrush	N
<i>Juncus effusus</i> var. <i>effusus</i>	European soft rush	l
<i>Juncus tenuis</i>	Slender rush	N, f
<i>Lolium perenne</i>	Perennial ryegrass	l, f
<i>Phalaris arundinacea</i>	Reed canary-grass	l, nox
<i>Phleum pratense</i>	Timothy	l
<i>Poa annua</i>	Annual bluegrass	l, f
<i>Poa pratensis</i>	Kentucky bluegrass	l
<i>Poa trivialis</i>	Rough bluegrass	l, f
<i>Scirpus acutus</i>	Hardstem bulrush	N, f
<i>Typha latifolia</i>	Common cattail	N
<i>Vulpia myuros</i>	Rat-tail fescue	l, f
Ferns and Horsetails		
<i>Athyrium filix-femina</i>	Lady fern	N
<i>Equisetum arvense</i>	Field horsetail	N
<i>Polypodium glycyrrhiza</i>	Licorice fern	N
<i>Polystichum munitum</i>	Sword fern	N



December 6, 2012

Ben Peterson, Aquatic Weed Specialist
King County Noxious Weed Control Program
201 S Jackson St
Ste. 600
Seattle WA 98104

SUBJECT: Sammamish River IAVMP (T26N R04E S11, 12; T26N R05E S7, 8, 9, 10, 15, 22, 23, 26, 27, 34, 35; T25N R05E S2, 11, 13, 14)

We've searched the Natural Heritage Information System for information on significant natural features in your project area. Currently, we have no records for rare plants or high quality native ecosystems in the vicinity of your project.

The information provided by the Washington Natural Heritage Program is based solely on existing information in the database. In the absence of field inventories, we cannot state whether or not a given site contains high quality ecosystems or rare plant species; there may be significant natural features in your study area of which we are not aware.

The Washington Natural Heritage Program is responsible for information on the states rare plants as well as high quality ecosystems. For information on animal species of concern, please contact Priority Habitats and Species, Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia WA 98501-1091, or by phone (360) 902-2543.

For more information on the Natural Heritage Program, please visit our website at http://www.dnr.wa.gov/ResearchScience/Topics/NaturalHeritage/Pages/amp_nh.aspx. Species lists and fact sheets, as well as rare plant survey guidelines are available for download from the site. For the self-service system, please follow the Reference Desk link to Location Search. Please feel free to e-mail us at natural_heritage_program@dnr.wa.gov if you have any questions.

Sincerely,

Jasa Holt, Data Specialist
Washington Natural Heritage Program

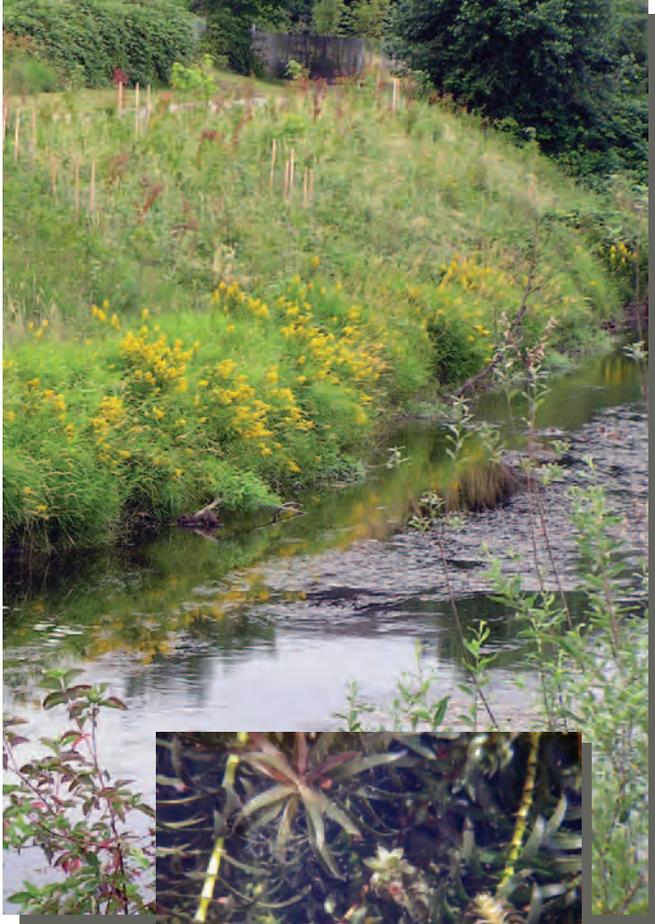
Forest Resources & Conservation Division, PO Box 47016, Olympia WA 98504-7016

APPENDIX D:

Outreach Materials

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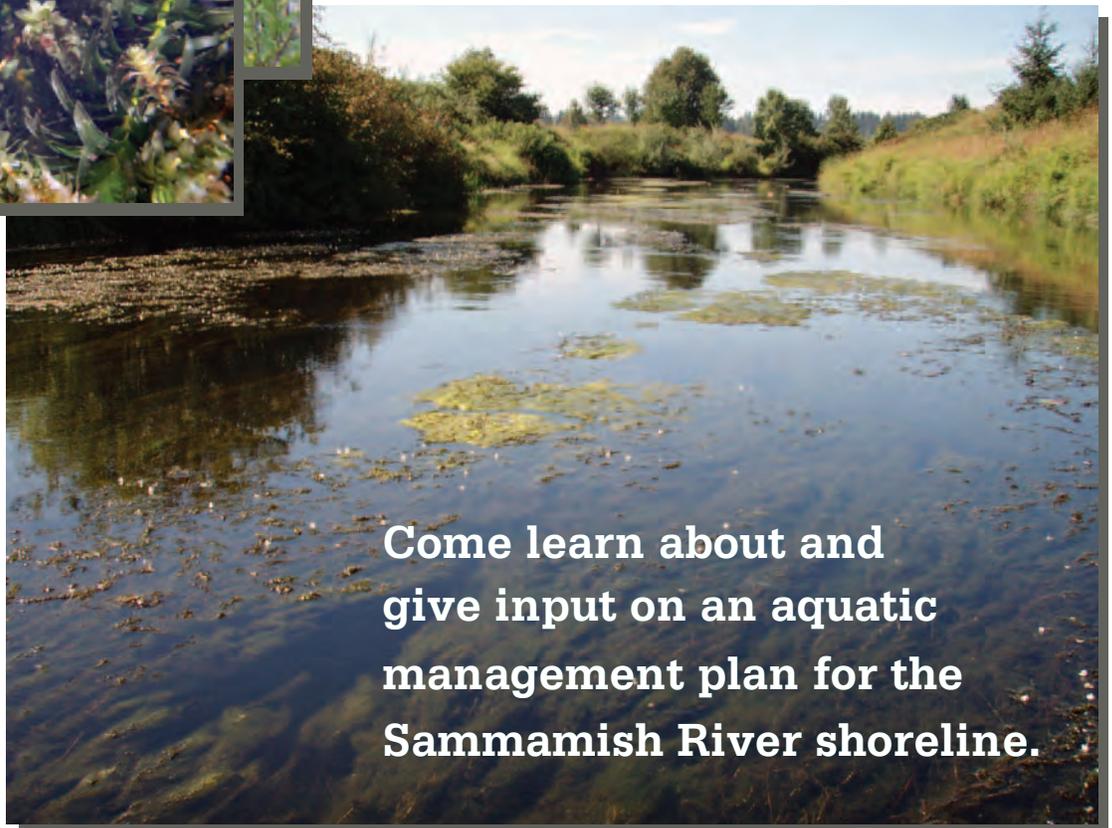
Sammamish River IAVMP Public Meeting



**Thursday, May 9, 2013
7:00-8:30pm**

**Redmond City Hall (Council Chamber)
15670 NE 85th Street, Redmond, WA**

Come learn about and give input on the Sammamish River Integrated Aquatic Vegetation Management Plan (IAVMP). The plan is being developed by King County Water and Land Resources Division staff in conjunction with local municipal, commercial, non-profit and citizen interests. This plan is intended to provide a framework to help shoreline land owners achieve control of regulated aquatic noxious weeds along the Sammamish River.



**Come learn about and
give input on an aquatic
management plan for the
Sammamish River shoreline.**

Contact:

Beth leDoux
Water Quality Planner
King County WLRD
beth.ledoux@kingcounty.gov
206-263-6242



**Department of
Natural Resources and Parks**
Water and Land Resources Division
King Street Center, KSC-WLR-0600
201 S. Jackson Street, Suite 600
Seattle, WA 98104-3855

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Alternative Formats Available
206-684-1280 or 711 TTY Relay



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Contact:

Beth leDoux | Water Quality Planner | King County WLRD
beth.ledoux@kingcounty.gov | 206-263-6242

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206-684-1280 or 711 TTY Relay

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King County



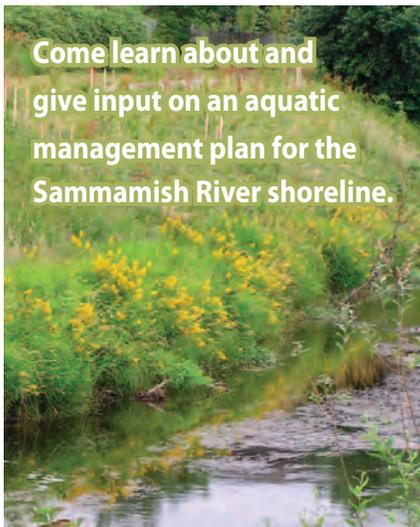
King County

Department of Natural Resources and Parks
Water and Land Resources Division

Noxious Weed Control Program

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