North Fork Coquille River Knotweed & Riparian Restoration Plan

Coos County, Oregon
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Prepared by: The Coquille Watershed Association

In partnership with: Coos Soil and Water Conservation District, Oregon Department of Environmental Quality, and the Bureau of Land Management – Coos Bay

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I. Description of the North Fork Coquille River

The North Fork Coquille River (NFCR) is located in the Oregon Coast Range in Coos County, Oregon. It is approximately 53 miles long (not including tributaries and drainages) and the drainage covers 154 square miles in the basin with a 0.57% average gradient. The average discharge is 945 $ft.^3/s$ with high flows reaching 38,400 $ft.^3/s$.

The steep hill slopes above the valley areas are sparsely populated. Timber production, agriculture, and some mining are the predominant land uses. Approximately 70% of the watershed is forested. The upper reaches of all four forks of the Coquille River and most tidal streams are commercial forests and public lands. Ownership of the NF basin is: 0% USFS, 0% State, 0.7% County, 18.7% BLM, and 79.6 other timber companies and privately owned.

The NFCR has runs of Oregon Coast coho salmon, fall Chinook salmon, winter steelhead, and sea-run cutthroat trout. The upper NFCR contains some of the best spawning and rearing habitat in the Coquille River system. Also found in the NFCR basin are sections of undisturbed Douglas-fir dominated riparian zones that are optimum habitat for numerous wildlife species, such as the northern spotted owl.

II. Purpose and Scope of the NFCR Knotweed & Riparian Restoration Plan

This plan is a guide to concentrate available resources on noxious weeds with a focus on the NFCR knotweed infestation and riparian corridor. The aim is to prevent, contain, and reduce knotweed and other noxious weeds within the riparian areas along the NFCR and to restore the riparian buffer with native plants. The term riparian buffer describes an area of land adjacent to waterways (streams, rivers, creeks, ponds, ditches etc.). Riparian buffers often include a variation of native trees, shrubs, flowers and native grasses that line the banks. They are sometimes referred to as riparian management areas (RMAs).

This restoration plan is an outcome of the multi-year, whole basin restoration approach being implemented in the NFCR entitled the NFCR Knotweed and Riparian Restoration Project. Since 2008, the Coquille Watershed Association (CoqWA) has been a partner in implementing stream restoration projects within approximately 32 miles of tributaries of the NFCR. In addition to instream wood placement projects, riparian buffer improvements will provide shade and long term natural wood recruitment. However, many areas of the NFCR are becoming infested with knotweeds, altering the riparian buffer.

Benefits of a riparian buffer: Native plants in riparian corridors are key to improved water quality. Native grasses, trees and shrubs have ~~deep~~ root systems that protect the bank from erosion subsequently reducing sediment input into the waters. In addition, nitrogen, phosphorus, pesticides and other pollutants are sequestered in the riparian buffer as the vegetation filters the runoff prior to entering the stream. The vegetation also provides a major source of energy and nutrients for stream ecosystems. Riparian canopies maintain cool stream temperatures and provide a variety of habitat for salmon and their prey. They also provide future ~~re~~sources of instream wood that provide addition habitat benefits. Lastly, in addition to providing food and cover for aquatic life, a healthy riparian buffer provides travel corridors for wildlife.

Riparian vegetation slows floodwaters, helping to maintain stable streambanks and protect downstream properties. By slowing both floodwaters and rain water runoff these buffers help improve water retention and ground water recharge. However, invasive weeds can reduce or eliminate riparian functions and habitats.

Why focus on knotweed?: CoqWA and partners have found that knotweed is spreading throughout the NFCR system. Within the drainage, there is a lack of knowledge among landowners regarding the impacts of this noxious weed and how to treat it. Many landowners are trying to mow or brush mowers only spreads it across their property or downstream. While continuing to complete riparian restoration, CoqWA determined a need for comprehensive knotweed management.

Weeds of Concern:

The Coos County Weed Advisory Board refers to the Oregon Department of Agriculture state noxious weed list when updating the county noxious weed list. State and/or County noxious weeds known to exist in the NFCR watershed include:

Bull thistle (*Cirsium vulgare*)
Butterfly bush (*Buddleia (Buddleja) davidii*)
Canada thistle (*Cirsium arvense*)
English/Atlanic Ivy (*Hedera helix, hibernica*)
French broom (*Cytisus monspessulanas*)
Giant knotweed (*Polygonum sachalinensis*)
Gorse (*Ulex europaeus*)
Himalayan blackberry (*Rubus armeniacus*)
Japanese knotweed (*Polygonum cuspidatum*)
Meadow knapweed (*Centaurea x monktonii*)
Jubata grass (*Cortaderia jubata*) or Pampas grass (*Cortaderia selloana*)
Poison hemlock (*Conium maculatum*)
Purple starthistle (*Centaurea calcitrapa*)
Tansy ragwort (*Senecio jacobaea*)
Scotch broom (*Cytisus scoparius*)

NFCR Knotweed & Riparian Restoration Priority Weeds:

Noxious weeds have been introduced into the Coquille watershed from a variety of sources. According to landowners and land managers, weeds have been introduced from road traffic, other rights of ways including power lines, adjoining lands, equipment from off-site, was self-planted, or arrived via animals or the wind.

1. Knotweeds (Japanese, Giant, Himalayan and Bohemian -Highest priority: All these knotweed are species of high importance because they alter the vegetation in riparian areas, reducing streambank stability and benefits to landowners and fish and wildlife habitat. These noxious weed can spread quickly and establish a new plant from even a small fragment. The University of Idaho, Oregon State University and Washington State University jointly collected 865 knotweed specimens from 132 populations across the western US and Canada. Samples were sent to the

USDA-Agriculture Research Service Station in Sidney, Montana for DNA analysis. Results show that 72% of the samples were the hybrid of Japanese and Giant knotweed, commonly known as Bohemian knotweed, making it the most common knotweed found in the western US.

2. Armenian/Himalayan blackberry-High priority: Blackberry is the most widespread and economically disruptive of all the noxious weeds in western Oregon. It aggressively crowds out native plants and dominates riparian habitats. It is a significant impediment for riparian restoration projects. Reproduction occurs through rooting at the cane, by root fragments, and by seed.

3. Gorse-High priority: Gorse is a perennial, heavily armored evergreen shrub growing ~~from 3~~ to over 10 feet tall. Gorse plants are shrubby with stout and erect spreading branches covered in terminal thorns frequently forming dense thickets. Gorse is observed predominantly along the coast in Coos County; however, it has spread into the Coquille valley and has been observed at a few locations in the North Fork Coquille River drainage and was subsequently treated.

4. Canada Thistle-Medium priority: Canada thistle is a creeping perennial present in every county in Oregon. They impact cultivated fields, riparian areas, pastures, rangeland, forest, lawns, gardens, roadsides and waste areas. It has an extensive horizontal root system that spreads and allows the plant to create dense patches. Fragmentation of the root system aids in spreading as does its prolific seed production.

5. Brooms (French, Scotch, and Portuguese)-Medium priority: Brooms are present along roads and in forests. They are a primary concern for the timber industry and safety in the watershed as they reduce the productivity of timber lands and impede sight distance on roads. The brooms propagate more quickly than gorse and appear to be spreading in the watershed.

III. Objectives of the NF Knotweed & Riparian Restoration Plan

1. Objective #1: Develop a noxious weed and project inventory
   Mapping and documenting noxious weed infestations and treatments will be completed using a minimum of GPS and photo points with field notes of general site conditions. Landowners and land managers will continue to be encouraged to supply information as it exists or becomes available for entry into the database.

2. Objective #2: Develop an awareness and education campaign.
   Concern for the control of knotweed and other noxious weeds in the NF watershed area has been expressed from several different interest groups. Ranchers are concerned about reduction of property area and the quality of forage available for livestock as well as bank erosion. Forest owners and managers are concerned about property values and productivity. Rural residential landowners are concerned about loss of property area, aesthetics, the health of native trees, plants, and wildlife, and fire danger. An education campaign about knotweed will be implemented on several platforms to reach landowners. While working with landowners to improve riparian conditions, opportunistic projects may arise to incorporate other best management practices that can improve overall water quality and quantity as well as other fish & wildlife habitats.

3. Objective #3: Develop restoration projects and identify funding

   CoqWA will work with landowners and other technical resources to develop a project plan that will include a minimum of a riparian and land use assessment, treatment prescription, and planting plan. The project plan can include additional items (riparian fencing, off-channel water system and other best management practices). As part of the project design a planting plan will be designed specific for each site. Riparian restoration will address a variety of issues; restore native and cultural plant communities, improve riparian habitat complexity, stabilize stream banks and streamside fish & wildlife habitat needs.
   *If treatment will take longer than one season grass seed and mulch will be applied prior to the onset of rain season to establish some sort of ground cover and filter strip.

   The first treatment phase will include treating a manageable area of knotweed, a reasonable size 5-10 landowners or approximately 5 river miles. Opportunistic sites above the infestation may also be included throughout the process to improve riparian buffers. New phases will be developed every 1-2 years if landowner participation and funding are available. Project funding will be sought though a variety of methods including but not limited to partners, grants, special programs and landowners. Federal, state, and local government grants will be identified in addition to private funding as well.

4. Objective #4: New Invaders
   Prevention: Prevention is the first and most effective defense against noxious weeds. Making the public more aware of the need for weed prevention and best management practices to prevent the spread of weeds from other areas is needed. Management tools can help assure land users follow the best management practices.
   Early Detection and Rapid Response: A rapid-response system to eradicate a new weed before it spreads is also essential.

IV. NF Knotweed & Riparian Restoration Guidelines

1. Site condition assessment:
   Each infestation will be evaluated by CoqWA and/or project partners along with the landowner based on location, species of weed, intended land use, and topography. The method of control will be at the discretion of the landowner(s) and manager(s) using technical resources available including: weed control literature, OSU Extension Offices, NRCS, the Coos County Weed Advisory Board, and other partners. It is advised that when landowners apply herbicides, application will be in accordance with all applicable laws, management plans, label instructions, and safety precautions specified in the material safety data sheets (MSDS) shall be followed. Landowners and land managers are encouraged to send treatment location and control information to the Coos Watershed Association for weed management monitoring and educational purposes.

2. Management of noxious weeds in accordance with area priorities:

*Knotweed-High *Canada thistle-Medium *Other ODA listed weeds- Low
*Gorse-High *Brooms-Medium
*Himalayan-High

The first basis for priority of weed control practices will be high to low and the location of the infestation in relationship to topography and the potential of spread through land use. Infestations at the head of watersheds or along trails, roads, or other right of ways with high use are the types of areas that shall receive first consideration when initiating a control plan. This is especially true for knotweeds.

The second priority is for early detection and rapid response (EDRR). EDRR refers to weeds that have not been previously detected or previously known weeds of the NFCR that are found in small, isolated spots within the NFCR watershed that can be completely removed with a rapid treatment.

The third priority would reflect all other weeds in this management plan at lower elevations, low use areas, or are species of medium or low priority.

3. Knotweed and other Noxious Weed Treatment Options:

   Knotweed project areas will be evaluated on a site specific and landowner preference when developing treatment options at each site. Mechanical, manual and chemical application for knotweed control can be used in conjunction with various other invasive weeds in the area to be treated.

4. Collection and Management of Funds:

   At this time, CoqWA will seek and manage funding from federal, state, and private sources to assist in the success of the NFCR Knotweed and Riparian Restoration Project. Landowners may participate solely on their own or with other technical and financial partners at their discretion.

5. Riparian Restoration Projects

   A riparian restoration plan would be site specific.
   Riparian restoration is the reestablishment of riparian functions and related physical, chemical, and biological linkages between terrestrial and aquatic ecosystems. The goal is to ensure that the dynamics of natural ecosystem processes are again operating efficiently so that both ecosystem structure and functions can be recovered and sustained (Beschta et al. 2000).

   Major considerations when creating a restoration & planting plan:
   1) Where is the restoration taking place? (Forest, field or waterway buffer area)
   2) What are the landowner intentions with the area?
   3) Has there been or is treatment going to be done?
   4) What are the competing vegetation?

5) What native vegetation is in the area or nearby?

6. Monitoring completed projects and/or treated areas
    - Water quality
    - Plant Establishment
    - Invasive species recolonization

V. Knotweed Treatment Options (Adapted from Soll 2004 and McHugh 2006)

a. Mechanical or Manual Control

Digging is a mechanical control used to remove or starve the root system. In experiments conducted by The Nature Conservancy between June 2000 and June 2003 and as reported in the literature, in the vast majority of cases, monthly cutting fails to eradicate even isolated and relatively small knotweed patches unless conducted for several years. However, the Japanese Knotweed Manual (Child and Wade 2000) reports successful control of an isolated and small patch after three consecutive years of uprooting the plants in August. TNC was able to control one small patch (25 stems) with 17 monthly cuttings over three field seasons. Child and Wade recommend against trying this technique for larger, more established patches. Unless you are prepared to cut knotweed patches twice a month or more, especially between April and August, and then once a month or more until the first frost, a program based on cutting alone is likely to be a recipe for frustration and failure. In some cases however, using manual / mechanical control may be the only viable option. For instance, if the knotweed is in a very environmentally sensitive area or if a particular landowner is opposed to pesticide use. To be successful, one should plan for an aggressive mechanical control program to be continued for at least two or three years if the patches are well established. In the end, timely, thorough and persistent cutting over several years can eliminate knotweed, especially small, isolated patches. Due to the level of effort required, this approach is best suited for individual landowners with easy access to their knotweed patches and a strong commitment to avoiding herbicides. If a mower/weed-eater is set close to the ground, is an option for use. It is best to remove, rake and carefully dry all knotweed vegetation that is cut or mow, because stems or stem fragments can sprout, and the area (or adjacent areas) may become re-infested. Do not allow cut, mowed or pulled vegetation to enter waterways.

Pulling (uprooting) is a good option if the soil is soft. This will eliminate some portion of, but not all of the root system each time it is done. Be sure to carefully dry or dispose of the roots. Do not put them in a compost pile. Follow up frequently to catch re-sprouted stems. Be sure to search at least 20 feet (7 meters) away from the edge of the original patch center.
If the knotweed has established in soft soil, or better yet sand, try pulling the plant and major rhizomes up by the root crown to remove as much of the root system. Although the plant will not be killed in one treatment, the root mass will be reduced. Each time new sprouts are observed (start looking a week after the first pull and search at least 20 feet away from the original plant), uproot them as well, trying to pull out as much of the root as possible. This is probably only feasible with small patches. Be sure to carefully dispose of any root material.

Covering has been anecdotally reported as a control option, however there are no reports of successful knotweed control with covering. This includes those of the Lummi Nation in Washington, who combined digging, tilling and covering with several layers of cardboard on 2, ¼ acre patches. The results were poor however; they achieved only 80% reduction in stem number, at a cost of $32,000/acre. An effort to control knotweed by covering conducted by the USFS Mt Hood National Forest in Zig-Zag, Oregon, also failed, despite extensive pre-covering digging. TNC also failed to achieve good control covering a single large patch for about 6 weeks in the spring. Others have also reported that knotweed grows out from under the covering material. If it must be employed, this method is likely to work better with isolated and smaller patches on open terrain. Plan to leave the covering material in place throughout the growing season and well into the next. As always, check the site through at least September the following year and again the year after.

To use this technique first cut stems down to ground surface (and possibly follow with tilling).* Cover the area with thick black plastic or multiple layers of cardboard expanding beyond the plant base and stems at least 2 meters (and preferably 7 meters) beyond the outside stems. Weight down the covering material and watch the perimeters to be sure new stems are not popping up outside the cover material. Try this right at the beginning of the year or after the plant has been cut down a couple of times in the spring and reduced some of the rapid plant growth. It may be necessary to leave the plant covered through at least one entire growing season.
*Note - there are no reports of successful long-term control using covering alone.

Hand Cutting can be done using a machete, loppers or pruning shears, cut the stems down to the ground surface as often as possible, but at least every 2-3 weeks from April (or as soon as the plant appears) through August. Sprouting slows after August, so cutting frequency can be reduced, but try and prevent the plants from ever exceeding six inches (15cm) in height. Pile the cut stems where they will quickly dry out.

Mowing can be done using a weed-eater or mower, cut as low as possible and as often as possible, but at least every 2-3 weeks through August. Be sure to not scattering stem or root fragments onto moist soil or into the water.
Goats are reported to eat knotweed and in some circumstances controlled goat grazing may be an option similar to intensive mowing. Be aware they will eat desirable vegetation as well.

General Comments on Manual Control and Combining Treatments

No matter which control method(s) is used, manual or mechanical control is going to be a lot of work. But, combining digging/pulling with cutting or even herbicides use, helps break up the root system and encourages the plant to send up new shoots. The more shoots there are per linear foot of root, the more likely they can physically be pulled out and exhausted by depriving them of energy (i.e. by cutting the shoot off) or kill them with herbicides.
If manual control is pursued, be sure to practice the four T's: be timely, tenacious, tough and thorough. And as always, carefully dispose of any stem or root material.

b. Herbicides

An important note to herbicide users receiving or applying for federal funding: A pesticide label approved by the U.S. Environmental Protection Agency and registered by the appropriate state agency does not guarantee that the product will be allowed to be used in certain federally funded weed eradication projects. If federal funding is received for the knotweed eradication project, the United States Fish and Wildlife Service (USFWS) and / or the National Oceanic and Atmospheric Administration (NOAA) has the right to consult on herbicide use, and may not approve the use of certain herbicides or additives. Check with the grant coordinator to ensure compliance with agency/grant specifications.
NOTICE: *Mention of specific pesticide products in this document does not constitute endorsement of any material.*
Application method variations include spraying, wicking, injecting, pouring or combinations thereof.

General Herbicides
Many herbicides, herbicide combinations and application methods have been tried on knotweed, and work to a greater or lesser degree depending on many factors. But like any weed control method, herbicides will fail if used incorrectly. Because knotweed thrives in riparian areas, herbicide exposure to water, the susceptibility of surrounding desirable plants to the herbicide, and the potential impact of herbicides on aquatic organisms must be considered in choosing the most appropriate product for the particular weed control program. Furthermore, using any herbicide correctly means using:
• An herbicide that has a label allowing applications on the particular use site;
• The correct concentration (rate);
• An adjuvant if recommended (adjuvants are spray solution additives that may make the herbicide more effective);
• The right application method;
• The correct timing to coincide with plant susceptibility.
As always with herbicide use, carefully read and follow all use directions and any restrictions or precautions listed on the product label. If in doubt, contact the OSU extension agent, pesticide dealer, Department of Agriculture, or the herbicide manufacturer for advice or clarification.

Herbicide - Foliar Spray
Whether using a small hand held, backpack, or large volume sprayer, spraying herbicide on the leaves is one way to apply herbicides. Spraying poses a relatively high risk of creating drift (allowing pesticide onto the soil, into water or on surrounding desirable plants) if precautions are not taken and care is not used. A basic rule to consider is that the faster the application method, the more likely it is to hit non-target areas. In Oregon, permits for aquatic applications are not currently required. However, contact the local Department of Environmental Quality for further information. In any state, it is a requirement of federal and state law that the herbicide user follow the product label.

Herbicides with an active ingredient of glyphosate (Rodeo, Aquamaster, Gly Star, Round-up), triclopyr (Garlon 3a and many "shrub-killers"), 2,4-D, picloram (Tordon) and Imazapyr (Arsenal) have shown to be variably effective in controlling knotweed either separately or in combinations. Each offers benefits and potential risks. Please consult with the OSU extension agent or herbicide company representative for advice on which product is most appropriate to use in the specific situation.

Foliar Treatment Timing

The right time to apply herbicides is greatly affected by herbicide choice. According to Oregon Department of Agriculture materials, the ideal time to spray most deep-rooted perennials is when they are in flower bud stage. However, because knotweed may be 15 feet tall when it begins to flower (July or August in the PNW) this is not always practical. The best time, from a practical standpoint, is when the patches are 1-2 meters tall. Shorter plants may not have adequate leaf surface to absorb, and translocate, enough chemical to be effective. However, young, rapidly growing plants do have a more efficient biological process to translocate chemicals. Spraying taller plants means creating more risk of pesticide drift and older plants may not be as efficient in chemical translocation. A spring spray 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 first encountered late in the year can be cut to 1.5 meters 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 (Soll 2004).

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. Just as when treating patches mechanically, be sure to search for new shoots at least as far as 20 feet away from the central patch after herbicide treatment begins.

Foliar Treatment - How To

When mixing herbicides always follow safety precautions and mixing instructions listed on the product label. At a minimum, always wear the required personal protective equipment specified on the label, which may include safety glasses, chemical proof gloves, and long sleeves, especially when handling the concentrated herbicide. A standard mixing sequence for most herbicides that would be used in knotweed control would be to add half the total amount of water to your spray tank, add the measured amount of herbicide, any surfactant (and dye), then the rest of the water. Mix carefully, but thoroughly between steps. After mixing the herbicide solution, follow the directions for foliar applications on the label, which is usually to spray just enough solution to wet the leaves and stems while avoiding dripping. Try and spray the top surface of every leaf on the plant and the stems. The plant may take several weeks to show significant adverse effects. Do not worry or retreat, the best control happens slowly. Return later in the season and again the next season to determine if additional treatments will be necessary.

Herbicide: Stem Injection

Injecting concentrated herbicide directly into the hollow of the lower nodes of knotweed stems is an experimental method showing great promise in trials conducted under experimental use permits from the states of Oregon and Washington (photographs 11 and 12). Although time consuming, not only does this approach essentially eliminate drift, but Clark County (WA) Weed Management reports obtaining 100% control in one treatment by injecting 5ml of 100% Aquamaster or Round Up Pro into each stem of a given clump. More than 20 patches were so treated (please visit www.co.clark.wa.us/ environ/knotweed.pdf for more information).

**Note:* A high quality injection tool has been created, see www.jkinjectiontools.com for more information).

Contact the state pesticide regulatory agency to stay informed as to the availability of this treatment method. Any use of the injection method that is not clearly allowed for on the product label is a violation of federal and state regulations.

Herbicide: Cut Stem -Wick (wipe) Applications

This method relies on direct application of herbicide to plant tissue, typically using a sponge or brush of some sort. Although very slow, this approach greatly reduces or eliminates drift. This method may be useful in areas where plants are established in particularly sensitive areas or for landowners who are concerned about spraying. Unfortunately, control is generally mediocre without multiple repeat applications.

After cutting the stem about 2 inches above the ground (between the lowest nodes), apply glyphosate or other herbicide into the stem cavity and onto the cut stem surface. Different herbicides allow various concentrations of solution to be applied by this method. TNC has experienced only partial control of weed growth even after multiple treatments on small patches using a wiper or sponge application method and 33-50% concentrations of Garlon 3a and Rodeo herbicides. Using a handheld mister type sprayer to direct a small amount of concentrated herbicide into the stem cavity as well as the cut surface appears to give better results than wick applications since more herbicide is absorbed by the plant. A follow-up foliar or wicking treatment may be needed to control new seedlings and new sprouts.

Herbicide: Cut Stem - Pour Applications

This still somewhat experimental method also relies on direct application of herbicide to plant tissue. Although very slow, this approach also greatly reduces or eliminates drift. This method may be useful in areas where plants are established in particularly sensitive areas or for landowners that are concerned about spraying. Clark County Washington Weed Management reports control results somewhere between injecting and wicking as described above.

After cutting the stem about 2 inches above the ground (between the lowest nodes), carefully pour ~5ml of undiluted herbicide into the stem cavity. Different herbicides allow various concentrations of solution to be applied by this method (EPA has just approved this method for Aquamaster). Please read and follow the label. A follow-up foliar or wicking treatment may be needed to control new seedlings and new sprouts.

A note about adjuvants

Adjuvants (also referred to as surfactants, penetrants, activators or sticker spreaders) are agents added to the herbicide mix that help it stick to or penetrate into the leaf. They can make a significant difference on how well the herbicide treatment works. The surfactant LI-700 has been considered the most salmon safe and has been approved by the National Oceanic and Atmospheric Administration - Fisheries. Where direct risks to aquatic organisms aren't involved other non-ionic surfactants such as R-11, Activator or various seed oil derivatives may work safely and most likely will be better than LI-700 for glyphosate based herbicides. Away from water, surfactants with silicone (Syltac by Wilbur-Ellis for instance) may be helpful. Please seek the advice of the pesticide dealer, consultant or OSU extension agent to determine which adjuvant is best for the herbicide chosen and in consideration if there is any potential exposure to waterways.

To successfully control knotweed with herbicide treatments, the active ingredient in a herbicide product must have a mode of action designed to move the chemical from the leaves into the root system (i.e. be

translocated) at sufficient concentration to kill the root tissue. To achieve successful translocation at the site, it may be necessary to conduct some field trials to test the efficacy of different concentrations of spray solution. Some herbicides may need to be used at low concentrations in order to avoid damaging the above ground tissues of the plant before the herbicide is well dispersed in the root system. *Remember, with herbicides more is not necessarily better*. For instance, using triclopyr (e.g. Garlon 3A) at 5% concentration appears to give good top-kill to leaves but does not adequately destroy the plant root system and results in mediocre long-term control on large patches.

TNC has heard reports of successful control using Garlon at rates as low as 3/4% (about 1 oz per gallon) in high volume application. In TNC's field experiments, both 3-5% Garlon 3a and 3-5% Rodeo with LI-700 eradicate about 50% of small patches after two to four treatments over two years. In controlled experiments comparing treatments on small patches (30-200 stems), Garlon 3a provided 90+ percent control in one year and 100% control within 2 years. Rodeo was slightly but consistently less effective, typically taking 3 years of treatment to achieve full control.

Although some glyphosate products demonstrate acceptable control with one or two treatments in some cases, they frequently allow survival of several badly mutated stems (so called epinastic growth) from a given clump. These stems appear likely to survive and recover if left untreated. Clark County (Washington) Weed Management reports getting good control from applications of 7-8% glyphosate (e.g. Aquamaster) on first year plants or sprouts from nodes, with some patches requiring additional treatments. However, inadequate control was observed with a different glyphosate product (e.g. Rodeo) applied at 7-8% concentration on established knotweed patches. Because both products used in this trial have the same concentration of active ingredient (53.8%) it was not clear as to why the difference in product performance was observed (total root mass is probably an issue).

Besides glyphosate (Aquamaster, Rodeo, Roundup, etc) and triclopyr (Garlon 3A), other herbicides that may be considered for knotweed control are those with active ingredients of 2,4-D, Imazapyr (Arsenal) or Picloram (Tordon). Please remember to check with the pesticide regulatory authority before making the chemical decisions to ensure compliance and applicability for the intended site.

Comments on herbicide based techniques

If stem injection proves to provide consistent control, a new label is approved by the appropriate state and federal agencies, and an injection tool is available on the market, this will be an important method for knotweed eradication projects. This is especially true for sites along sensitive waterways and very hard to access sites. Until the injection method is approved as needed for knotweed control, foliar applications appear to be a reasonably efficient approach (1 to 4 treatments over two seasons) to obtain control over small and medium size knotweed patches. Larger patches will often require treatment over several years and combinations of manual and chemical control methods. Each project manager will need to weigh the advantages and disadvantages of the control methods presented here to design a comprehensive, integrated approach to manage available resources to attain the goal of eradicating knotweed in the project area.

c. Integrated approaches

Combining different control methods offers additional choices and provides flexibility in the weed control program. TNC has found little difference in control effectiveness of cutting the plant in the spring and spraying in the summer / early fall versus spraying both times. The spring cutting may reduce total herbicide load into the NFCR watershed and may be more labor efficient than spraying twice. Maximizing available labor and reducing program expenses allows more patches to be treated in a given season. Furthermore, cutting allows the use of volunteers, which is difficult or impossible with herbicide applications.

Digging, pulling or tilling (if conditions warrant) before August and at least one month prior to spraying may also help by increasing the shoot to root ratio and reducing plant vigor and root mass, thereby increasing plant susceptibility to the herbicide.
Many knotweed patches have a significant percentage of stems too small to inject. Research is currently underway comparing the effect of spot spraying the small stems at the time of stem injection, with leaving the small stems untreated until the following year (when they presumably, but not certainly could be injected).

VI. Annual Operating Plan

Currently the North Fork Coquille River Knotweed and Riparian Restoration Project is operated by the Coquille Watershed Association with technical support from various partners. The North Fork Coquille River Knotweed and Riparian Restoration Project will operate in phases.

Phase 1

2015 through 2017: Conduct initial survey on knotweeds and riparian condition. Create a pilot treatment area in Reach 1 for knotweed infestation. Continue to build data over treatment period.

Phase 2

2016 through 2022: Conduct outreach to landowners and develop project within Reach 1. Locate funding for invasive treatment and riparian Restoration. Conduct monitoring/maintenance for 5 years.

Phase 3

2017 through 2023: Conduct outreach to landowners and develop project within Reach 2. Locate funding for invasive treatment and riparian Restoration. Conduct monitoring/maintenance for 5 years.

Phase 4

2019 through 2025: Conduct outreach to landowners and develop project within Reach 3. Locate funding for invasive treatment and riparian Restoration. Conduct monitoring/maintenance for 5 years.

VII. Referenced Literature and Additional Information

A variety of sources are available for further information about weed control methods.

Online Resources

Center for Invasive Plant Management at http://www.weedcenter.org/. Education resources; grant and funding information; weed prevention; invasive plant management techniques; Worst Weeds of the West; and invasive plant biology, photos, and species information.

Oregon Department of Agriculture Plant Division, Noxious Weed Control System at http://egov.oregon.gov/ODA/PLANT/weed_index.shtml. The state weed board web site to find the state weed list and species profiles, distribution of weeds (Weedmapper), grant funding information, and more.

Oregon Department of Agriculture, Oregon Noxious Weed Profiles at http://www.oregon.gov/ODA/programs/Weeds/OregonNoxiousWeeds/Pages/AboutOregonWeeds.aspx

Oregon State University Weed Science Program at http://cropandsoil.oregonstate.edu/weeds/. Weed identification, weed management, herbicide information, news, OSU publications, links to other sites.

The Nature Conservancy Wildlands Invasive Species Website (tncweeds.ucdavis.edu)

This website has a wealth of information on exotic species control, and tools, and includes a review of knotweed control literature. The knotweed page is found at tncweeds.usdavis.edu/esadocs/Polycusp.html.

Books & publications

Aquatic and Riparian Weeds of the West by Joseph M. Ditomaso (2003). Emergent, floating leafed and submerged weeds including species profiles, identification keys.

Biology and Management of Noxious Rangeland Weeds by Roger L. Sheley and Janet K. Petroff (1999). Theory and practice of weed management, weed species profiles.

Beschta, Robert L. 2000. Watershed management in the Pacific Northwest: The historical legacy. USDA Forest Service Proceedings RMRS–P–13.

Child, L. and M. Wade. 2000. The Japanese knotweed manual - the management and control of an invasive alien weed. Packard Publishing Limited, Chichester.

This is a comprehensive guide to designing and executing a Japanese knotweed control program from folks in Great Britain.

Coos Bay District Resource Management Plan & Environmental Impact Statement, Volume II. August 1992- US Department of the Interior, Bureau of Land Management, Coos Bay District Office.

McHugh, J. 2006. A Review of Literature and Field Practices Focused on the Management and Control of Invasive Knotweed {Polygonum cuspidatum, P. sachalinense, P. polystachium and Hybrids), http://tncweeds.ucdavis.edu/ moredocs/polspp02.pdf.

North Fork Coquille Watershed Analysis Umpqua Resources Area, Coos Bay District Bureau of Land Management, North Bend, Oregon- Second iteration July 20, 2001 with edits through January 9, 2002.

PNW Weed Management Handbook online at http://weeds.ippc.orst.edu/pnw/weeds.

The handbook is designed as a quick and ready reference of weed control practices used in various cropping systems or site/situations in Oregon, Washington, and Idaho.

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

The Weed Worker's Handbook by the Watershed Project and California Invasive Species Council (2004). Also downloadable at http://www.cal-ipc.org/ww_handbook/. The *Handbook* provides:

- *A simple, strategic approach to dealing with wildland weeds*
- *Guidelines for planning and leading volunteer control projects*
- *Descriptions of techniques used to control wildland weeds*
- *Tool illustrations and a chart explaining how each tool can be used*
- *Color illustrations, detailed descriptions, and thorough explanations of the best ways to control the Bay Area's worst weeds*

Weeds of the West by Tom D. Whiteson (2000).

This book from the Western Weed Science Society contains color photographs of nearly 300 species of weeds. Each species is presented with three colors pictures and an easy to read narrative gives the descriptions, habitats and characteristics of each weed.