PROGRESS OF THE 2005 STATEWIDE KNOTWEED CONTROL PROGRAM

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WSDA
WASHINGTON STATE
DEPARTMENT OF AGRICULTURE

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Cover Photo: Knotweed invades play equipment in a backyard. (WSDA)

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EXECUTIVE SUMMARY

Knotweed is an aggressive noxious weed that spreads quickly, shades out other native plants and destroys habitat. It thrives in any moist soil or river cobble, in full or partial sunlight and is most common in the flood zone along rivers and creeks, roadside ditches, and beaches. Knotweed forms massive and deep root clusters, some as deep as nine feet, and grows in dense stands up to 12 feet tall.

In recent years, hundreds of patches of knotweed have appeared along Washington rivers. If unchecked, knotweed will steadily take over riverbanks and beaches.

This report is a progress report of the Statewide Knotweed Control Program.

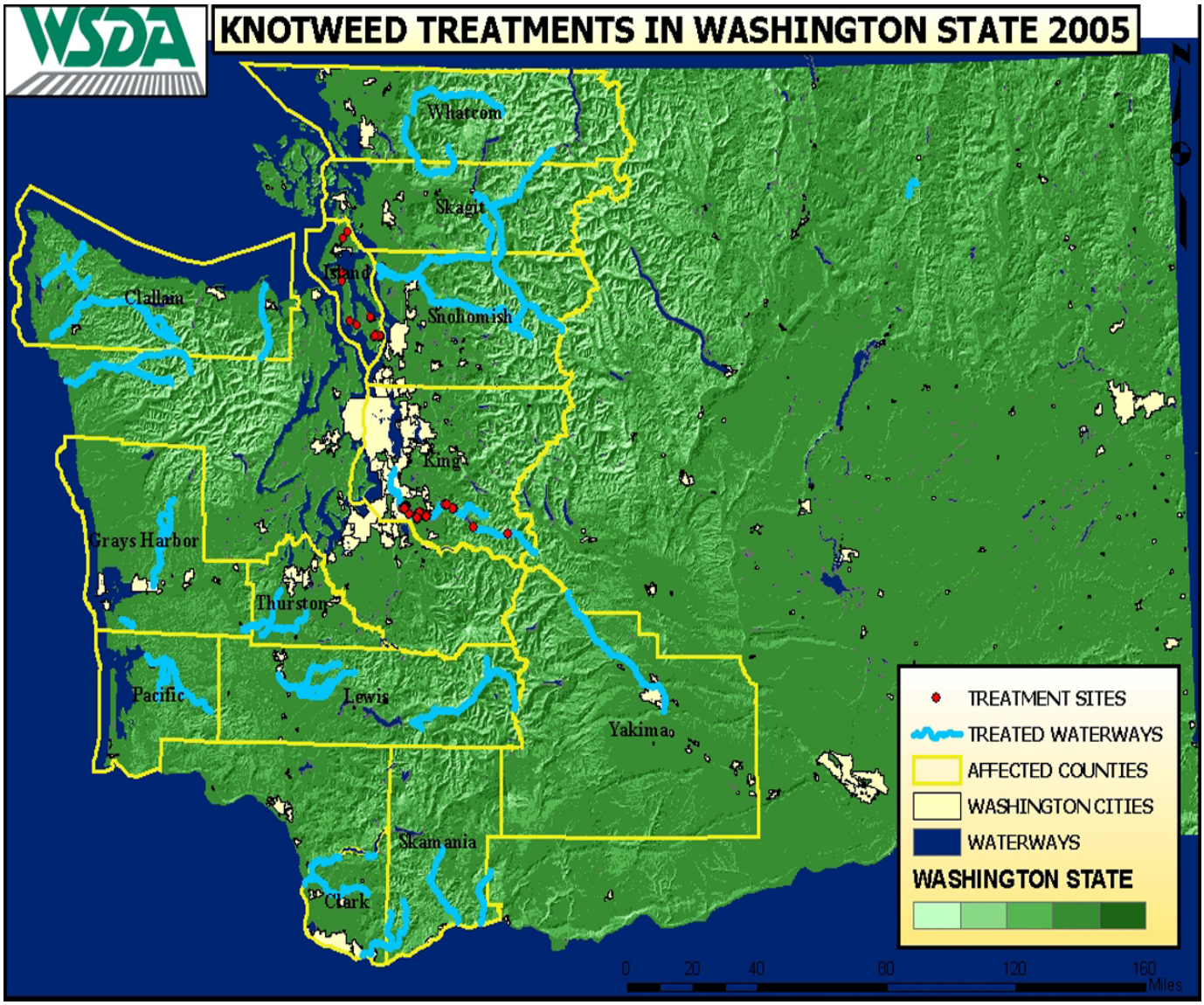
The Washington State Department of Agriculture (WSDA) initiated a knotweed control pilot program in Southwest Washington in 2004 using an appropriation of $500,000. In 2005, WSDA used the same appropriation level to continue control work in southwest Washington and to expand the program to control of Japanese knotweed in watersheds statewide. WSDA has used the funds to contract with 10 county weed boards, another state agency, and a non-profit group to carry out control projects in selected watersheds throughout the state. The programs utilized integrated pest management strategies based on a Washington State University evaluation of treatments during the 2004 pilot project.

More than 600 river miles were surveyed and approximately 1,012 acres of infestation was treated in the project area during the 2005 control season. Control activities took place in summer and early fall 2005. The treatment strategies were a mixture of foliar treatments and injection of herbicides.

Surveys and treatment occurred in areas where work occurred the previous season and all re-growth was treated before the projects expanded the scope of their projects into new areas.

Most programs benefited from increased public awareness within the watersheds being treated. The results of this awareness included increased landowner participation and an increase in volunteer numbers.

Figure 1. Map of Watersheds and Parks Treated



STATEWIDE KNOTWEED CONTROL PROGRAM

Overview

Knotweed is an aggressive noxious weed that spreads quickly, shades out other native plants and destroys habitat. It thrives in any moist soil or river cobble, in full or partial sunlight and is most common in the flood zone along rivers and creeks, roadside ditches, and beaches. Knotweed forms massive and deep root clusters, some as deep as nine feet, and grows in dense stands up to 12 feet tall.

In the Pacific Northwest, knotweed usually spreads when roots and stems are moved by waterways, by floods or in contaminated soil. Root and stem fragments as small as one-inch can produce a new plant. As a result, even one patch can produce dozens of new populations. It poses a significant threat to riparian areas, where it can survive severe floods and is able to rapidly colonize scoured shores and islands.

In recent years, hundreds of patches of knotweed have appeared along Washington rivers. If unchecked, knotweed will steadily take over riverbanks and beaches, as it has in the eastern United States and Europe.

The knotweed infestations in Washington are relatively recent and may be controllable by aggressive, well-coordinated survey and eradication efforts.

Effects of Knotweed

Knotweed species were originally introduced as garden ornamentals for their attractive cascading blooms and large leaves. The plants were able to thrive with surprisingly little care. This ability to thrive allowed for rapid spread after escape from gardens.

The plant's native habitat is the harsh environment on the slopes of volcanoes. This environment's very poor soil characteristics are reproduced in the sand and gravel environments of Pacific Northwest streams. In many of these areas, knotweed is able to grow without competition because other plants are unable to grow in such harsh conditions.

Knotweed's success as a colonizer also gives the species a competitive edge over natives in less harsh areas of riparian zones. Knotweed emerges early in the season and quickly grows tall, shading out smaller plants with its large leaves. Even tree species such as willow and alder exhibit decreased populations when competing with knotweed.

By choking out and displacing native plants, knotweeds can decrease biodiversity and disrupt food chains by limiting habitat available for the large percentage of species that depend on riparian areas. Between 80 to 90 percent of Washington wildlife species use riparian areas during some life stage.

Perhaps more importantly, knotweed also affects aquatic species and the invertebrates that compose the basis of the aquatic food chain. The food chain is disrupted by an alteration to the quality and timing of the leaf litter regime. This alteration changes nutrient runoff, soil composition, and invertebrate food sources. Invertebrates are the basis of the aquatic food chain and are the main food source of anadramous fish smolts.

Probably the greatest change to riparian habitats by knotweed is its comparative inability to control erosion. Despite having an extensive root system, knotweeds do not hold soil in place during flood events. This is thought to be an adaptation of the plant that helps it spread. Rather than holding soil, sections of the infestation wash downstream where rhizome and stem pieces can set roots and create a new infestation.

The consequence of this allowed runoff is an increase in siltation of streams. Increased siltation is a major factor in the loss of productive viability of native salmonids. Silt fills in the spaces between riverbed gravels that salmon utilize for egg laying. Siltation is also known to smother viable salmon eggs that have already been buried in gravel beds.

Knotweed infestations can block river views and limit river access, which can affect recreational opportunities and property values.

Knotweeds Present in Washington

There are four genetically interrelated species of knotweed in Washington State. All are listed as Class-B noxious weeds on Washington State's Noxious Weed List. The four species are commonly designated as Japanese, Giant, Bohemian, and Himalayan. The extent of the different species throughout the state is currently unknown though the levels of infestation in eastern Washington is known to be significantly less than in western Washington. Listing as a Class-B weed generally means that infestations can be controlled.

- Japanese knotweed (*Polygonum cuspidatum*) is the variety most commonly associated with knotweed problems. This species spreads vegetatively.

- Giant knotweed (*Polygonum sachalinense*) spreads vegetatively, but it does produce some viable pollen and hybridizes with Japanese knotweed.

- Bohemian knotweed (*Polygonum bohemicum*) is the hybrid produced by the Giant and Japanese strains. It is thought to produce greater amounts of viable pollen and may back cross with both parent species. This species can spread by seed or vegetatively.

- Himalayan knotweed (*Polygonum polystachyum*) spreads mainly through vegetative means. The lance-shaped leaves of this species make it readily identifiable when compared to the other species.

Treatment Techniques

Knotweed spreads quickly along riparian corridors in a general downstream direction. To successfully treat an entire watershed the following steps need to be taken:

- Survey for and treat all infestations with best available IPM technology starting at the top of a watershed and moving in a downstream direction. This includes a survey of all tributaries.

- Re-survey the watershed for several years and re-treat any new growth.

- Continue to survey the watershed and conduct public education activities. Follow up on any sightings that occur as a result of the public education campaign.

A fully implemented IPM program consistently looks to maximize efficacy while minimizing ecological and economic effects.

WSDA Knotweed Program

The WSDA Knotweed Control Program supports and facilitates the control programs carried out by participating cooperators. In 2005, WSDA's work included producing required environmental review, providing public notification materials, coordinating with federal agencies on matching funding, providing technical training, and publishing required notices.

WSDA continued to work cooperatively with Ecology to administer the National Pollutant Discharge Elimination System (NPDES) permit for aquatic noxious weed control. This included providing coverage in compliance with the permit to its contractors and conducting required water quality monitoring.

WSDA provided funding through interagency agreements and contracts for work to control knotweed conducted on selected watersheds by the noxious weed control boards of Clark, Skamania, Pacific, Snohomish, Clallam, Whatcom, King, Island, Yakima, and Lewis counties, the Washington State Parks and Recreation Commission, and The Nature Conservancy. WSDA provided the cooperators with public information materials and the herbicide used for control treatments.

WSDA facilitated a mandatory field training for cooperators using herbicides as part of their knotweed projects. Field crews received training on proper herbicide application techniques and record keeping. Attendees also used the training as an opportunity to exchange tips and advice on how to deal with knotweed infestations. In addition to the WSDA training, an industry representative from the primary herbicide vendor demonstrated proper application techniques for its products.

Knotweed Program Budget

WSDA received an appropriation of $500,000 from the State General Fund in FY 2006 to control knotweed. WSDA allocated $357,000 of the appropriation for contracted knotweed control. Other expenditures were for activities that directly supported the survey and control work of cooperators.

In April 2005, WSDA sent out a request for proposals for knotweed eradication projects through its stakeholder contact information and the county weed boards. Unlike 2004, requests were accepted for any area of the state, rather than limited to southwest Washington. In late May 2005, project proposals were reviewed internally and then a knotweed advisory panel was convened to provide input on the criteria for awarding cooperative agreements based on submitted proposals.

Members of the knotweed advisory panel included county weed board members, WSDA personnel and parks and recreation representatives. The panel recommended that 2005 cooperative agreements focus on: 1) projects that were well underway from the 2004 season; 2) projects that could quickly and cost effectively eradicate recent introductions; and 3) projects that demonstrated a statewide commitment. Fourteen proposals requesting a total of $823,442 were submitted. Projects that supported the broadest combination of these criteria received award contracts in June 2005.

The amount allocated for contracted knotweed control is up $67,000 from last year's $290,000 allocation. The six continuing cooperators received funding comparable to the amount each received in 2004. WSDA was able to award contracts to seven other projects in 2005. This was made possible by continuing savings on herbicide purchases and funds freed up from spending on one-time equipment and WSU study costs. Table 1 details the estimated expenditures for this year's program.

Table 1. Estimated Budget Activity, FY 2005

Activity		Budgeted Expenditure
[1]**Purchased Services**		$357,000
Clallam County *	$10,000	
Clark County	$93,000	
Island County	$5,000	
King County *	$10,000	
Lewis County	$22,500	
Pacific County	$43,000	
Skamania County	$55,500	
Snohomish County *	$10,000	
The Nature Conservancy – Southwest	$65,000	
The Nature Conservancy – Skagit *	$19,500	
WA State Parks & Recreation Commission	$5,500	
Whatcom County *	$10,000	
Yakima County	$8,000	
[2]**Herbicide Purchases**		$24,000
[3]**NPDES Water Quality Monitoring**		$2,000
[4]**WSDA Coordination**		$117,000
Total		**$500,000**

Notes for Table 1:

1. Contracts and agreements with county weed boards, a state agency, and a non-profit group to carry out control projects in selected watersheds and with WSU to evaluate efficacy of various control treatments.
2. WSDA provides all herbicide used in the projects. Herbicide is purchased through Dept. of General Administration to utilize economies of scale to obtain the lowest cost.
3. Laboratory analysis of water samples for water quality monitoring required by the NPDES permit.
4. WSDA coordination expenses include agency administration costs, salaries and benefits for a full-time coordinator and part-time clerical support, travel, attorney costs, vehicle and equipment costs, printing, and other goods and services.

* Programs that were partially funded through WSDA.

Survey and Treatment

More than 600 river miles were surveyed and approximately 1,012 acres of infestation were treated in the project area during the 2005 control season. This compares to 311 miles surveyed and 326 acres treated in 2004.

Most cooperators surveyed the streams by either walking creek beds or boating the larger streams. GPS points were taken of located infestations, and these points were used to obtain information on the ownership of the parcels. Landowners were then contacted and asked to sign a permission/waiver form before any treatment was conducted. Most landowners were familiar

with the program because of the previous year's control work and various articles that have appeared in newspapers throughout the state.

The treatments used were determined on a site-by-site basis according to integrated pest management (IPM) principles. IPM is a pest management concept that uses the most appropriate pest control method and strategy to meet pest management objectives in an environmentally and economically sound manner.

An important IPM consideration of the program was to treat each river system, when possible, starting in the headwaters and working in a downstream direction. This strategy prevents re-infestation of treated areas during high-water events of the winter and fall.

Treatments consisted almost entirely of herbicide applications. Manual controls, including digging and hand pulling, require return site visits and are not ecologically sensible in riparian habitats. Digging and hand pulling are known to encourage sprouting, but were tried as a treatment technique when herbicides could not be used. We expect there will be a need for follow-up treatments at sites where these techniques were used.

Four types of herbicide applications were used during the 2005 control season. These included injection of glyphosate, and foliar applications of triclopyr, glyphosate, and a glyphosate/imazapyr mix. The herbicide products used by the contractors are registered for use in aquatic environments.

Injection of glyphosate is a herbicide application system that is specific to knotweed control. It was first approved for use in 2004. The technique consists of injecting undiluted glyphosate directly into the hollow stem of the plant. An applicator gun developed specifically for this technique injects a fixed amount of herbicide through a hollow needle. This technique showed an efficacy of 90 to 100% during trial use and minimizes the possibility of herbicide drift. However, injection is labor intensive and inappropriate for large-scale treatments and for situations when small stem size does not support the application, such as found in early infestations or regrowth.

Foliar treatments were used much more so in 2005 than in 2004. This change came about primarily because the stems of regrowth at previously treated areas were too small for injection and injection is more labor intensive and more costly. Perhaps most significantly, the results from the WSU efficacy study demonstrated that all of the available treatment options provided similar high levels of control. Knotweed control resulting from a single herbicide application in 2004 was excellent at about one year after treatment, averaging 90% over all sites and applications. Knotweed vigor was probably more important than herbicide choice or manner of application at each study site. With this information, cooperators were able to select the treatment option that best met their local needs based on specific site conditions, without compromising effectiveness.

Public Outreach Activities

WSDA produced a flyer used throughout the state to educate the general public on the threat knotweeds present to Washington ecosystems and the treatment programs that can assuage this

threat. Several of the cooperators worked with local media to provide information to the public through news stories and notices. Several of the county programs displayed exhibits explaining the local knotweed program at their county fairs. Washington State Parks and Recreation Commission installed interpretive signs explaining the control project at Cape Disappointment State Park. These signs will reach a wide audience as large numbers of visitors are expected at the park for the Lewis and Clark Bicentennial.

Plans for 2006

With continued funding at $500,000 annually, WSDA's knotweed program will continue to work with cooperators in Washington to survey and successfully treat infested watersheds. WSDA will work with cooperators to complete current contracts and will accept proposals for funding for the 2006 control season starting in April. It is hoped that the program will further expand into eastern Washington, as the infestations there are less well developed and can be eradicated before expanding to the extent of those in western Washington.

In addition to WSDA's program, various efforts are underway to control knotweed in a number of the state's watersheds. Those involved include the state departments of Fish & Wildlife, Natural Resources and Transportation; public utility districts; US Forest Service; county noxious weed boards; several tribes; 10,000 Years Institute; Native Plant Society; private landowners and others. Several county weed boards and local conservation and salmon enhancement groups are working to assemble control programs and have expressed interest on working with WSDA on these efforts.

PROGRAM RESULTS BY GEOGRAPHIC AREA

All projects, except for the Cape Disappointment and Island County projects, concentrated treatment in the riparian areas of the project streams. Upland sites were also treated if the infestations were deemed to pose the danger of spreading into the adjacent riparian areas.

The projects included a mix of treatment options that concentrated on differing methods of herbicide-based control methods. Other treatment alternatives were reserved as secondary options because mechanical removal would create unwanted substrate disturbance in the sensitive riparian areas and other physical treatments, to be effective, would require re-treatment every few weeks.

The program results are discussed in more detail by area with associated maps in the following section.

Table 2. Project Activity

Cooperator	Watersheds To Be Treated	Funds Awarded	River Miles Surveyed	Acreage Treated
Southwest Washington				
Clark Co. NWCB	North & East Fork of the Lewis River	$93,000	80	468
Lewis Co. NWCB	Upper Cowlitz River	$22,500	35	13.5
Pacific Co. NWCB	Willapa River	$43,000	33	303
Skamania Co. NWCB	Little White Salmon River, Wind River, Washougal River	$55,500	44	70
State Parks and Recreation Commission	Little Creek at Beacon Rock State Park (Skamania Co.) Cape Disappointment State Park (Pacific Co.)	$5,500	na	2
The Nature Conservancy Southwest	Scatter Creek, Wishkah River, Black River, Elk River, Newaukum River (Thurston, Grays Harbor, and Lewis Co.)	$65,000	242	9.5
Northwest Washington				
Whatcom Co. NWCB	North Fork Nooksack River	$10,000	15	7.5
The Nature Conservancy Skagit	Skagit River, Sauk River	$19,500	24	4.5
Snohomish Co. NWCB	Stilliguamish River	$10,000	43	24
Island Co. NWCB	Whidbey Island	$5,000	na	3
Clallam Co. NWCB	Big River, Hoko River, Hoh River, Sol Duc River, Dungeness River	$10,000	55	94
King Co. NWCB	Green River	$10,000	18.5	4.5
Eastern Washington				
Yakima Co. NWCB	Naches River, Yakima River	$8,000	18	8.5
Total			**606.5**	**1,012**

NWCB = Noxious Weed Control Board

Southwest Washington

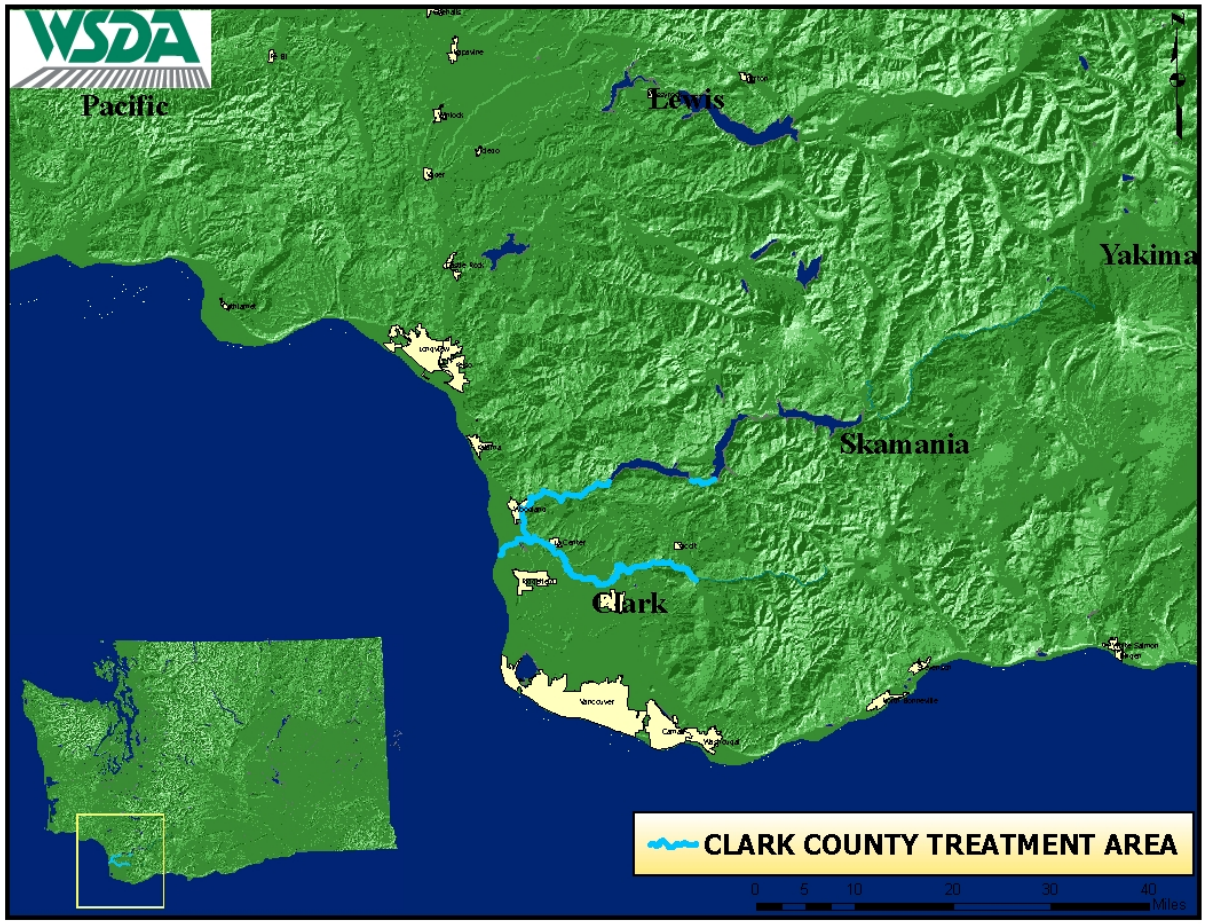
Clark County

In 2004, The Clark County Noxious Weed Board crew surveyed 53 river miles and treated approximately 125 acres. In 2005, the crew surveyed and retreated all infestations along the entire length of the East Fork Lewis River. Work then began on survey and treatment of the North Fork Lewis River. The work was completed with county personnel and landowner volunteers.

The treatments consisted of both injection of glyphosate and foliar applications of a glyphosate/imazapyr mix. Approximately 468 acres of infestation were treated on 80 river miles.

The entire length of both forks will be re-surveyed and re-treated as needed next season.

Figure 2. Clark County Treatment Area

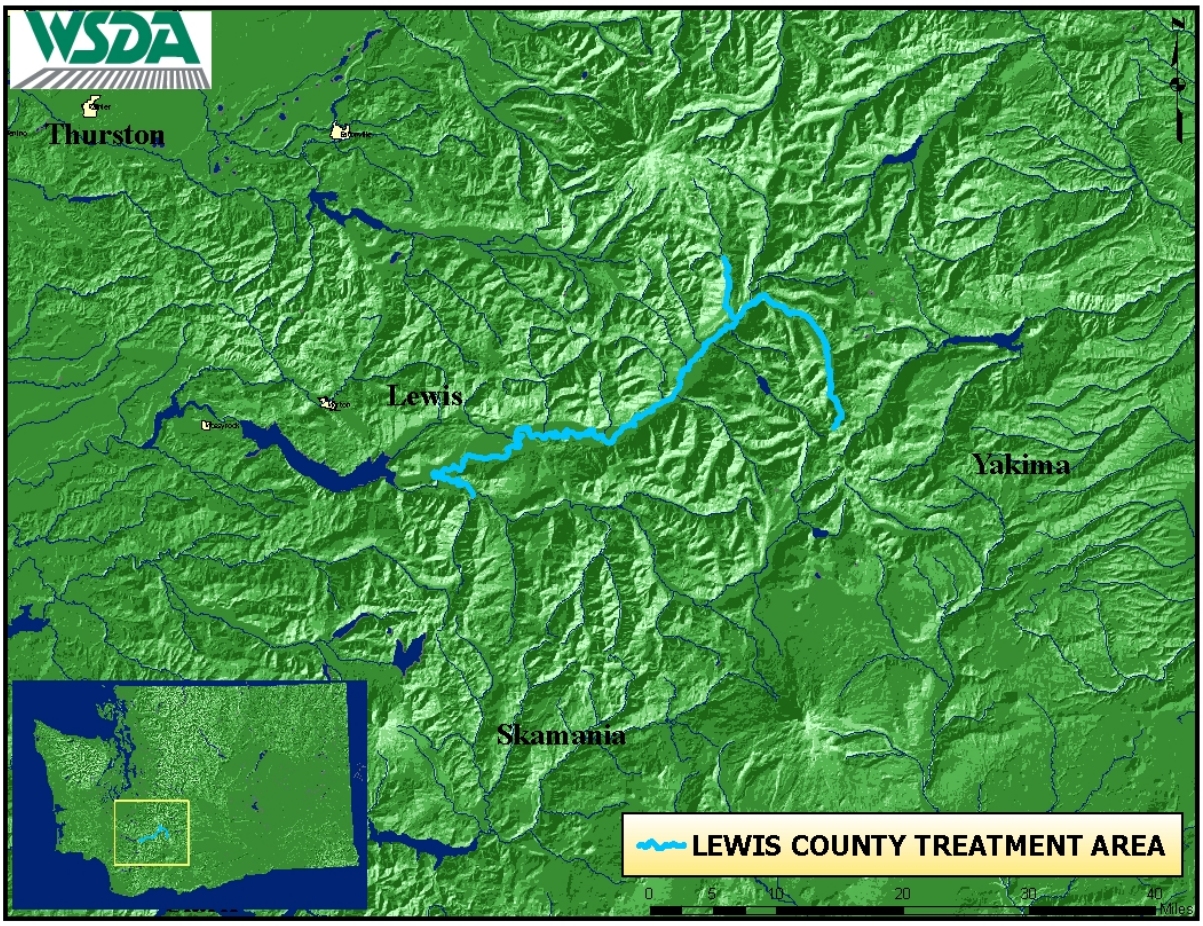


Lewis County

The Lewis County Noxious Weed Control Board crew surveyed and treated 35 miles of the upper reaches of the Cowlitz River to just past the confluence with the Cispus River. This compares to 28 miles surveyed and treatd in 2004. All areas treated last year were retreated with the inclusion of the initial treatment of properties with absentee landowners where permission to treat could not be obtained last season. The program then expanded downstream into new areas.

Most of the treatments were conducted with a foliar application of a glyphosate/imazapyr mix. The injection of glyphosate was used when preferred by the landowner.
Approximately 13.5 acres of infestation were treated along the river and will be checked for regrowth in the spring. This compares to approximately 7.2 acres treated in 2004. Work will continue to obtain permission to treat infestations from landowners where permission was not obtained this year.

Figure 3. Lewis County Treatment Area



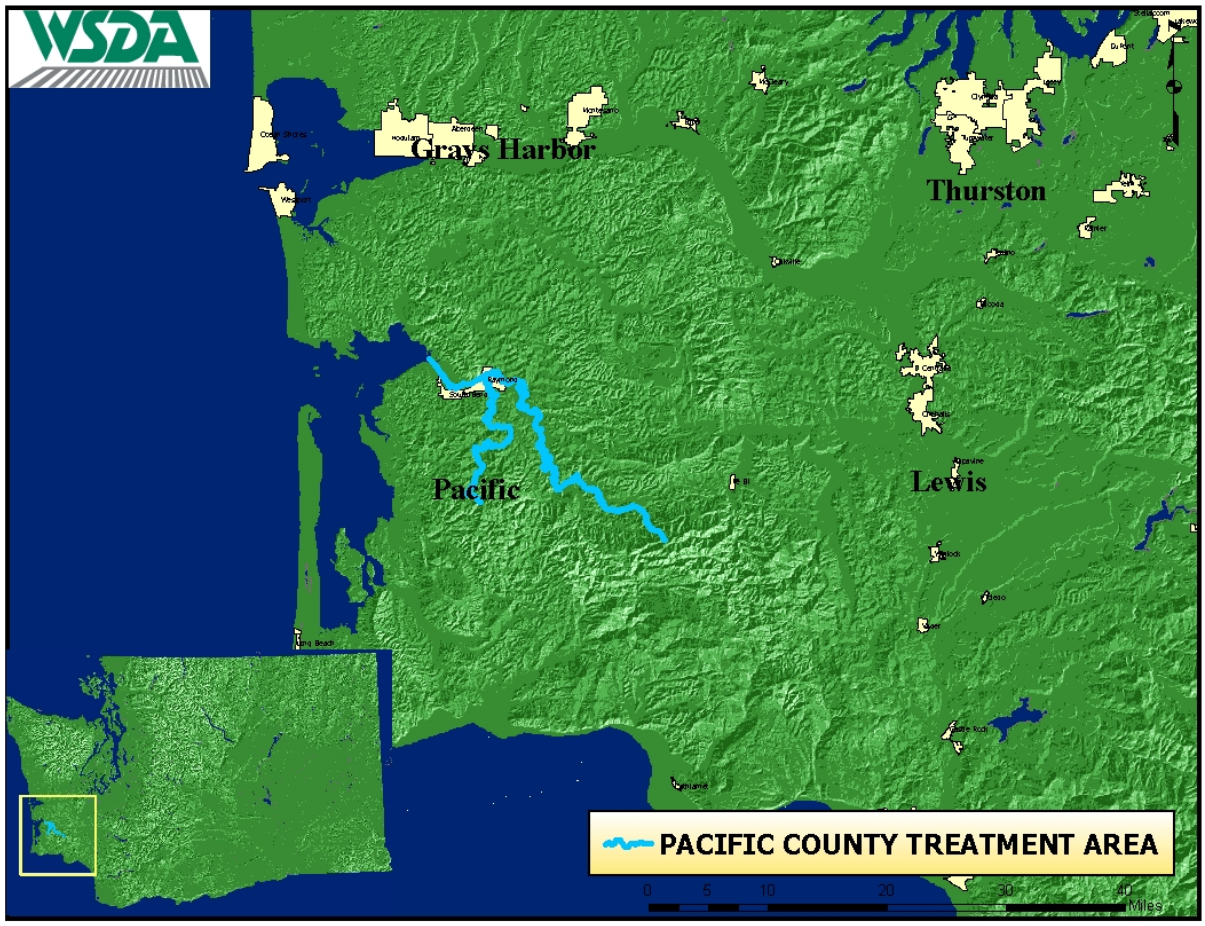
Pacific County

The Pacific County Noxious Weed Board surveyed and treated the Willapa River in conjunction with its project partner, the Pacific Conservation District. All knotweed located during the surveys of the upper watershed were treated. This area covered approximately 33 river miles, double the area covered in 2004.

The tributaries surveyed included Fern Creek, Half Moon Creek, Forks Creek, Ellis Creek, Trap Creek, and Green Creek. As in 2004, infestations were located and treated on Forks Creek and Trap Creek for approximately one mile from the confluences with the main stem.

Treatments consisted exclusively of foliar applications of a glyphosate/imazapyr mix. The total acreage treated is approximately 303 acres, compared to 158 acres in 2004. The treated area will be re-surveyed in the spring.

Figure 4. Pacific County Treatment Area

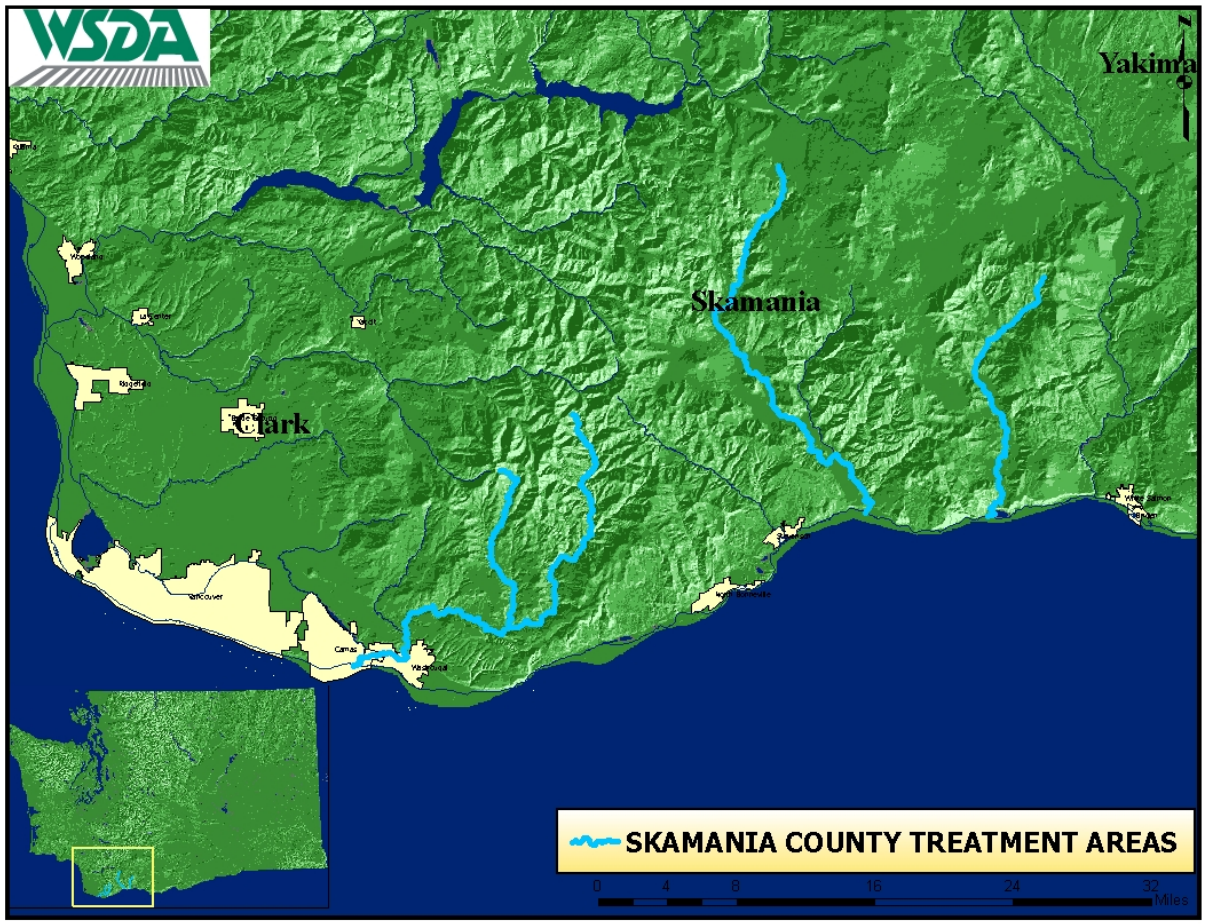


Skamania County

As in 2004, the Skamania County Noxious Weed Control Board surveyed and treated infestations on the Wind, Washougal, and Little White Salmon rivers. Each river was treated from the closest infestation to the headwaters in a downstream direction to the confluence with the Columbia River.

Treatments consisted of foliar and wiper applications of glyphosate for retreatments. Initial treatments consisted of foliar applications and injection of glyphosate. Approximately 70 acres of knotweed were treated. This compares to approximately 31.9 treated in 2004. Each site will be re-treated in the spring.

Figure 5. Skamania County Treatment Area



Washington State Parks and Recreation Commission

Washington State Parks contracted with the Pacific County Noxious Weed Control Board to foliarly apply imazapyr to an upland infestation in Cape Disappointment State Park that threatens two rare vegetation communities that are listed as globally imperiled. This area was treated with triclopyr last season with disappointing results. Approximately 1 acre of infestation was treated, the same size area as in 2004.

The Parks staff also contracted with the Skamania County Noxious Weed Control Board to inject glyphosate into the infestations along Little Creek and Woodard Creek that flow through Beacon Rock State Park. Approximately 1.1 acres of infestation were treated. This compares to approximately 1.3 acres of infestation treated in 2004. Park staff will re-survey all infestations next spring.

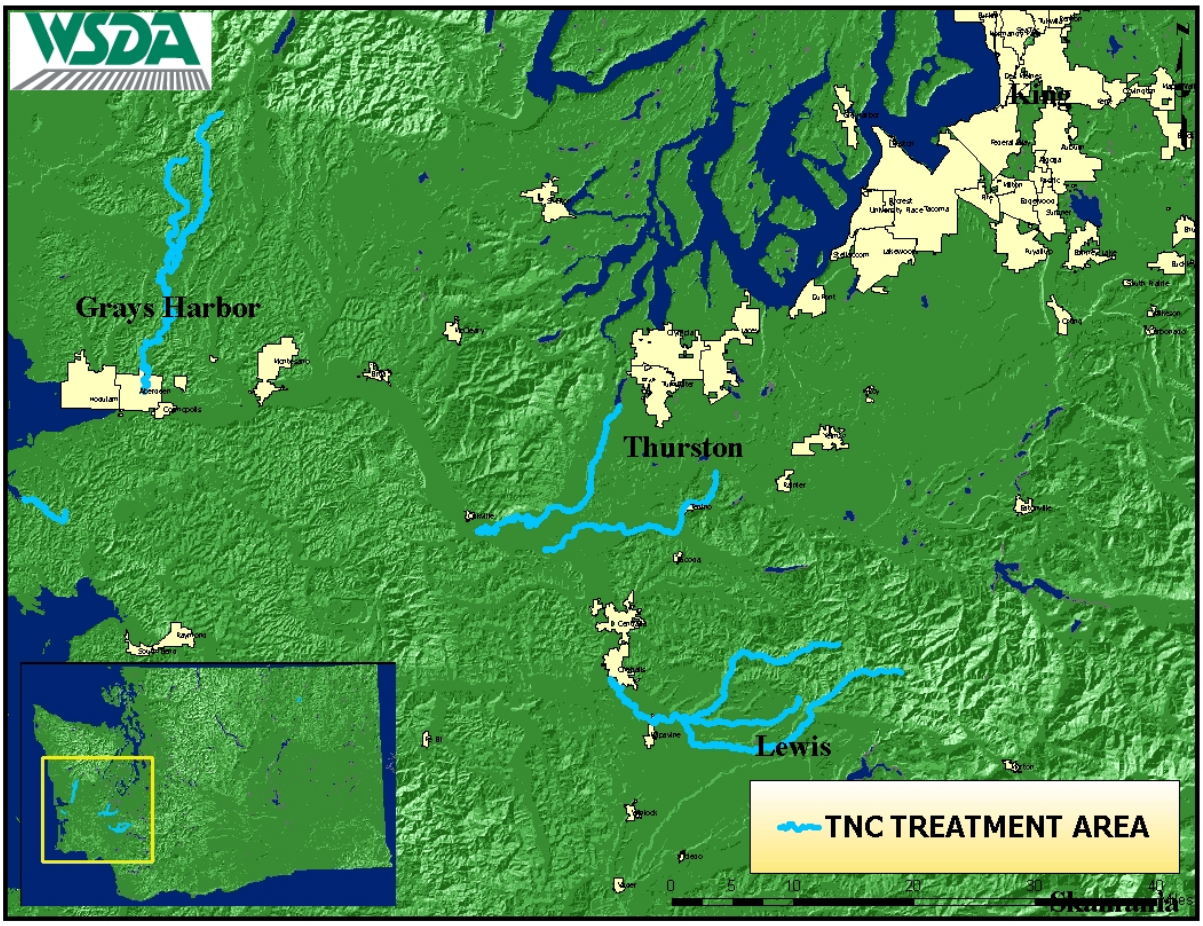
The Nature Conservancy - Southwest

This Nature Conservancy crew worked in conjunction with state and county agencies to treat the lightly infested watersheds of Scatter Creek and the Elk and Black Rivers based on the extensive surveys done in 2004. The crew conducted further surveys and treatments of the more heavily infested watersheds of the Wishkah and Newaukum Rivers. In all, 242 river miles were surveyed. The total treatments consisted of 9.5 acres.

As in 2004, the crew surveyed and treated all known infestations on the entire length of the Black River and its tributaries in Thurston County. The crew also again worked with Department of Natural Resources personnel to locate and treat all infestations on the Elk River in Grays Harbor County. Some of the treated area includes the Elk River Natural Resource Conservation Area. The work on these two rivers protected large ecologically sensitive areas from the threat of extensive infestations of knotweed.

The crew also worked with the Grays Harbor County Noxious Weed Board to survey and treat infestations on the Wishkah River. The work on the Newaukum River was in conjunction with the Lewis County Noxious Weed Control Board.

Figure 6. The Nature Conservancy Southwest Treatment Area

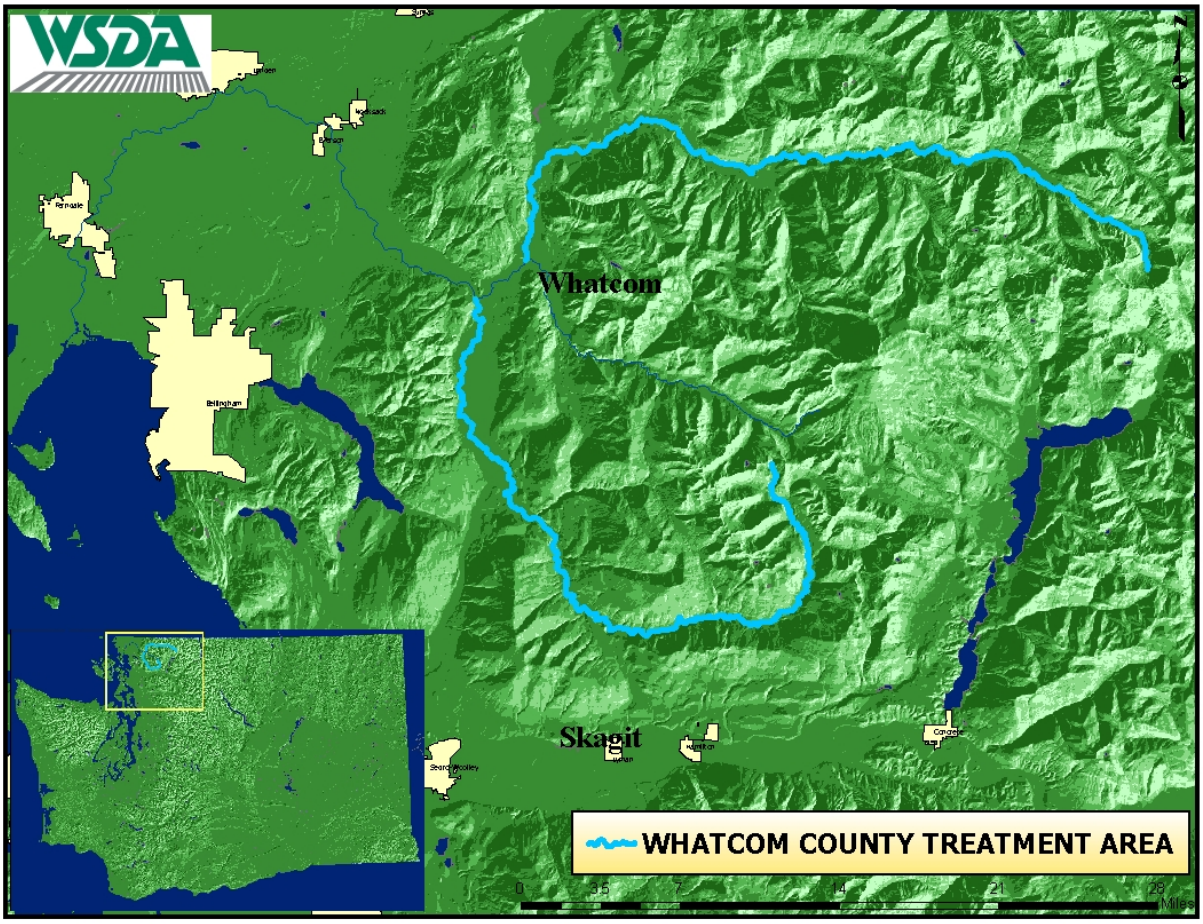


Northwest Washington

Whatcom County

The Whatcom County Noxious Weed Control Board treated knotweed infestations in the uppermost reaches of the North and South forks of the Nooksack River. The majority of the treatments consisted of foliar applications of glyphosate. Other treatments included injection and a mix of foliar and "cut and wipe" applications. A total of 15 river miles were surveyed and approximately 7.5 acres was treated.

Figure 7. Whatcom County Treatment Area

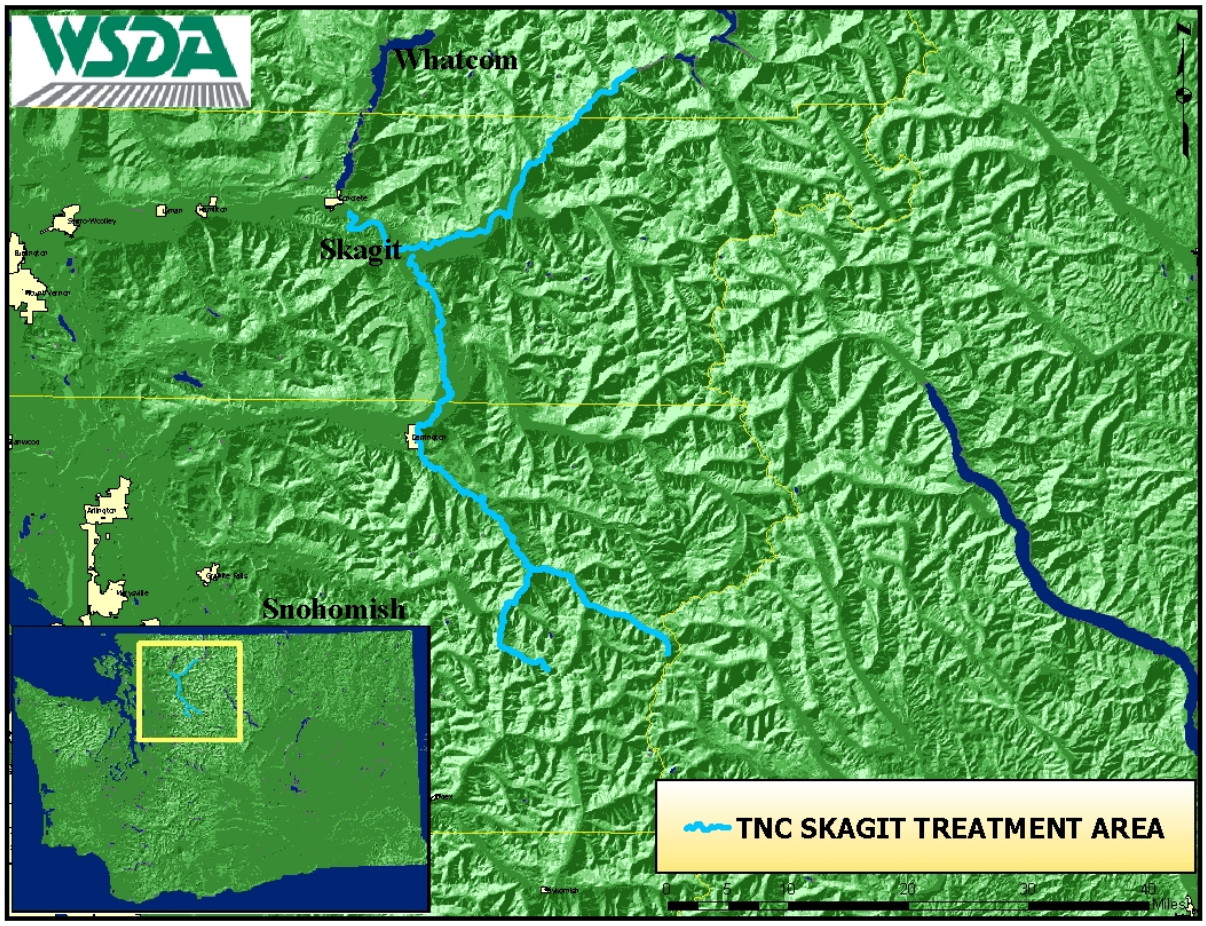


The Nature Conservancy – Skagit

The Nature Conservancy treated a total of 4.5 solid acres of upland and riparian knotweed along the Skagit and Sauk rivers under WSDA's program in 2005. The Nature Conservancy is part of the Skagit Knotweed Working Group, made up of private landowners, non-profit groups, and state, federal, and county agencies, that has been controlling knotweed in the upper Skagit basin since 2002.

The 4.5 acres treated with WSDA funding took place over 500 miles of surveyed rivers, tributaries and roads in the upper Skagit watershed. Other Skagit Knotweed Working Group partners treated additional acreage in the watershed.

Figure 8. The Nature Conservancy Skagit Treatment Area

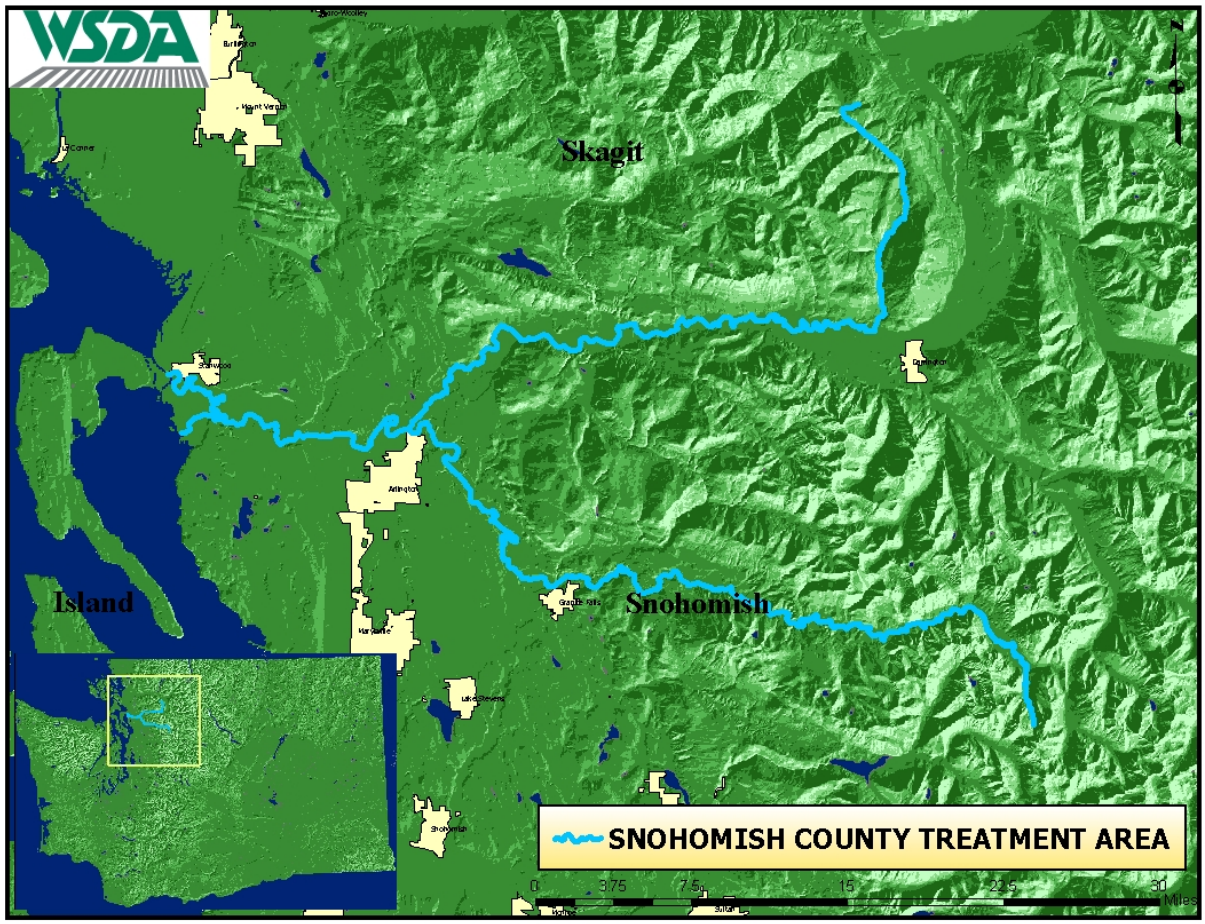


Snohomish County

The Snohomish County Noxious Weed Control Board conducted knotweed treatments in the Stilliguamish River Basin. The project treated knotweed located during a previous survey conducted with a Department of Ecology grant. The total acreage treated with WSDA funds was approximately 24 acres. The treatments consisted of foliar applications of glyphosate. Approximately 43 river miles were surveyed.

Other treatments in the watershed were conducted with county and US Forest Service funding. Approximately 45.4 acres of knotweed were treated with this additional funding for a total of 69.4 acres treated in the basin.

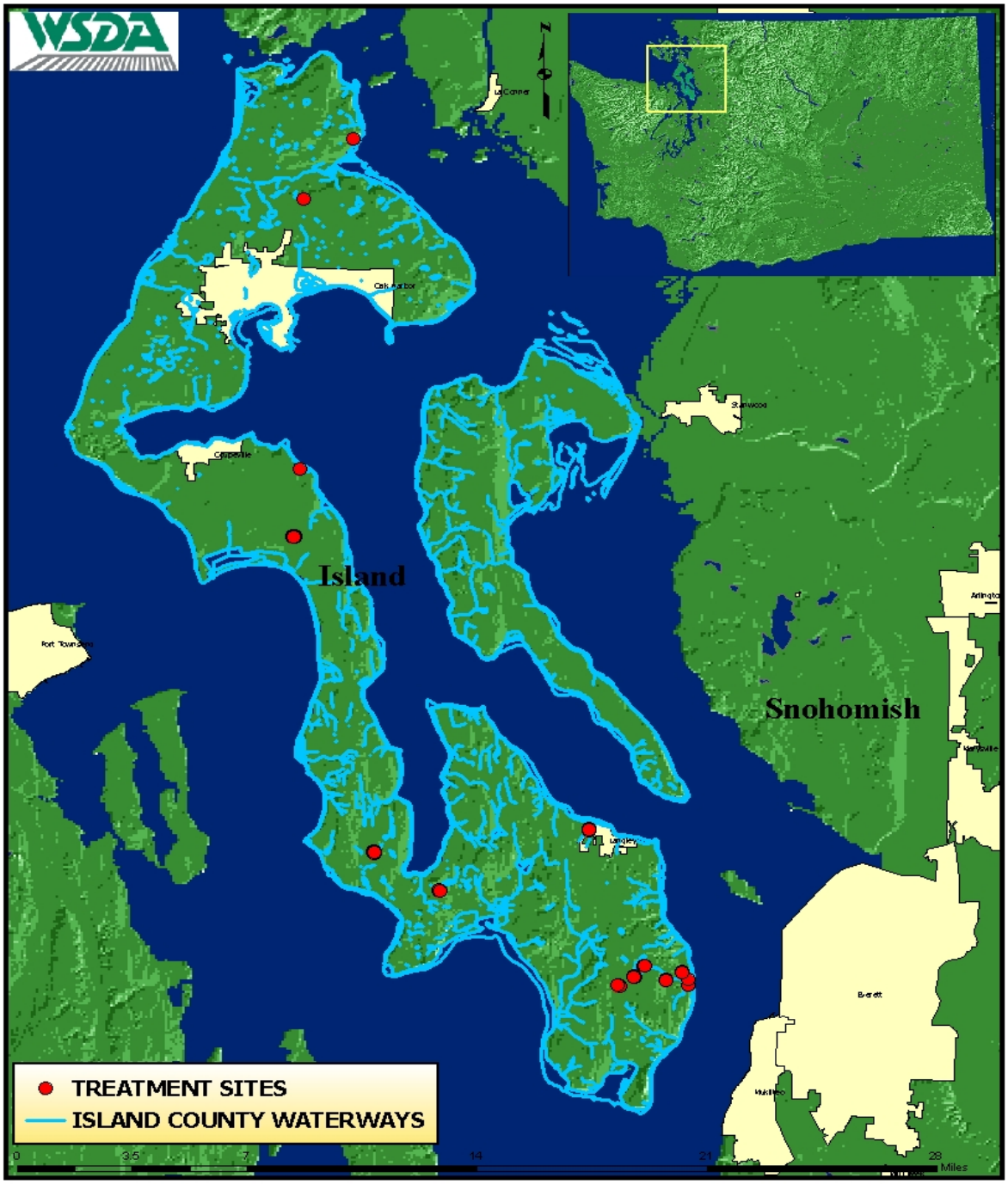
Figure 9. Snohomish County Treatment Area



Island County

The Island County Noxious Weed Control Board worked with a private contractor to survey Whidbey Island for knotweed infestations. The area treated totaled approximately 3 acres that were spread over the southern section of the island. The treatments consisted of foliar applications of imazapyr and triclopyr.

Figure 10. Island County Treatment Area

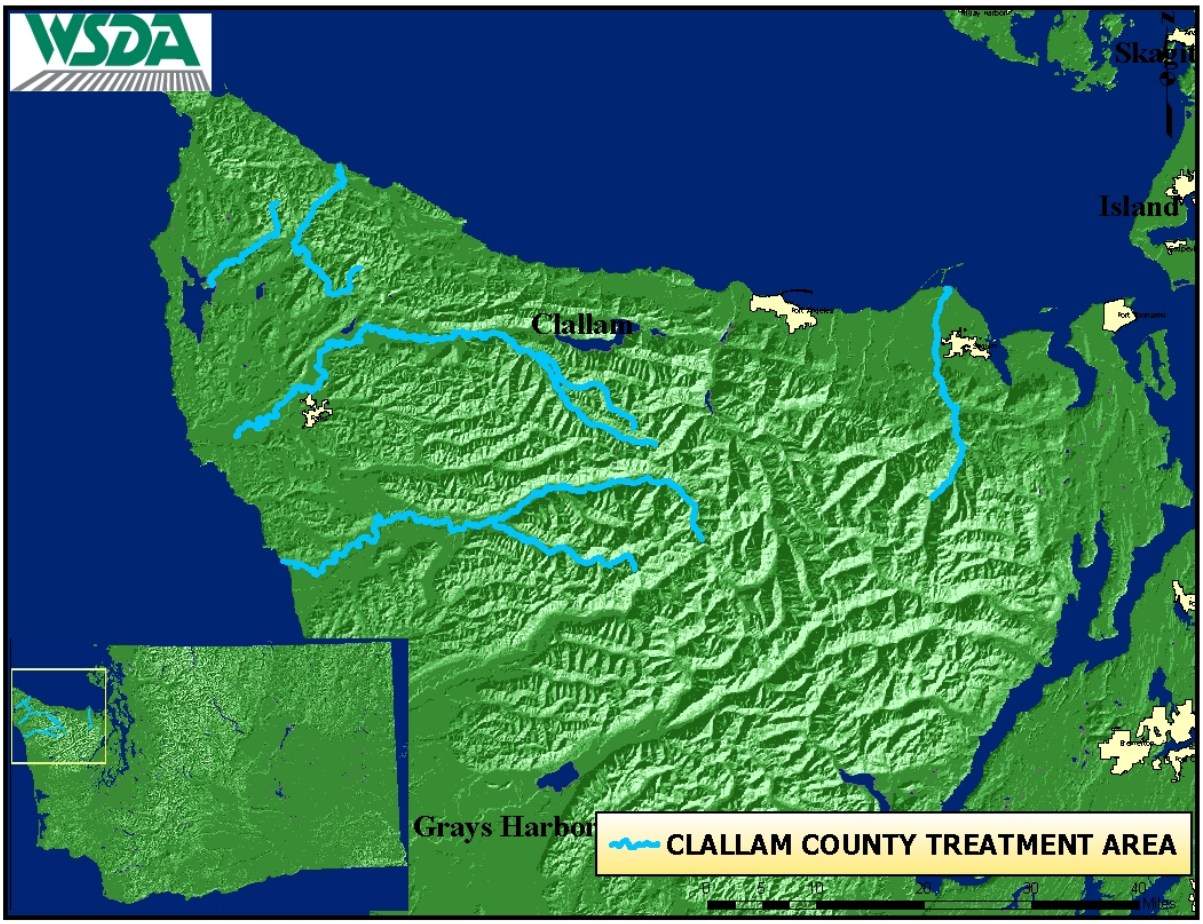


Clallam County

The Clallam County Noxious Weed Board completed work on a number of rivers in conjunction with the Jamestown SKallam, Hoh, Quilute and Macaw tribes. All treatments consisted of foliar and injection applications of glyphosate. River miles surveyed totaled approximately 55 miles with 94 acres of area treated directly by the county crew.

The crew worked with the Hoh tribe to survey and retreat areas of the Hoh River that were treated by the tribe the previous season. County personnel provided consultation and herbicide to the Jamestown SKallam and Quilute tribes for work on the Dungeness and Dickey rivers. The crew also worked with the Macaw tribe to survey and treat on the Big and Hoko rivers.

Figure 11. Clallam County Treatment Area

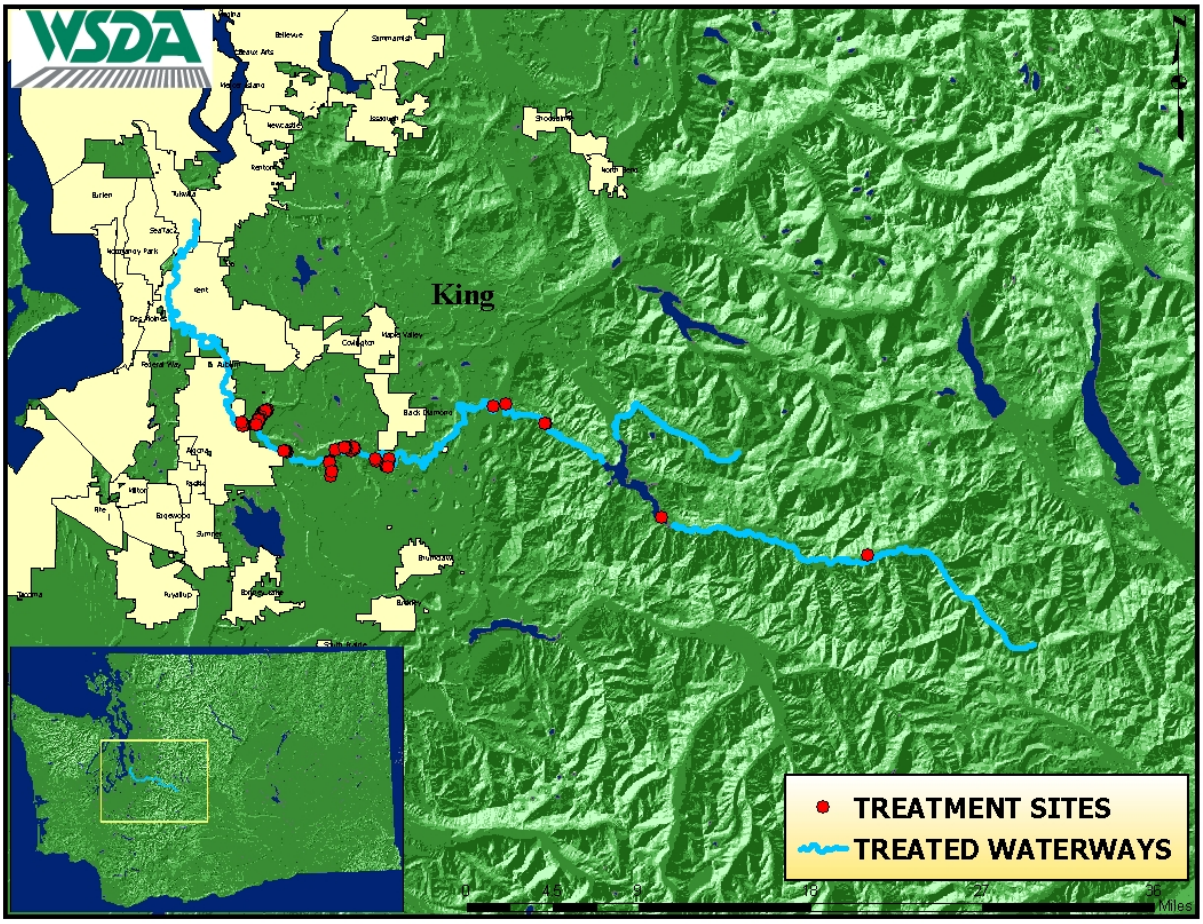


King County

The King County Noxious Weed Control Board, as the lead entity in the Green/Duwamish Cooperative Weed Management Area, treated approximately 4.5 acres of knotweed and surveyed 18 river miles with WSDA funding. The treatments consisted of injection and foliar glyphosate treatments.

The total area treated in the management area was 9 acres. The US Forest Service funded the other work in the management area. All of the work was conducted by crews comprised of county staff, Washington Conservation Corps members, and members of Earth Corps.

Figure 12. King County Treatment Area



Eastern Washington

Yakima County

The Yakima County Noxious Weed Control Board surveyed and treated knotweed on the Naches and Yakima Rivers in conjunction with a crew from the Yakima Indian Nation. This work was in continuation of a project that was started by the county last season.

Some of the work was retreatment of areas from the previous project before initiating treatments in new areas. Approximately 8.5 acres was treated over a project area of 18 river miles. All treatments consisted of foliar applications of imazpyr. All known infestations in riparian areas were treated.

Figure 13. Yakima County Treatment Area

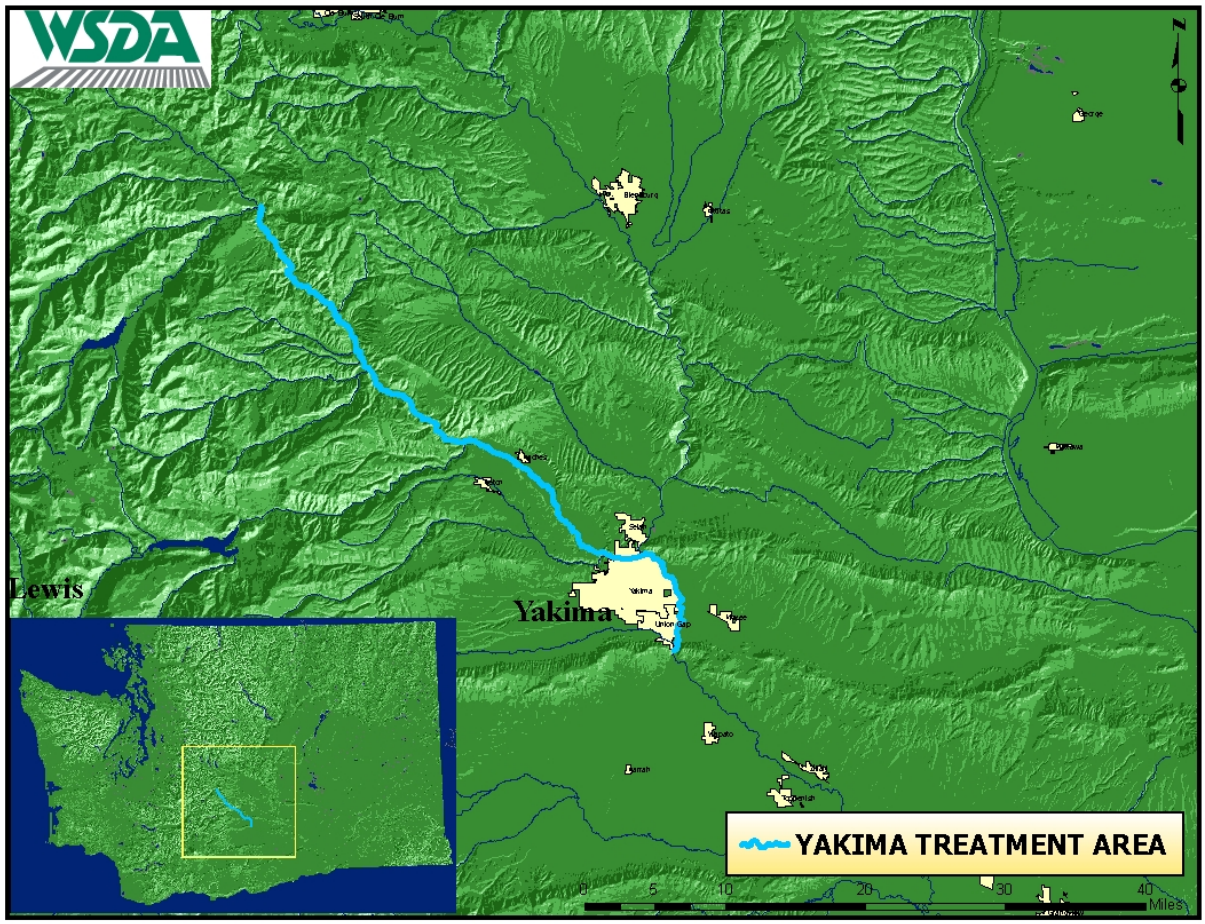


Figure 14. Example of Knotweed Prior to Treatment

Figure 15. Example of Knotweed After Treatment

Figure 16. WSDA-Facilitated Applicator Training