

IPM PROFILE

Japanese Knotweed (*Polygonum cuspidatum* ~ *Fallopia japonica*)

Giant Knotweed (*P. sachalinense* ~ *F. sachalinensis*)

Bohemian Knotweed (*P. bohemicum* ~ *F. x bohémica*)

Himalayan Knotweed (*P. polystachum* ~ *Persicaria wallichii*)

July 9, 2004

UPDATED November 2007

Plant Characteristics:

These knotweed species and their hybrids are tall shrub-like, perennial herbaceous plants currently listed as Class B Noxious Weeds. There is some dispute about the botanical nomenclature of these four species (Flora of North America North of Mexico Volume 5 2005), but the detrimental effects on the native habitat by all of these species remain unchanged.

The basal root crown will produce 30-50 stout bamboo-like shoots that may reach to 15 feet tall or more (giant knotweed). The hollow shoots may be an inch or more in diameter with swollen nodes three to five inches apart that are reddish-brown in color. The leaves are produced on upper stems and on the limited side branching. The leaves size and shape vary between species. Japanese knotweed leaves have a truncated base; giant knotweed has huge elephant ear shaped leaves; and Himalayan knotweed has elongate triangular-shaped leaves. The smooth-edged leaves are green and occur singly at each node in an alternate pattern. Tiny white or greenish flowers appear in open sprays near stem ends during July and August and produce a small winged fruit. The tiny seeds (about one tenth of an inch long) are transported by water, short distances by wind, and in attached mud. The seeds of hybrid knotweeds are considered fertile. The Nature Conservancy has germinated knotweed seeds in the laboratory. Plants arise from fibrous roots and produce a spreading rhizome system, possibly from each major shoot, that may extend to 25 to 40 feet or much more. The rhizomes can penetrate more than seven feet into the soil. Individual plants may be 8-15 feet in diameter or more, and often occur in large clumps of several hundred square feet to several acres or they can occupy an entire shoreline. The plants die back after a hard frost, but bare brown stalks often remain through the winter. Knotweeds regrow very rapidly in the spring, often reaching 15 feet by June (giant knotweed). Japanese knotweed typically grows to ten feet with the smaller Himalayan knotweed only reaching four to six feet. Himalayan and Japanese knotweeds are known to form a viable hybrid called Bohemian knotweed (*P. bohemicum*). Growth of the knotweed plants starts in April or earlier in warmer regions, or as late as June in higher elevations. Young knotweed shoots resemble red asparagus. New plants can establish from seeds, broken off stem parts, or from any node along the rhizomes. As little as a half inch plant piece can start a new plant. Pictures are provided on the following website: <http://dnr.metrokc.gov/wlr/lands/weeds/weedid.htm>

Distribution and Impacts:

Knotweeds prefer sunny locations, but they can tolerate a wide variety of environmental conditions. They can exist in nearly complete shade with reduced growth. These knotweed species are widespread in western Washington, and occur in almost any environment with at least temporary damp soil to get plants established. They are found in riparian zones along rivers and streams, in disturbed uplands and along crop field edges, in city lots and forest edges, etc. in areas that usually have a fairly high rainfall. Knotweeds are also found in eastern Washington. Currently their distribution is mainly as planted garden ornamentals, but they are also found in limited areas outside of ornamental plantings.

Knotweed is fast growing and extremely aggressive. One small plant can grow up to a foot a week. Huge patches establish fast, invading river and creek banks. In the Pacific Northwest knotweed usually spreads when roots are moved by floods or in soil contaminated with root or shoot fragments. Mowing knotweed can also spread it further. Because root fragments as small as ½ inch can start new plants, even one knotweed patch can produce hundreds of new plants.

Without intervention, knotweed can permanently displace native vegetation, destroy fish and wildlife habitat and reduce recreational opportunities. Initial research indicates that knotweed pulls nitrogen out of our nitrogen-deficient soils without returning it with leaf fall (L. Urgenson). This could eventually disrupt the food chain in an aquatic system. Knotweed threatens our current and future salmon populations through loss of insects and shady areas. Knotweed infestations compete for space with trees. Trees not only provide more shade for fish habitats, but also provide better root structure to slow erosion, and decomposing logs produce important nutrients for animals that line in or around the water. Also, trees supply large woody debris which slows water velocity and creates pools, improving habitat for salmon. Knotweeds can also invade man-made structures such as foundations and roads, causing expensive damage.

MANAGEMENT PLANS

Integrated Pest Management, as defined by RCW 17.15, is a coordinated decision-making and action process that uses the most appropriate pest control methods and strategy in an environmentally and economically sound manner to meet programmatic pest control objectives.

When following this IPM plan, be sure that site-appropriate control methods are used.

A knotweed control guide *Controlling Knotweed in the Pacific Northwest* was developed by The Nature Conservancy, Metro, Portland Parks, and the Northwest Chapter of the Society for Ecological Restoration in February 2002. Information from this control guide was used extensively for this initial IPM plan (July 2004).

Many western Washington County Noxious Weed Programs are now involved in large scale knotweed management programs. Much of the control information found in this

IPM Knotweed Profile update (November 2007) was used in the field by the Olympic Knotweed Working Group and reported by the Clallam County Noxious Weed Control Program in 2007.

- **When dealing with these riparian infestations, it is imperative to start at the upstream edge of the infestation and work downstream. An infestation along the Hoh River was traced back to a single ornamental planting where broken off plant parts entered the river and established new plants downstream.**

Knotweeds continue to be increasingly problematic along riparian corridors in western Washington. These plants are very difficult to control because they have an extensive rhizome system and an incredible ability to resprout. Except for small patches that might be able to be controlled non-chemically, any management of these species will likely require some herbicide use.

It is not considered possible to eradicate these knotweeds species from Washington, but with large scale removal projects and long term monitoring it may be possible to eliminate them from high quality riparian areas, particularly areas where knotweeds may be degrading salmon rearing habitat.

For more information, please contact:

- **Clallam County Noxious Weed Control Program 360-417-2442**
- **Clark County Noxious Weed Control Board:**
<http://www.co.clark.wa.us/enviro/Knotweed.pdf>
- **Knotweed Alliance:**
http://www.cabi-bioscience.org/html/japanese_knotweed_alliance.htm
- **WSDA Knotweed Control Program, Marshall Udo, Coordinator**
<http://agr.wa.gov/PlantsInsects/Weeds/Knotweed/Knotweed.htm>

CONTROL METHODS

Listed below are a range of options, or a combination of options, that may be suitable for site specific control of knotweeds. These control methods are listed in the following order, and include: Prevention, Mechanical, Cultural, Chemical and Biological Controls.

EARLY DETECTION, PREVENTION, FOLLOW-UP

The knotweeds are very widespread throughout western Washington, and they continue to spread. Learn to identify these knotweed species and remove any new infestations. In eastern Washington it is still an option to prevent these species from becoming widespread, as many of the known sites are mainly ornamental plantings in private yards.

All four knotweed species in this profile are quarantine species, found on the WSDA Prohibited Plant List. It is prohibited to transport, buy, sell, offer for sale or distribute plant parts of the regulated species within the state of Washington, or to sell, offer for sale, or distribute seed packets of the seed, flower seed blends or “wildflower mixes” of these species within the state.

MECHANICAL CONTROL

Mechanical Removal: This technique can be used on single plants and on some larger infestations, but it will be costly to contract suitable equipment. Remove all top vegetation and rhizomes out to at least 50 feet from each plant. It is critical to remove all vegetation including rhizomes and stems, because they will generate new plants from each node if they remain in contact with moist soil. Once this operation is completed, revegetate with appropriate native plants that cast heavy shade on the ground. Plan for at least annual monitoring for new plants from missed plant parts and seed, and treat or remove immediately.

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

In soft soil or sand, pull up the plant by the root crown, trying to remove as much of the rhizomes as possible. About a week after this effort, search for and pull up any resprouting plants and as much of the rhizome as possible. Search for resprouts at least 20 feet around the location of the original plant. Continue this effort until frost and then start again in the spring. The Nature Conservancy reports that it can take up to three years of consistent effort to eradicate a small patch of plants using this method.

Plants and rhizomes of knotweeds might possibly also be dug out, but this is a slow labor intensive process and probably not practical with anything more than a very small infestation of several plants. Tilling also produces many resprouts but could be used in combination with a hand pulling effort.

The Four T's - If you control knotweed manually, be sure to practice the four T's: be Timely, Tenacious, Tough and Thorough. This advice applies to other noxious weeds with rhizomes.

--The Nature Conservancy, from "*Controlling Knotweed in the Pacific Northwest*"

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

Covering: There are anecdotal reports of successful control of small patches of plants using a combination of cutting, hand pulling, and/or tilling, followed by covering. After cutting the plants down to ground level, cover the area with several layers of black plastic or several layers of cardboard. Extend the area of coverage to at least 20 feet or more around the outside of the plant and check at intervals to make sure that shoots are not coming up outside of the cover or through the cover. Knotweeds have been known to grow through asphalt! The cover needs to be left in place for at least one full year and probably longer. Inspect the site on a frequent basis to locate new growth or seedlings and remove immediately to maintain major management gains.

CULTURAL CONTROL

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

Grazing: The Knotweed Alliance Website (http://www.cabi-bioscience.org/html/japanese_knotweed_alliance.htm) indicates that the young shoots of Japanese knotweed are palatable to sheep, goats, cattle and horses and grazing may be used in suitable situations to keep the plant under control. Goats will eat most plants down to stems too woody for ingestion. Grazing will not eradicate Japanese knotweed and the plant will continue to grow once grazing ceases. Grazing may be suitable for quarter acre and larger infestations when the plants have put up enough top growth to support the livestock. Contain the animals on the area by fencing. When all weed growth has been grazed, remove the animals and let the plants develop new shoots. When growth becomes abundant enough to support grazing again, let the animals eat it down a second time. Continue this throughout the growing season and at least through next summer. This may kill some plants and greatly weaken others, as well as, breakup the dense mat of rhizomes extending out from each plant. Under an IPM plan, grazing could be followed, by herbicide application to kill existing re-growth, then re-vegetation with suitable native plants to create dense shade. Plan on at least annual monitoring for re-growth from seed, rhizomes or broken off stems and treat or remove immediately.

Please contact the Clallam County Noxious Weed Program for information regarding a booklet on goats used for knotweed control.

CHEMICAL CONTROL

The following control information was reported in the Olympic Knotweed Working Group 2007 Report, prepared by the Clallam County Noxious Weed Control Program.

The Olympic Knotweed Working Group, covering Clallam and Jefferson Counties, has tried manual control methods and concluded they were ineffective for all but the smallest infestations. The Nature Conservancy was only able to control one small patch (25 stems) with 17 monthly cuttings over three field seasons. Clallam County does not have the

resources to use this method because knotweed is spreading rapidly. The size of existing infestations on many of the rivers is already daunting, and they needed to act quickly before the problem is out of control. Some patches have over 1000 stems, and one site in Clallam County had over two solid acres of knotweed!

- Knotweed has a huge root system with the ability to resprout following cutting. Thus, manually pulling or digging the root system usually leaves behind rhizomes that can resprout in a couple of weeks.
- The herbicides chosen to treat knotweed have been selected for the lowest toxicity possible, as well as for the maximum efficiency to kill the plant.

Several different herbicides are used to remove knotweed. These include:

- Glyphosate, the active ingredient of Roundup. Aqua Neat, AquaMaster, or Glypro are brand names of glyphosate products designed to be less toxic to the environment and labeled for use on rivers, lakes, and streams.
- Imazapyr, in small amounts, may be mixed with glyphosate. Some brand names for imazapyr products used in water are Habitat or Polaris AQ. Imazapyr is similar to glyphosate, has a very low toxicity to most animals, but does remain in the soil longer than glyphosate. Mixing two kinds of herbicides together often improves the effectiveness when compared with using each herbicide individually. Mixing the glyphosate and imazapyr together, reduces the total amount of herbicide used.
- Surfactant, (sometimes called a sticker) is an ingredient that is added to the spray mixture to ensure that the foliage soaks up the herbicide. The Working Group has chosen surfactants that studies have shown to have low toxicity to animals, especially ones that live in water.
- Marker dye, a blue-colored dye called Blazon is mixed into the herbicide spray mix. The dye indicates where herbicide has been applied and minimizes accidental human contact. This dye is not toxic.

General Steps for Knotweed Control:

1. Positively identify your knotweed species.
2. Treat after the canes are four or more feet tall. Treatment is recommended from around May-October, or until plants are dying back for the season.
3. Check your site. To use herbicides in or near water, you must be a licensed, aquatic applicator. Most aquatic sites also require a special permit. Contact the Weed Board for help with knotweed control in aquatic sites at 360-417-2442 or in the west Olympic Peninsula, call 360-963-2300.
4. It is a violation of Federal law to use herbicides in a manner that is inconsistent with the label. Carefully read all directions for use before applying. Call if you have questions.
5. Post notices that an area has been treated wherever there is public access, such as businesses or parks. With glyphosate and imazapyr, notices can be taken down after 24 hours.
6. Before treatment, protect yourself with non-absorbent gloves (thin latex works well), eyewear, long-sleeved shirt, long pants, and closed toe shoes. The greatest risk generally occurs when mixing or pouring concentrated herbicide. Consider protecting

your mixing site with disposable plastic to catch any spills. Carefully wrap up and dispose of the plastic properly after treatment, or you may wash in the same way as herbicide equipment. See instructions below.

7. Have water available for mixing or rinsing equipment after treatment.
8. Treatment: Injection, Foliar, Wipe. See below for specific application instructions.
9. Document your treatments, to know how much you had, what you did, and how well the treatment worked. Monitor treated areas for several years. Re-treat as needed. Don't let plants come back!

2007 Treatment Recommendations and Rates Summary:

- For **small patches** (less than 2300 canes) with large diameter canes: Inject 3-5 ml of undiluted glyphosate. If using AquaNeat-do not use more than 7 ½ quarts/acre. Be sure to check the acreage limit for the specific product you are using.
- For treatment of **large patches (or if foliar application is desired)**: Spray foliage until wet using a solution of one of the following:
- **6%-8% solution of glyphosate** (For AquaNeat this equals 7 oz. -10 ¼ fl. oz per gallon water), **PLUS ½ % to 2% surfactant**, (Use the specific label to determine how many ounces per gallon must be added to equal this percentage. Many non-aquatic formulations of glyphosate already contain some surfactant), **PLUS marker dye**, (Blazon Blue for aquatic sites, many others available for terrestrial) as needed (just enough to make it blue, **as little as ½ fl oz.** per gallon of water).

OR

3%-5% glyphosate, PLUS ½ to 1% imazapyr (For Habitat this equals 0.6 oz-1.3 fl oz per gallon water), **PLUS ½ % to 2% of surfactant**, (See above-Use the specific label to determine how many ounces per gallon) **PLUS marker dye** as needed, (just enough to make it blue, as little as ½ oz. per gallon of water).

For Re-Treatments: Several Options and Recommendations

- **INJECT** at highest allowed rate, if cane diameter is large enough
- Foliar treat at the higher rate. Plants may have been missed the previous season. For those showing herbicide symptoms, use the combination of glyphosate (AquaNeat) and imazapyr (Polaris AQ or Habitat), at the higher rates mentioned above, with higher rates of surfactant.
- For small plants, wipe with 33% solution of glyphosate (mix one part of AquaNeat product with 2 parts water) plus 10% by volume of surfactant (12 oz per gallon). Add enough marker dye to make it blue.

OR

- **WIPE** a total of 33% solution of glyphosate (eg. AquaNeat) plus imazapyr (eg. Polaris AQ or Habitat)- add surfactant as above, and marker dye.
- Where feasible, and after multiple retreatments have greatly destroyed much of the root system and reduced overall infestation, consider digging last spindly plants and as much of the root as possible.
- **MONITOR** site for several years, and remove any plants that develop.

NOTE: Some programs have used triclopyr successfully. Ask your weed control specialist for the latest information about rates and efficacy. Improper disposal of knotweed canes or roots often leads to new infestations. Never throw untreated knotweed plants or parts into the water. Burn canes and roots or allow knotweed debris to dry thoroughly in a location that can be monitored frequently to ensure that no resprouting occurs.

INJECTION TREATMENT

- **Injection Application:** Use on patches less than 1400-2000 canes, depending on the label and application rate. Canes need to be about ¼ inch diameter or larger (about the size of a little finger). Smaller canes will likely need to be sprayed or wiped with a concentrated mixture (see Wipe below). Only glyphosate is registered for injection.
- **Herbicide:** Use concentrated glyphosate **only**, no surfactant, or dye. **Glyphosate is a non-selective herbicide that can injure other desirable plants**, so be careful not to drip or rinse onto non-targeted plants. **Check the label for maximum rates.** Generally, YOU MAY NOT USE MORE THAN 7 1/2 -8 quarts of **glyphosate/acre**. Do not exceed the maximum rate allowed on the label!
- **Equipment:** Each injector kit contains: a numbered injector gun, an herbicide canister, a capped measuring tube with a long and a short needle inside, and an allen wrench. Marking paint and a garbage sack are optional, but suggested.

Directions for Injection Treatment:

- **Measure** the area of the infestation to determine how much herbicide is needed.
- **Post** an herbicide notice if it is required. Remove after 24 hours.
- **Write** down the amount of herbicide in the container before you pour any out; this makes it easy to know how much has been used by the end of the treatment.
- **Put on personal protection equipment**, including gloves and eye-protection. Wear long-sleeved shirt, pants, and closed-toe shoes.
- **Assemble** the injector tool. To attach the needle, pull back the quick release ring on the gun. Attach the needle, with the **hole pointing down**. Be sure the quick release ring snaps fully into place or the needle will come loose. Before attaching the canister to the top of the injector gun, inspect the threads for any debris. Rinse or clear anything in the threads. Do not tighten down the canister too hard, or you will crack the body of the injector and it will leak or fail to pressurize.
- **Pour** undiluted glyphosate into the injector canister. Try to measure out only the amount you plan to immediately use for treatment and no more. Close the lid to the herbicide container as soon as you have finished pouring. **ALWAYS AVOID POURING HERBICIDE BACK INTO THE ORIGINAL CONTAINER.**
- **Calibrate**, using the small plastic, measuring tube provided in the kit. It takes a couple of squirts to build up pressure. Make sure the tool is not delivering more than 5 ml. Turn the set screw in the handle (using the allen wrench provided in the kit) to adjust flow. Out-reduces flow, in-increases flow. After adjusting, recheck calibration. After you are satisfied, pour the herbicide generated from calibration into the injector's canister. Calibrate every time you fill the canister again.
- **Inject 3-5 mls of undiluted** glyphosate into the middle of the lowest node of each suitable cane. Short needles seem to work best, long ones tend to bend or break, but

may be best when the plant is full of water. If you feel too much back pressure, poke a couple of holes higher up in the node to let out the pressure. Try slanting the needle down for canes that are smallish for this method. Older canes can be brittle and may crack when injected. Consider marking treated canes as you go. This will avoid “skips”. We use a small dot of spray paint.

- **Rinse all** equipment that may be contaminated with herbicide three times (triple rinse). **There will be a cleaning fee charged for any loaned equipment that is returned without adequate cleaning.**
- **Dispose** of rinsate on undesirable plants on-site.
- **Repack** injector kit and **return** promptly along with any unused herbicide.
- **Fill out** knotweed control sheet and turn in with equipment. Let us know of any equipment problems.
- **Don’t cut or disturb stems for at least a week to ten days after an application.**
- **Wash** before eating or drinking and after treatment.
- **Wash clothes** that may have been contaminated by herbicide separately from other laundry.

FOLIAR TREATMENT

- **Foliar Application:** Use on large patches, small diameter plants, or simply as desired. Several treatments will be necessary, but each treatment is generally faster and uses less herbicide than injection. Foliar applications can be used in conjunction with injection. When combining treatment methods, inject first, follow with spot foliar treatment. Consider shielding desirable plants.
- **Herbicide:** Many products are available but we are currently using glyphosate, (or a mix of glyphosate and imazapyr), surfactant, and marker dye.
- **Equipment:** Handheld backpack sprayer, (holds up to 4 gallons), measuring cup.

Directions for Foliar Application:

- **Measure** the area of infestation to determine how many gallons of spray to mix. A gallon of spray solution should treat approximately 1000 square feet, depending on plant size and infestation density.
- **Note** any vegetation or areas that you may want to protect from drift. Ask about techniques, such as waxed cardboard shields, that might help in your situation.
- **Write** down the amount of herbicide in the container just before you start; this makes it easy to know how much has been used by the end of the treatment.
- **Put on personal protection equipment**, including gloves and eye-protection. Wear long-sleeved shirt and pants, and closed-toe shoes. Consider wearing a hat to protect against potential drift or drips.
- **Protect** mixing site from possible spills by laying plastic under mixing area.
- **Fill** sprayer to approximately half the amount of herbicide spray you want to mix (4 gallons maximum). Leave the strainer at the top to keep things from falling in. You may have to put the lid on and pump up the sprayer to detect problems. Check to see that the sprayer is not leaking out the bottom, that the handle shuts off appropriately, and that the nozzle tip is not clogged. Fix any problems before adding herbicide or other ingredients, or get another sprayer.

- **Measure** herbicide according to how many gallons you want to mix (4 gallons maximum) then pour into sprayer. Replace the lid on the herbicide container as soon as you have finished pouring. Try to mix only the amount of herbicide solution you will need to use and no more. Next, add surfactant, if required. Finally, add a small amount of marker dye, if desired. **ALWAYS AVOID POURING HERBICIDE BACK INTO THE ORIGINAL CONTAINER.**
- **Rinse** measuring cup and empty into sprayer several times; finish filling sprayer with water. Avoid overfilling or the mixture may slosh out the vent hole in top. **NOTE:** Marker dye gets on EVERYTHING! The blue will wash out of clothes, but takes a while to fade from skin or shoes. The dye is non-toxic, and its presence does NOT necessarily mean you have been contaminated with herbicide! A good trick is to rinse the pack, especially the lid, and the dye container, until you don't see any more blue.
- **Attach and tighten** the sprayer lid, gently shake the sprayer side to side to mix solution.
- **Put on pack**, but avoid bending over with full pack because of potential sloshing and spillage.
- **Pump up pressure** with handle on the left side. Do not over pressurize.
- **Apply herbicide** to all the leaves as uniformly as possible, just until they are wet. Knotweed plants can be very tall. Position yourself so you are **not underneath** a spray stream. **For a very large site**, it is sometimes necessary to ring the infestation, and return after those initial plants have died back, moving inward with each treatment. **Or**, cut a path into the interior and spray on either side and back out as you go. **Or**, cut plants in May or June and return in August and September to treat the regrowth. You will have to determine what works best for each individual site.
- **Rinse all** equipment that may be contaminated with herbicide three times (triple rinse). **There will be a cleaning fee charged for any loaned equipment that is returned without adequate cleaning.**
- **Dispose** of rinsate on undesirable plants on-site.
- **Return** equipment promptly along with any unused herbicide.
- **Fill out** knotweed control sheet and turn in with equipment. Let us know of any equipment problems.
- **Don't cut or remove stems for at least a week to ten days after an application.**
- **Wash** before eating or drinking and after treatment.
- **Wash clothes** that may have been contaminated by herbicide separately from other laundry.

WIPE METHOD TREATMENT

- **Wipe Application:** For small patches, small plants, or areas requiring very selective treatment. In 2007 we are recommending wipe as a trial treatment on previously treated plants, that are small, but showing signs of herbicide damage.
- **Herbicide:** Many herbicide products are available but we are currently using glyphosate, (or a mix of glyphosate and imazapyr), surfactant, and marker dye. Dilute from concentrated product.
- **Equipment:** Foam brush, container-additional container carrier and loppers to cut canes before wiping are optional.

Directions for Wipe Application:

- **Write** down the amount of herbicide in the container just before you start; this makes it easy to know how much has been used by the end of the treatment.
 - **Estimate** the amount of solution needed.
 - **Put on personal protection equipment**, including gloves and eye-protection. Wear long-sleeved shirt and pants, and closed-toe shoes.
 - **Protect** mixing site from possible spills by laying plastic under mixing area.
 - **Measure** One part full strength AquaNeat into container, add two parts water. The goal is to mix a 33% solution. Be sure to leave room in the container for surfactant. Add up to 10% surfactant.
 - **Close** bottle tightly, shake to mix. Replace the lid to the herbicide container as soon as you have finished pouring. Try to mix only the amount of herbicide solution you will need to use. Finally, add a small amount of marker dye, if desired. Try to measure out only the amount you plan to immediately use for treatment and no more.
- ALWAYS AVOID POURING HERBICIDE BACK INTO THE ORIGINAL CONTAINER.**
- **NOTE:** Marker dye gets on EVERYTHING! The blue will wash out of clothes, but takes a while to fade from skin or shoes. The dye is non-toxic, and its presence does NOT necessarily mean you have been contaminated with herbicide! Rinse the dye container, especially the lid, until you don't see any more blue.
 - **Consider** placing container into a small bucket with a handle to prevent container from spilling, and to hold the foam brush between applications. Or, consider placing brush in an extra glove between uses. This is especially useful if you have to travel any distance.
 - **Dip brush** into solution-**For large canes**-lop to a three foot height, and paint all sides of the stem thoroughly. Stack the portion that is removed where it will dry out and not be allowed to root. **For small plants**, paint as much of the exposed surface as possible.
 - **Rinse all** equipment that may be contaminated with herbicide three times (triple rinse). Foam brushes should rinsed, then deposit along with used gloves in a garbage bag. **There will be a cleaning fee charged for any loaned equipment that is returned without adequate cleaning.**
 - **Dispose** of rinsate on undesirable plants on-site.
 - **Return** equipment promptly along with any unused herbicide.
 - **Fill out** knotweed control sheet and turn in with equipment. Let us know of any equipment problems.
 - **Don't cut or remove stems for at least a week to ten days after an application.**
 - **Wash** before eating or drinking and after treatment.
 - **Wash clothes** that may have been contaminated by herbicide separately from other laundry.

The following information was reported for the original IPM Knotweed Profile 2004

Herbicide Treatment:

Glyphosate (Rodeo® and other glyphosate brands with aquatic labels) has been used to effectively control Japanese knotweed in aquatic situations. Glyphosate is not selective and will damage most other plant species. When desirable vegetation is nearby, applicators should try to minimize its loss by focusing their application just on the target plants.

Foliar application, using backpack sprayers or similar methods, is more efficient on larger monoculture stands of more than a few plants to several acres in size. To achieve the best chance of complete kill, apply herbicide in the spring to plants that are less than 4 feet. The plants need to be large enough to ensure that there is adequate leaf surface. Spray to wet and try to avoid dripping of the herbicide from the leaves. Larger plants will not be killed with just one herbicide application and killing these plants with foliar application may take several applications over several growing seasons. Although the late bud stage of growth is considered to be the most effective time for herbicide application for knotweed species, waiting that long also means dealing with a huge plant.

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

Stem injection of Japanese knotweed for some formulations of glyphosate has been approved for the 2004 growing season. Two holes are made through the first or second node of each stem using an ice pick-like probe to penetrate each cane. A syringe, or commercial injection gun can be used to deliver a metered dose of herbicide to the stem through one of the holes. Having a second hole, allows any liquid in the stem to escape as the glyphosate is injected. The Clark County Weed Control Board reports that the plant takes up the herbicide within 20 minutes of injection. They also report that each stem appears to be supported by a separate rhizome. This means that to kill the entire plant, each stem must be injected! For large plants, the Weed Board suggests injecting the outer most stems, coming back later to remove the dead stems and then injecting the remaining stems. Although, like the cut stem method, this is labor intensive, 100 percent kill has been reported. It also ensures selective control of just the target species.

An aquatic labeled formulation of triclopyr has been approved for use in Washington in 2004. The Nature Conservancy reports that triclopyr will control Japanese knotweed, but there are no specific control recommendations for Japanese knotweed on the Renovate® label. *Controlling Knotweed in the Pacific Northwest* advises that for successful translocation to occur, some herbicides should be used at the lowest effective

concentration in order to avoid damaging the above ground tissues of the plant before the herbicide is well dispersed in the root system. This guide indicated that triclopyr (Garlon 3a) at five percent solution appeared to give good top-kill on Japanese knotweed but resulted in mediocre long-term control on large patches. However, there are reports of successful control using triclopyr at rates as low as $\frac{3}{4}$ percent in high volume application. In Nature Conservancy field experiments, a 3-5 percent triclopyr application (Garlon 3a) eradicated about 50% of small patches after two treatments. In controlled experiments comparing treatments on small patches (30-200 stems), triclopyr (Garlon 3a) provided 90+ percent control in one year and 100 percent control within 2 years. Renovate® is the aquatic labeled formulation of Garlon 3a and presumably should provide similar results.

BIOLOGICAL CONTROL

In their native range, Japanese and giant knotweeds are impacted by a large number of natural enemies that are absent in North America. If proven to be host specific, these natural enemies could be used as biological control agents. Biological control can be a highly cost effective and sustainable means of controlling widespread weeds. However, it requires extensive surveys in the native range and rigorous testing of candidate biocontrol agents to make sure that they will not feed on non-target plants.

Research toward the development of a biological control program for knotweed is well underway. Much of the initial research has already been carried out for a biological control program against Japanese knotweed in the United Kingdom. The U.S. Forest Service has sponsored additional surveys and initial testing of promising natural enemies for a North American program. In 2007, two insects were imported into a quarantine facility for host range testing. These include a leaf-chewing chrysomelid beetle, *Gallerucida bifasciata*, and a sap-sucking psyllid, *Aphalara itadori*. With additional funding, the required research could be completed within two years.

(Information provided by Fritz Grevstad, Weed Biocontrol Program, Olympic Natural Resources Center, University of Washington, 2007).