Watershed-scale Cooperative Weed Management: An Assessment of the King County Knotweed Control Project

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ABSTRACT

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The desire to extend weed management efforts from a particular area of land ownership to an entire community or watershed motivated the conception of the Cooperative Weed Management Area (CWMA) framework. By bringing groups and individuals from within a given watershed or community into the planning and implementation process, CWMA participants share the responsibilities and benefits of weed management.

The CWMA framework offers an effective strategy for managing invasive knotweed on a watershed-scale throughout King County. Most commonly, invasive knotweed spreads along rivers and riparian areas when rhizome and stem fragments wash downstream, reroot, and grow into clones of parent plants. Because a single infestation along a river or stream can spread downstream, invasive knotweed cannot be effectively managed on a site-by-site basis but, rather, needs to be managed on a watershed-scale. Watershed-scale weed management necessitates collaboration and cooperation among the different stakeholders in a given area.

This thesis examines the management strategy of the King County Knotweed Control Project to identify its strengths and challenges. To do this, I use an interdisciplinary approach that examines both quantitative GPS data for acres of treated invasive knotweed and qualitative data from interviews and surveys of the various project stakeholders. Analysis of the project indicates that invasive knotweed management in King County will benefit most significantly from greater focus on community education, outreach, and overall communication with project participants. Furthermore, I recommend framing the project within the context of salmon habitat improvement in order to build a cohesive place-based group identity around the watershed-scale project. The lessons derived from this project can provide beneficial direction to other watershed-scale weed management efforts.

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LIST OF ACRONYMS

BMPs	Best Management Practices
CWMA	Cooperative Weed Management Area
KCNWCP	King County Noxious Weed Control Program
SRF Board	Salmon Recovery Funding Board
USDA-FHP	US Department of Agriculture- Forest Health Protection Program
WCC	Washington Conservation Corps
WSDA	Washington State Department of Agriculture

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Chapter One. Introduction

Today many American weed scientists and land managers advocate ignoring invasive species that have become so widespread and abundant that there are not enough human and financial resources to effectively manage them. They advocate instead focusing on emerging weed populations—before they progress beyond control. The King County Knotweed Control Project deviates from this prevailing strategy. Washington State Weed Law does not require management of invasive knotweed. However, it densely inhabits thousands of acres of riparian land throughout the County, so the King County Noxious Weed Control Board identified the impacts of invasive knotweed to be so great that it prioritized watershed-scale management of the plants in critical riparian habitat areas in King County. The King County Knotweed Control Project is a trial of an alternative strategy for weed management—tackling a widespread invasive weed by using a cooperative watershed-scale approach. Invasive knotweed is a good candidate for this trial because it is an ideal "poster child" in the invasive weed community: its impacts on sensitive riparian ecosystems are well-documented, including negative impacts on habitat for a Pacific Northwest icon—wild Pacific salmon species (*Oncorhynchus* spp.).

The purpose of this thesis is to conduct an assessment of the King County Knotweed Control Project using an interdisciplinary approach to determine the project's strengths and challenges and to make recommendations for its improvement. In 2008, the project completed its fifth year of action— an appropriate time to assess

and adapt. My interest in this subject comes from personal involvement with the King County Knotweed Control Project. Over the course of three years, I had the chance to play two distinct roles in the project. First, I served as a member of a conservation crew who had been contracted to execute the on-the-ground treatment of invasive knotweed. Second, I served as a member of the staff who managed the watershed-scale control project. Through these two lenses, I saw the project quite differently. In an assessment of the project's success, incorporating the perceptions of different stakeholders is integral.

Using quantitative data gathered using GPS surveying technology and analysis of interviews and surveys of various project stakeholders, I identify the strengths and challenges of the current management strategies of the King County Knotweed Control Project and make recommendations for its improvement. My assessment of the project indicates that invasive knotweed management in King County will benefit most significantly from greater focus on community education, outreach, and overall communication with project participants. Furthermore, I recommend attention to be paid to project messaging as a means for building a cohesive place-based group identity around the watershed-scale project. The lessons derived from this assessment can provide beneficial direction to other watershed-scale weed management efforts.

The focus of each chapter is briefly summarized as follows. Chapter Two looks at the foundation of invasive knotweed management in Washington State. It will also examine current literature regarding watershed-scale land management and posit

the importance of stakeholder involvement in weed management at this scale. Chapter Three offers an overview of the King County Knotweed Control Project strategy and methods including its guiding framework of Cooperative Weed Management Areas (CWMA's). Chapter Four discusses my research methods. Chapter Five presents the findings of my research, which include quantitative results from surveys completed by different stakeholders in the project and an in-depth exploration of the themes that arose from their feedback. That chapter concludes with a discussion of what the findings mean for the future of the King County Knotweed Control Project. Lastly, Chapter Six highlights the recommendations for King County and explores what the research means in the wider context of watershed-scale land management.

Chapter Two. Literature Review

Most simply, a weed is defined as "a plant out of place." However, when weeds are discussed in terms of their management, the term becomes more difficult to define in an absolute and encompassing way (Evans 2002). The definition put forth by the Washington State Noxious Weed Control Weed Board serves as a guide for the management strategies of the King County Knotweed Control Project (King County Noxious Weed Control Program 2010). So, for the purpose of this research, I will utilize the following definition.

> Noxious weeds are non-native plants introduced into Washington State. They spread quickly and can be difficult to control. They invade our croplands, rangeland, forests, prairies, rivers, lakes, wetlands, and estuaries, causing both ecological and economic damage that affects us all (Washington State Noxious Weed Control Board 2010).

Noxious weeds are classified into lists by Washington State and its county weed boards based on the characteristics of abundance, distribution, and level of threat. The classifications are the following:

> Class A Noxious Weeds: non-native plants that are limited in distribution in Washington State. State law requires eradication and complete removal of these plants;
>
> Class B Noxious Weeds: non-native plants that are absent or limited in distribution in parts of the state and very abundant in other regions. These

plants are required to be controlled to prevent further spread on a county-by-county basis;

Class C Noxious Weeds: non-native plants already widespread throughout Washington. Counties can either require the control of these plants or educate residents and landowners about methods for controlling these noxious weeds (Washington State Weed Board 2009).

Invasive Knotweed

Japanese knotweed (*Polygonum cuspidatum)*, Giant knotweed (*Polygonum sachalinense)* and Bohemian knotweed (*Polygonum x bohemicum*) are three closely-related species of knotweed in the buckwheat family (Polygonaceae) that are invading stream banks, riparian areas, roadsides, and parks throughout Washington (Zika and Jacobson 2003). *Polygonum X bohemicum,* a hybrid of *P. cuspidatum* and *P. sachalinese,* is the most widespread of the three; it has been recently understood that it is capable of cross-breeding with either of its parent species (King County Noxious Weed Control Program 2009). Therefore, the invasive knotweed is more adept at spreading than previously thought. Because these three species' morphological characteristics are very closely related and they all occur in King County, I refer to them collectively as "invasive knotweed". A less genetically similar

species, Himalayan knotweed (*Polygonum polystacyum*) is also invading many riparian ecosystems in Washington (Udo 2007; Urgenson 2006**)**.

All four species of knotweed are listed as Class B Noxious Weeds on the Washington State Noxious Weed List (King County Noxious Weed Control Program 2007). Invasive knotweed was introduced as an ornamental from Asia; its native habitats include harsh environments like volcanic slopes (Udo 2007). The International Union for the Conservation of Nature has listed *Polygonum cuspidatum* on the "100 of the World's Worst Alien Invasive Species" (Lowe et al. 2004).

Photo 1. Young Invasive Knotweed (Shaw 2010).

Photo 2. Streamside Infestation of Invasive Knotweed in Flower (Shaw 2010).

Dense invasive knotweed infestations are a problem for aquatic ecosystems because they choke the flow of small streams and displace streamside vegetation, which lowers the quality of riparian habitat for fish and wildlife. Although infested riparian areas are visibly dominated by dense vegetation during the spring and summer, invasive knotweed dies down to the ground in late fall and Winter; the resulting

bare stream banks are at increased risk of erosion. Invasive knotweed roots can reach as far as seven feet down into the earth and twenty feet horizontally from their parent plants; their root systems can effectively out-compete those of surrounding native groundcover, shrub, and even tree communities (King County Noxious Weed Control Program 2010, Urgenson 2006). Also, invasive knotweed nutrient absorption patterns have been found to alter the nutrient cycle of Pacific Northwest riparian ecosystems. A study conducted by Lauren Urgenson at the University of Washington has found that knotweed species reabsorb 75.5% of the foliar nitrogen into their roots as their leaves senesce, while native species reabsorb only 2.3-33%. In turn, significantly less nitrogen is available to the surrounding riparian forest ecosystem. The study concurrently found reductions in native plant cover that ranged from 41-91% in plots infested by knotweed (Urgenson 2006). Urgenson has conducted a preliminary study of how a decrease in the concentration of nitrogen in leaf matter might affect the abundance of aquatic insects in river systems. Although no conclusive results have been determined, Urgenson discussed possible links between lower nitrogen compositions in leaf litter, slower decomposition rates resulting from fewer aquatic microbes, and, ultimately, fewer macroinvertebrate consumers—which are an important food source for some juvenile salmon populations (Urgenson 2006; Gerber 2008).

By outcompeting native plants that serve both to maintain stream structure and also to provide leaf litter and woody debris, and by disrupting the nutrient cycling of the state's riparian ecosystems, knotweed is altering riparian habitat that supports

some of Washington's most cherished wildlife species—like wild salmon. The Washington State Department of Agriculture (WSDA) states that 80-90% of Washington wildlife species spend at least one stage of their life in a riparian habitat area; considering this high percentage, successful knotweed control can impact the majority of Washington's native wildlife (Udo 2008).

Invasive knotweed can reproduce through seeds and rhizomes. Most commonly, it spreads along riparian areas when rhizome and stem fragments wash downstream, reroot, and grow into clones of parent plants (Udo 2008, Walker 2009). Fragments as short as 1/3 of an inch are capable of growing into viable plants. The plant's ability to spread via hydrological transport is a key reason that invasive knotweed is such an effective and challenging invader. Because a single infestation along a river or stream can spread downstream, invasive knotweed cannot be effectively managed on a site-by-site basis but, rather, needs to be managed on a watershed scale. Watershed-scale weed management necessitates collaboration and cooperation among the different stakeholders in a given area.

The Washington State Weed Board classifies all four of the invasive knotweed species as Class B Weeds. However, in King County, invasive knotweed is classified as "non-designate", which means that control of it is "not required, but strongly recommended" (Washington State Noxious Weed Control Board 2009). As a consequence, approaches to invasive knotweed control focus on voluntary and cooperative strategies rather than regulatory strategies.

Washington State Knotweed Control Program

In 2005, the WSDA created the State Knotweed Control Program and released the "Washington State Integrated Knotweed Management Plan". The plan sought to coordinate knotweed control efforts across the state by disseminating Best Management Practices (BMPs) more widely and by improving project cost efficiency through a collaborative effort. The State Knotweed Control Program came into existence as a result of the 2004 pilot collaborative knotweed management project in southwestern Washington. Since 2004, WSDA has annually invested at least $500,000 in regional watershed-scale invasive knotweed control projects (Figure 1).

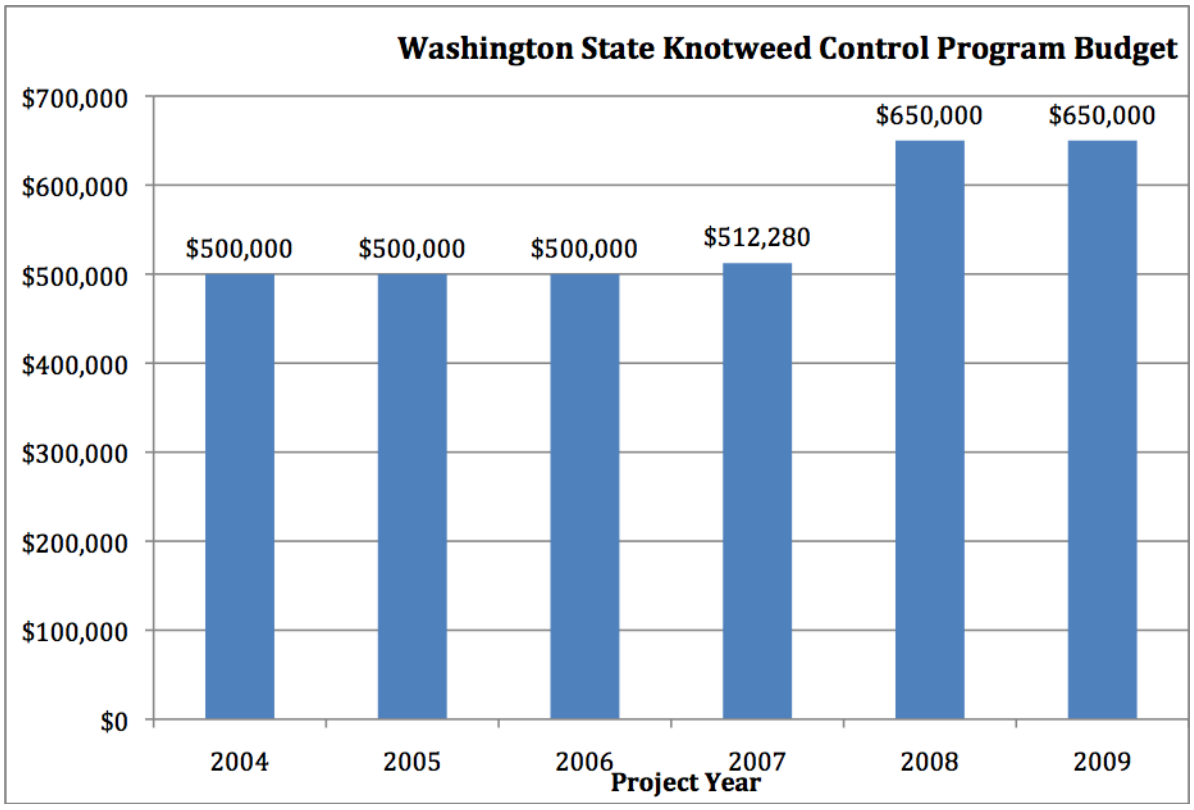


Figure 1. Washington State Knotweed Control Program Budget.

The Washington State Integrated Knotweed Management Plan has established a coordinated management strategy that is administered by the Knotweed Advisory Panel consisting of individuals from county weed boards, the Washington State Department of Natural Resources, the Washington State Noxious Weed Board, the Washington State Department of Fish and Wildlife, the Washington State Department of Ecology, and The Nature Conservancy (Udo 2007). This panel is responsible for selecting the organizations and agencies with whom the WSDA will collaborate each year in statewide knotweed control efforts. In 2008, the 19 selected cooperators received a total of $650,000: $512,280 for contracted knotweed control activities, $33,000 for herbicide purchases, and $104,720 for WSDA's coordination activities (Udo 2007). "Coordination activities" include contracted field staff, supplying herbicides, and WSDA administrative support. In 2009, 22 selected cooperators received a total of $650,000 from the WSDA: $522,242 for contracts and agreements, $30,000 for a centralized herbicide purchase, and $97,758 for WSDA coordination (Udo 2008). Below (Figure 2), is a map that illustrates the knotweed control project areas that received varying amounts of funding from WSDA in 2008.

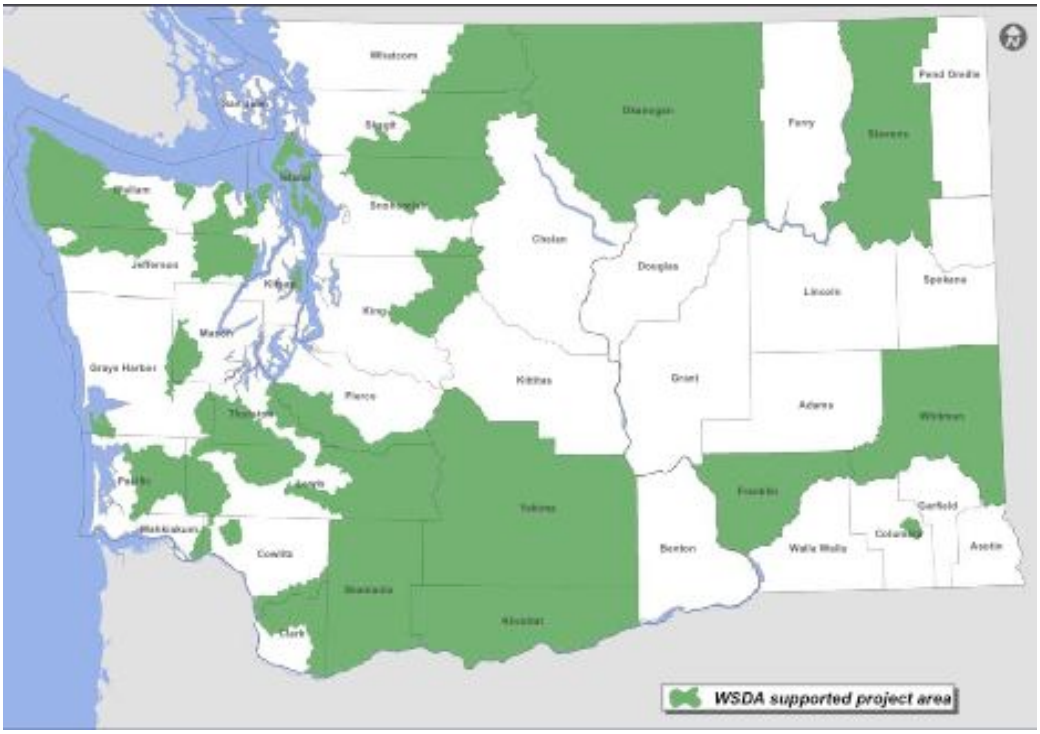


Figure 2. Statewide Knotweed Control Areas (Udo 2008).

Another aspect of the "Washington State Integrated Knotweed Management Plan"—perhaps most significant to my research—is that the WSDA and its cooperating partners are taking a *watershed-scale* approach to knotweed management. Due to the understanding of how invasive knotweed most frequently spreads—stream flow transports root and stem fragments to form new infestations downstream from older ones—it is essential that invasive knotweed be managed on the watershed-scale. So, in each participating watershed, the entire river system is first surveyed for knotweed, and then the observed patches of it are treated beginning at the uppermost infestation continuing downstream. This approach seeks to prevent reinfestations of treated areas in which valuable human and financial resources have already been invested.

Watershed Management

It would be useful to begin by examining two defining factors of watershed-scale land management. First, what *is* a watershed? Second, *who* makes land use decisions at the watershed scale?

The definition for "watershed" has varied a lot over time and across disciplines. In the late 1960's and early 1970's, most water-related policy was focused on flood protection, water quantity, and—to some extent—water quality, so surface water-centric definitions dominated the literature. As terms like ecosystem health and function began to be incorporated into land management strategies in the 1990's, the meaning of watershed began to evolve. Below are two more recent definitions for watershed:

> 1. Entire region drained by a waterway that drains into a lake or reservoir; total area above a given point on a stream that contributes water to the flow at that point; the topographic dividing line from which surface streams flow in two different directions (Corn 1993).
>
> 2. A watershed is a topographically delineated area that is drained by a stream system; a watershed is also a hydrologic-response unit, a physical-biological unit and a socio-economic-political unit for management planning and implementation purposes (Adams, Newton, and Noonan 2000).

While, factually, it is difficult to disagree with either of these definitions, each has an entirely different meaning and management implication. The first definition was written in a report for the US Congress entitled, "Ecosystems, Biomes, and Watersheds: Definitions and Use". At the time the report was written, Members of Congress were seeking alternatives to laws and regulations for land use that would have more permanent effects. Members began to advocate for "ecosystem management" as the means to that more permanent solution. This report, written by a Natural Resource Policy Specialist, sought to clearly define the meanings and applications associated with ecosystem management, watersheds, and biomes. By defining a "watershed" with the above definition, the report laid the foundation for a framework through which policymakers would manage land on this scale. This definition limits the concept of a watershed to the topographical boundaries of a geographical landscape—ignoring tangible aspects like groundwater flow and less tangible aspects like societal interactions with the land. The second definition was from a paper that was presented at the "Conference on Land Stewardship in the 21st Century" in Tucson, Arizona in 2000. The authors of this paper were employed by the Natural Resource Conservation Service (within USDA) including the Director of the Natural Resource Conservation Service, a Water Resources Planner, and a limnologist.

In *Watershed Management in the 21st Century: A National Perspective*, Carolyn Adams, Bruce Newton, and Thomas Noonan set out to examine this ongoing debate

over what a "watershed" truly is and how this lack of a popular consensus has impacted land management on this scale. The authors suggested that "watershed" is so difficult to define because the general motive of government agencies that manage land on the watershed scale is an "overt attempt to moderate the escalating tensions between the reality of the physical/natural world and human-contrived geopolitical boundaries" (Adams et al. pg 23). In essence, watershed-scale management attempts to address the obvious clash of political and natural boundaries. The challenge, however, lies in moving beyond ideological motivations to actual implementation of land management practices that achieve a holistic approach to successfully restoring and protecting aquatic ecosystems and health of natural and human communities as a whole.

Successful real-world implementation relies a lot on the second defining question that I posed above: *Who* makes land use decisions at the watershed scale? Watershed-scale management requires a collaborative effort among the different stakeholders in a given area because of the complex biological and societal relationships that exist within it. The need for stakeholder collaboration is widely agreed upon in the watershed planning community. However, what has not been agreed upon is *how* best to achieve this collaborative effort (Webler and Tuler 2001; Cheng and Daniels 2005; Higgins et al 2007; Leach et al 2002; France 2005).

Facilitating Watershed Management addresses the vast quandary of how best to achieve a collaborative effort. This book is a compilation of works inspired by a

symposium held at Harvard University in 2000 entitled, *Water Sensitive Ecological Planning and Design*. While the symposium resulted in a large book of technical solutions for improving watershed functions, the book's editor, Robert L. France, emphasized the significance of the policy-oriented task of facilitating watershed management by cultivating watershed stewardship (France 2005). In turn, France compiled a selection of papers into a book that attempts to show watershed managers how to build this sense of stewardship via three specific avenues: environmental communication, education outreach, and demonstration projects. This is one of the most comprehensive guides to real-world application of watershed-scale management. The book offers both theoretical and policy-inspired papers about the frameworks and definitions surrounding watershed-scale management as well as real-world examples of successful communication and education strategies implemented in watershed-scale projects in Massachusetts. Researchers Cheng and Daniels took a unique approach by examining the role that the geographic scale of a watershed project plays in the stakeholder dynamics within the given project. The authors conducted a comparative case study of two collaborative watershed planning efforts in Oregon and, drawing from the discipline of social psychology, they looked at the role geographic scale plays in determining "ingroup-outgroup effects" among stakeholders (Cheng and Daniels 2005). They looked at how stakeholders identified themselves and each other in terms of dominant "groups" in the collaborative efforts and how stakeholders identified with the key issues of the watershed planning efforts. Through semi-structured individual interviews, participant observation at planning meetings, and analysis of

watershed group reports, the authors found that with smaller-scale geographic planning areas, "stakeholders are more able to identify concerns over the interconnection between watershed and community health, and know and interact with one another as members of a shared community" (Cheng and Daniels pp 40). In larger-scale geographic areas, stakeholders more often identified with one another based on organizational affiliations instead of as members of a shared community. This was a case study that examined just two watershed planning efforts in the same region, so it is unwise to assume that small-scale watershed planning efforts are always the best way to build effective collaborative participation. However, it does draw attention to the importance of framing issues in watershed-scale management efforts. Forming place-based group identities through issue framing can foster the long-term watershed stewardship that France emphasized in *Facilitating Watershed Management: Fostering Awareness and Stewardship* (2005).

One benefit to watershed management in western Washington and the Pacific Northwest is the importance of salmon species to the cultural and economic history of the region. The existence of such an iconic regional symbol that is so closely connected and dependant on aquatic ecosystem health offers a great point from which to build a place-based group identity for collaborative watershed planning in the region.

Chapter Three. The King County Knotweed Control Project

For the purpose of this paper, I have conducted a case study of an agency that has been collaborating with the WSDA since 2005 in conducting watershed-scale invasive knotweed management in King County. The King County Knotweed Control Project is administered by the King County Noxious Weed Control Program (KCNWCP). KCNWCP is responsible for carrying out the mandates of the Washington State Noxious Weed Control Law (Chapter 17.10 RCW), setting county weed control priorities, annually adopting a weed control list, and advising the program staff responsible for conducting on-the-ground surveys, treatment, and enforcement. The program's mission is to minimize impacts of noxious weeds to the environment, recreation, public health and the economy (King County Noxious Weed Control Board 2009).

The efforts of the KCNWCP are primarily funded by a special assessment fee that is placed on all property tax bills in King County. The current assessment fee is $2.10 each year, per parcel with an added $0.15 for each additional acre (Shaw 2010). This fee funds efforts to eradicate or control weeds in Classes A, B, and C that are designated for removal by state or county law. The goal of the Washington State Weed Law (17.10 RCW) is to focus time and resources on preventing the spread of new and recently introduced weeds.

The Washington State Weed Board classifies all four of the invasive knotweed species as Class B weeds. In King County, invasive knotweed is classified as non-designate, which means that control of it is "not required, but strongly recommended" (Washington State Noxious Weed Control Board 2009). Therefore, the weed assessment property fee does not directly fund knotweed management in King County. In spite of non-designate classification, the King County Noxious Weed Control Board identified the need for a targeted management strategy to control invasive knotweed within the riparian ecosystems in King County.

Cooperative Weed Management Areas

The KCNWCP has been able to address the need for a targeted management strategy by establishing knotweed-focused Cooperative Weed Management Area's for the King County watersheds of the Cedar River, the Green River, the Middle Fork and South Fork of the Snoqualmie River, and the South Fork of the Skykomish River.

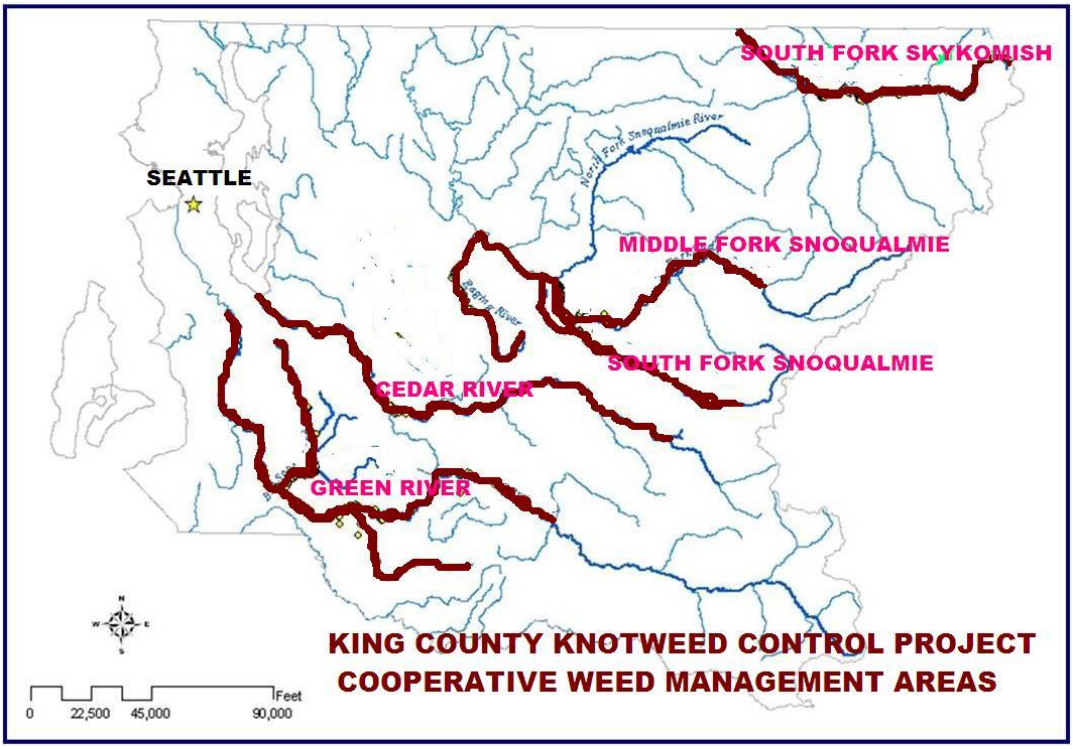


Figure 3. King County Knotweed Control Project Area (Shaw 2010).

The Cooperative Weed Management Area (CWMA) framework offers a strategy for managing invasive knotweed on a watershed scale. A CWMA is a partnership of federal, state, and local government agencies, tribes, individuals, and various interested groups who manage noxious weeds or invasive plants in a defined area (Western Weed Coordinating Committee 2006). CWMA's generally share the following five basic characteristics:

1). defined area distinguished by a common geography, weed problem, community, climate, political boundary, or land use;

2). involvement or representation of the majority of landowners and natural resource managers in the defined area;

3). a steering committee;

4). a commitment to cooperation; and

5). comprehensive plan that addresses the management or prevention of one or more noxious weeds or invasive plants (Western Weed Coordinating Committee 2006).

The desire to extend weed management efforts from a particular area of land ownership to an entire community or watershed motivated the conception of the CWMA framework, which integrates management and communication resources across jurisdictional boundaries. Previously, state and regional noxious weed management agencies experienced limited participation by different landowners within the weed jurisdiction areas, so resources and commitment were often wasted while noxious weeds continued to spread in surrounding unmanaged areas (Interagency Noxious Weed Program 2003). By bringing groups and individuals from watersheds and communities into the planning and implementation process, CWMA participants share the responsibilities and benefits of weed management.

KCNWCP serves as the lead entity for each of these Knotweed CWMAs. Because the invasive knotweed control projects are being managed on a watershed scale, establishing and maintaining partnerships with other stakeholders has been an integral component of project planning and implementation. King County Knotweed Control Project partners include private landowners, municipalities, state agencies, federal agencies, and community-based conservation groups (Table 1).

Table 1. King County Knotweed Control Project CWMA Partners.

Knotweed Cooperative Weed Management Area	Funding Partners	Other CWMA Partners
Cedar River Watershed	King Conservation District; Community Salmon Fund; Washington State Department of Agriculture (WSDA)	Private landowners; Seattle Public Utilities; Cascade Land Conservancy; EarthCorps; Washington Conservation Corps (WCC)
Green River Watershed	USDA-Forest Service Forest Health Protection Program (FHP); US Fish and Wildlife; WSDA; Tacoma Public Utilities	Private landowners; EarthCorps; WCC; King County Parks; Washington State Parks; King County Roads Division
Middle Fork Snoqualmie River Watershed	WSDA; USDA-Forest Service FHP; Mountains to Sound Greenway Trust	Private landowners; Washington State Department of Natural Resources; Washington State Department of Fish and Wildlife; Washington State Dept. of Transportation; US Forest Service; Cascade Land Conservancy; Middle Fork Outdoor Recreation Coalition; American Whitewater; Washington Native Plant Society; EarthCorps; WCC
South Fork Snoqualmie River Watershed	WSDA; USDA-Forest Service FHP; King Conservation District; Mountains to Sound Greenway Trust	Cedar Village Homeowners Association; private landowners; King County Parks; King County Roads; WS Dept. of Natural Resources, Fish and Wildlife, Transportation, and Parks; EarthCorps; WCC
South Fork Skykomish River Watershed	USDA Forest Service Mount Baker-Snoqualmie National Forest Resource Advisory Committees (RAC); WSDA.	Private landowners; Burlington Northern Santa Fe Railway; Town of Skykomish; King County Parks; King County Roads; Washington State Departments of Natural Resources, Fish & Wildlife, and Transportation; United States Fish and Wildlife Service, EarthCorps; and WCC

Knotweed Control Methods

The Washington State Integrated Knotweed Management Plan outlines the following knotweed control and removal techniques that have been used with varying degrees of success: hand pulling and digging; cutting and mowing; covering and shading out with black fabric; mechanical removal; grazing by goats; burning; and herbicide application. However, the current coordinated efforts consist mostly of aquatic herbicide treatment, because it has been deemed the most cost- and time-effective method. Foliar spraying and stem injection are the most commonly utilized herbicide application techniques for invasive knotweed management; however, types of herbicides vary across the state. Most invasive knotweed control efforts are conducted along rivers and in riparian areas, so herbicides used are aquatically-approved formulations and treatments are only conducted by individuals holding state aquatic pesticide applicator licenses (WSDA 2009).

A recent publication by the State Knotweed Program discusses efforts begun in 2003 by the University of Washington Olympic Natural Resources Center and the Center's Biocontrol Specialist, Fritzi Grevstad, Ph.D., towards the development of a biological control program for invasive knotweed in North America. The Center has partnered with the US Forest Service's Forest Health Technology Enterprise Team, Cornell University, CABI-Biosciences-UK, and Lethbridge Research Center of Alberta, Canada in these efforts (Udo 2008, Kurose 2006, Grevstad et al. 2009).

In 2003 and 2004, the knotweed biological control program partners conducted surveys of existing natural enemies in New York State, Oregon, and Washington. Of the fifty herbivorous species that were found, all were generalists (not focusing on invasive knotweed alone), none were root or stem feeders, and damage levels were low. So, the program partners studied management efforts in the native range of knotweed (Japan), in which eight herbivores and pathogens were selected as candidates for biocontrol. From those candidates, two insect species, a sap-feeding psyllid, *Aphalara itadori,* and a leaf and stem-feeding moth, *Ostrinia ovalipennis*, were selected for testing at the Oregon State University USDA-APHIS-certified quarantine facility to determine if they were sufficiently host-specific for release into North America. They are being tested to determine if they will feed and develop on 70 native and economically important plants here with an emphasis on closely related plants within the buckwheat family (Polygonaceae). Following the potential selection of one of these candidates, the biocontrol agent will go through a rigorous process of technical review and permitting before it can be introduced on a limited basis (Grevstad 2009). The psyllid has shown a high level of host specificity with only very marginal development on three of the selected non-target native or economically important hosts. These results are being for reviewed by the regulatory authorities, for a possible release as early as 2010. Testing of the moth will take at least two more years for completion (Grevstad et al. 2009).

Currently most land managers rely heavily on herbicides to control knotweed populations in combination with manual removal. In King County Knotweed Control

Project areas, knotweed stem injection with a 3 ml dose of an undiluted aquatic formulation of glyphosate was selected as the primary treatment option for sites directly adjacent to riparian corridors; and follow-up foliar applications of 1% aquatic imazapyr and 1% surfactant applied with five-gallon backpack sprayers were chosen for sites that were injected in previous years (Walker 2009; Hagen and Dunwiddie 2008).

The relatively new method of stem injection is conducted by utilizing a system that was specially designed for injecting concentrated herbicide into plants with large hollow stems, such as knotweed. The system consists of an injector gun that can be calibrated to release a specific volume of herbicide, a leak-proof canister that connects to the gun and holds up to 16 ounces of herbicide, a hollow needle, an Allen wrench for calibrating the injection dose, and a measuring vial for calibration (JK Injections Tools 2010). To control invasive knotweed, trained herbicide applicators inject every stem greater than a ½ inch diameter in a project area with one 3ml dose. The injection is applied just above the lowest visible node (Hagen and Dunwiddie 2008). Following an injection, a stem is marked with a paint marker or spray paint in order to keep track of which stems in a project area have been treated.

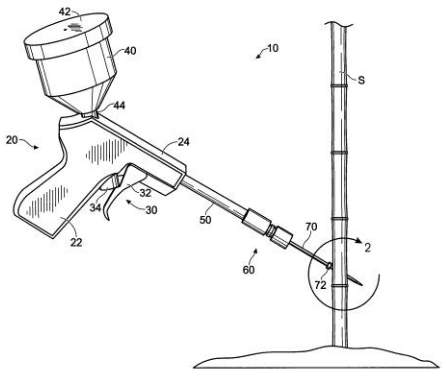


Figure 4. Injection System (Burgess 2007).

Photo 3. Knotweed stem injection process (Shaw 2010).

Chapter Four. Research Methods

In this case study of the King County Knotweed Control Project, I used an interdisciplinary approach to incorporate various measures of progress. Measures included stakeholder perceptions of the project and changes in the area of invasive knotweed treated over time. I selected assessment methods based on related studies that have been conducted pertaining to CWMAs (Izurieta, Paulson, and Enloe 2008; Tidwell and Brunson 2008; Hershdorfer, Gimenez, and Howery 2007). I have included data from an individual semi-structured interview, evaluative surveys, and project documents (Denzin and Lincoln 1998).

My research identified three groups of stakeholders involved in the King County Knotweed Control Project:

1). Lead Knotweed Control project manager

2). Landowners who own property along rivers within the project area

3). Conservation crew members who did on-the-ground knotweed treatment

Procedures

Lead Knotweed Control Project Manager Interview

I conducted a semi-structured interview with the lead project manager from the King County Noxious Weed Control Program, who also serves as the lead entity for each of the CWMAs. While a project manager is generally not considered a

stakeholder in a study of public agency management programs, this study examines the perceptions of the agency representative and other project participants to identify project challenges that might result from differing project perceptions or misunderstandings. Using a digital recording device, I recorded the fifty-five minute interview and transcribed it the following day. As I read the transcription, I highlighted words, phrases, or ideas that came up frequently and ideas that stood out as unique. Finally, I created a word or phrase to represent common and uncommon themes next to highlighted phrases. Using this open-coding process, I identified themes within the interview.

Project Documents

Following the interview, the project manager provided hard and digital copies of King County Knotweed Control Project outreach literature, grant reports, and annual reports. These documents the project's historical context, goals, and measured achievements.

Landowner Surveys

In September of 2008, I mailed surveys to all of the landowners who owned property parcels along rivers in the King County Knotweed Control Project Area. The mailing list included three hundred property owners—many of whom owned more than one property parcel within the project area. I used an existing mailing list that the King County Knotweed Control project manager had used to contact landowners at the beginning of the knotweed treatment season in June 2008. The

mailing list was created using parcel information from King County records and ArcGIS mapping technology. Each mailing included an end-of-season thank you letter, a survey, and a return envelope that included postage. Surveys were returned to the King County Noxious Weed Control Program office and relayed to me.

Landowner surveys included open-ended questions and five-level Likert items. Likert scaling is a method often used in questionnaires and survey research to determine a respondent's level of agreement with a statement by offering a number of ordered responses (Trochim 2005).

The format of a typical five-level Likert item is:

1	2	3	4	5
Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree

Conservation Crew Surveys

In September of 2008, I hand-delivered surveys to all the crew supervisors of crew members who had done knotweed treatment in King County project areas during the summer project season. I collected the completed surveys from crew supervisors at the end-of-season meeting between the crew supervisors and the King County knotweed project manager. Crew members had three weeks to complete the surveys. Conservation crew member surveys included open-ended questions and five-level Likert items.

Analytic Methods

To analyze the project manager interview and project document data, I thoroughly reviewed the transcript and accompanying documents, then performed an analysis of themes. I conducted a within-case analysis of the project documents and the project manager's interview responses, looking for differences in perceptions of project success, project goals, and public roles (Creswell 2007).

I conducted within-case analyses of landowner and conservation crew survey responses (Creswell 2007). Surveys were thoroughly reviewed and responses to the open-ended questions were systematically open-coded for common or overriding themes. Identified themes were interpreted in relation to the knotweed project manager's feedback as well as past research conducted in the fields of cooperative weed and watershed management. To analyze the Likert item questions, I created tables to express quantitative results visually.

Chapter Five. Findings

Of the 300 hundred surveys mailed to property owners in the King County Knotweed Control Project Area, 76 property owners responded to the survey. The 18 conservation crewmembers who conducted invasive knotweed control in the Summer of 2008 for the King County Knotweed Control Project all responded to the survey. In the subsequent pages, tables and graphs summarize participant survey responses. A detailed exploration of stakeholder feedback and the themes derived from it follow the tables and figures.

Tables 2 and 3 focus on stakeholder perceptions about the King County Knotweed Control Project. Table 4 focuses more broadly on how stakeholders became aware of invasive knotweed.

Table 2. "Why is it important to you that invasive knotweed is controlled by King County?

Reasons the King County Knotweed Control Project is important		
	Landowners (n=76)	**Work Crews (n=18)**
Knotweed is too difficult to control as an individual	6.6%	0.0%
Threat to the riparian ecosystem and wildlife habitat	28.9%	50.0%
Negative impacts on property value	18.4%	0.0%
It is rapidly taking over stream banks	28.9%	27.8%
Negative impacts on biodiversity	0.0%	22.2%
No response	11.8%	0.0%
Other*	5.3%	0.0%
*Other responses will be discussed in more detail in the text.		

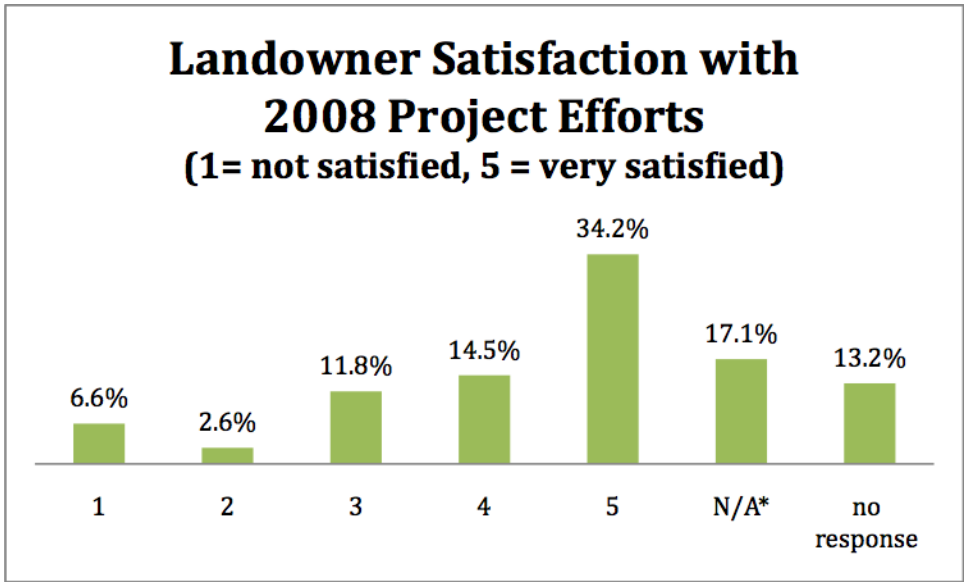
Table 3.“What are your hesitations about participating in the King County Knotweed Control Project?”

Hesitations about the King County Knotweed Control Project		
	Landowners (n=76)	**Work Crews (n=18)**
None	68.4%	5.6%
Working with King County	6.6%	0.0%
Use of herbicide	17.1%	83.3%
Being previously unaware of how “bad” knotweed infestations were	1.3%	0.0%
Concern about stream bank vulnerability	2.6%	0.0%
Slowness of eradication and time commitment to project	3.9%	0.0%
Effectiveness of control techniques	0.0%	5.6%
Health impacts of spray paint	0.0%	5.6%

Table 4. "How did you first learn about invasive knotweed?"

Stakeholder introductions to invasive knotweed		
	Landowners (n=76)	**Work Crews (n=18)**
Contacted by King County regarding the Knotweed Control Project	60.5%	0.0%
Saw invasive knotweed growing on their property	17.1%	0.0%
From neighbors	9.2%	0.0%
From books, articles, or other media	9.2%	0.0%
From King County Knotweed Injection Training	0.0%	100.0%
No response	3.9%	0.0%

Figures 5-7 illustrate participant perceptions about success or effectiveness of the project and related trainings based on responses to five-level Likert item question on the surveys.



***Project did not reach their property in 2008 season or they have yet to see results.**

Figure 5. Landowner evalations of satisfaction with the 2008 project.

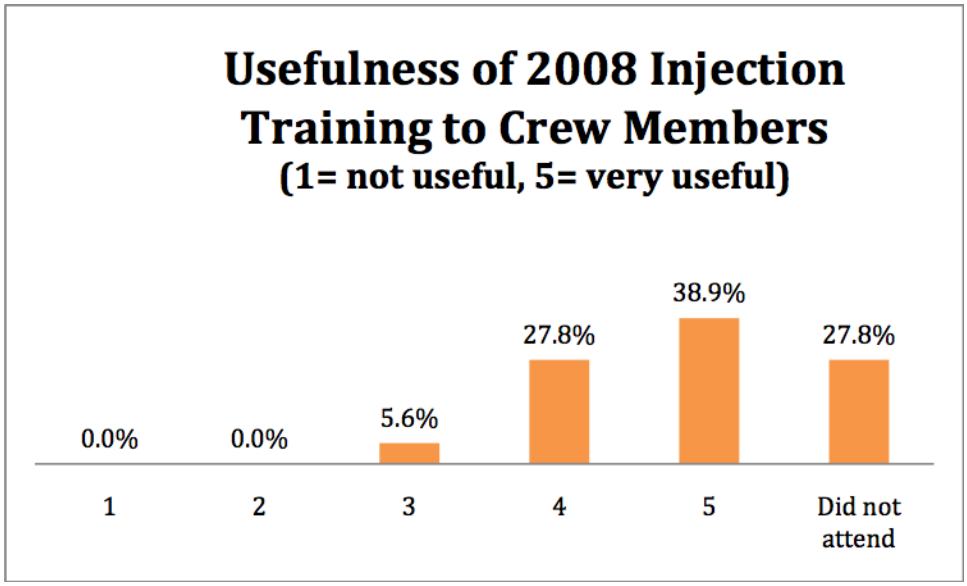


Figure 6. Crew member evaluation of 2008 injection training

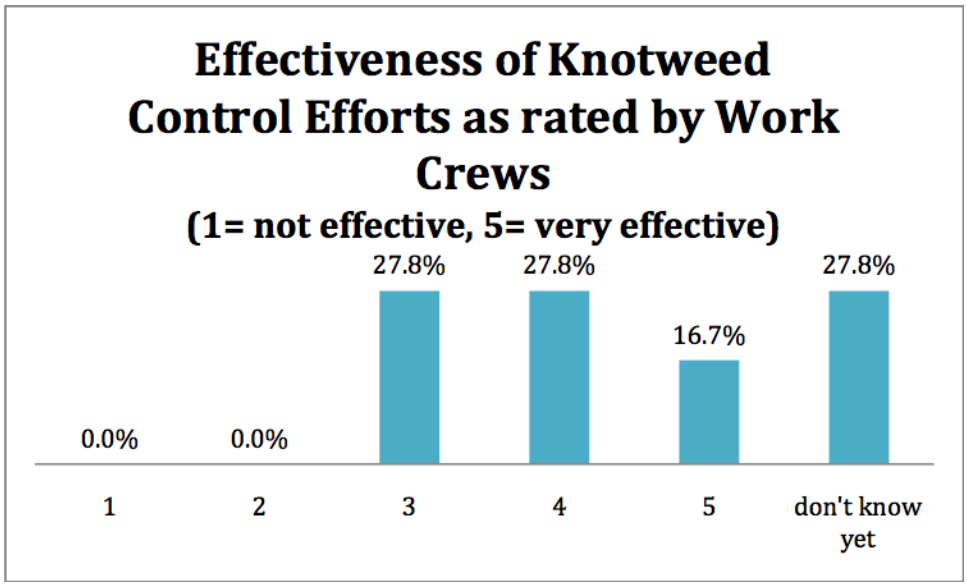


Figure 7. Crew member evaluation of 2008 control effectivness

Based on the survey responses, I have identified four themes regarding stakeholder perceptions of the King County Knotweed Control Project.

1). The Role of Education and Outreach

2). Why Invasive Knotweed Control Matters

3). Herbicide Use for Invasive Knotweed Control

4). Perceptions of an Effective Project

The Role of Education and Outreach

The King County Knotweed Control Project Manager cited property owners' lack of knowledge about proper removal and disposal of invasive knotweed as a major obstacle to the project's success. In conversations with a number of property owners, she learned that many cut down thickets in their yard and tossed the

cuttings into the river, which can grow into new infestations downstream (Walker Interview 2008). 46(60.5 percent) of property owners responding to the survey first learned about the existence of invasive knotweed and its impacts on riparian ecosystems as a result of being contacted by the King County Noxious Weed Control Program in regards to the Knotweed Control Project. These points emphasize the important role that outreach and education play in laying the groundwork for landowner interest and participation in the project. When the project began in 2005, targeted education and outreach in the project area was minimal. The King County Noxious Weed Control Program Outreach Specialist introduced the project in a bi-monthly newsletter that was sent to individuals who had previously requested it. Individuals could and still can find a great deal of information about invasive knotweed and the Knotweed Control Project on the King County Noxious Weed Control Program website, which annual reports about the Knotweed Control Project. Proactive outreach focusing specifically on the project consisted of the Knotweed Control Project Manager calling or visiting property owners in the project area to ask for permission to work on their property.

Beginning in 2008 , education and outreach received a more focused effort including $2000 in a grant from the US Department of Fish and Wildlife that was designated specifically for outreach efforts. The knotweed control project manager identified education and outreach as an important part of the watershed-scale knotweed management strategy. In 2008, the King County Education Specialist and the King County Knotweed Control Project Manager conducted a total of 11 education and

outreach events for property owners in the project areas, conservation crews, volunteers in the project watersheds, and the general public (Table 5). These events sought to introduce people to the King County Knotweed Control Project, show where the project was taking place, and offer resources to individuals or community groups dealing with the invasive weed. At events directed toward people in the project areas, property owners learned about different knotweed control methods and were trained on proper use of herbicide injection equipment so they could check out it from the King County Noxious Weed Control Program and perform work on their own property. The King County Noxious Weed staff sent out 2600 training announcements for workshops that were hosted in the project area watersheds. 40 people (not including the conservation crew members) attended the 2008 workshops.

Web based outreach and education included a Mid Fork Snoqualmie Invasive Weed Project web page, a Knotweed Biology and Control Slideshow and a Knotweed Biology and Control Fact Sheet. Additionally, a Knotweed Best Management Practices (BMP) document and a Knotweed Do's and Don'ts fact sheet were created for park kiosks and landowner mailings.

7 (9.2 percent) of the responding property owners learned about the impacts and existence of invasive knotweed from their neighbors. One respondent wrote, "We thought it was bamboo until neighbors told us differently."

Table 5. 2008 King County Knotweed Control Project Outreach Events

Type of Outreach	Outreach Event	Intended Audience
Education Booth: Introduction to Issues of Invasive Knotweed	King County Fair; Issaquah Salmon Days	General public
Technical Training Workshop: Chemical Control	WCC training day, EarthCorps training day	Conservation Crews
Community Meeting: King County Knotweed Control Project Overview and Available Resources	Meadowbrook Farm Snoqualmie Knotweed and Invasive Weed Workshop; Covington Knotweed and Invasive Weed Workshop; Cedar River Council Knotweed and Invasive Weed Workshop	Property owners in Project areas
Service Learning Workshop: Knotweed Identification and Control Techniques	WSU Forest Steward Invasive Weed Training; Middle Fork Snoqualmie Weed Watcher Training and Volunteer Trails Survey; Naturescaping Workshop	Interested Community Members

In one of the project areas, the South Fork of the Snoqualmie, one landowner became so passionate about controlling invasive knotweed, after being contacted by the Knotweed Control Project Manager to treat the invasive knotweed on his property, that he hosted a community meeting to introduce the project and to demonstrate control methods for individuals in his homeowners association. This example illustrates the possible trickle down effect that an investment in education and outreach can have.

Additionally, when asked what hesitations property owners might have about the King County Knotweed Control Project, 5 (6.6 percent) of the respondents indicated

that they were hesitant to work with King County and cited a variety of reasons: concern that untrained King County employees would damage the river; past negative experiences working with other King County departments; concern that they would be financially responsible for the control of invasive knotweed; and the requirement by King County for all participating property owners to sign a legal waiver. These hesitations might be alleviated if familiar and passionate community members throughout Knotweed Control Project Areas were given the tools and a more formal role in the outreach portion of the Knotweed Control Project.

18 (100 percent) of the conservation crewmembers who responded to the survey first learned about the existence of invasive knotweed and its impacts on riparian ecosystems from a knotweed injection training that was hosted by the King County Knotweed Control Project. Crewmembers were required to attend the training in order to be able to conduct treatment of knotweed infestations using aquatically approved herbicides in riparian areas. Although 5 (27.8 percent) of crewmembers were unable to attend the King County-hosted training, those individuals received on-site trainings from their crew supervisors who had both attended the King County training and held Washington State Aquatic Pesticide Applicators licenses.

The high response rates (60.5% of property owners and 100% of conservation crewmembers) regarding a lack of awareness of invasive knotweed before contact by the King County Knotweed Control Project staff indicate a major challenge to the growth of a watershed-scale effort to control invasive knotweed. However, the

increased focus towards education and outreach in the 2008 control season illustrates a move to meet that challenge.

Why Invasive Knotweed Control Matters

The Knotweed Control Project Manager identified two main reasons why property owners wanted to be involved in the King County Knotweed Control Project:

> They're concerned about the health of their river and they want to see the river. Mainly, the most common response—they can see it (invasive knotweed) taking over and they can see that it's not creating a healthy environment for how a river system should be. That's the main response. Some people say, you know, I want access to my river, I want to see the river (Walker interview 2008).

The survey responses articulated similar results. 22 (28.9 percent) of the property owners and 9 (50 percent) of the conservation crewmembers who responded to the survey cited invasive knotweed's threat to the riparian ecosystems and wildlife habitats in which it most often thrives as the reason for needing to control it. More specifically, responses frequently included concern about invasive knotweed's impact on Pacific salmon and their habitat. One landowner put it simply, "(It is important to control invasive knotweed) to allow natural vegetation to flourish and assist salmon spawning." A conservation crewmember responded similarly, "Because I want natives to thrive; it's crucial for salmon habitat."

Frequent reference to Pacific salmon is not surprising; they are keystone species in Pacific Northwest ecosystems. The stakeholder perception of a connection between invasive knotweed and healthy salmon habitat may be a useful tool for framing the issue of invasive knotweed control in order to achieve greater project interest, funding, and support at the watershed scale. Region-wide interest in watershed-scale restoration and conservation of salmon habitat has been beneficial to the financial side of invasive knotweed management. The King County Knotweed Control Project has been partially funded by the following salmon-focused conservation programs:

1. The Community Salmon Fund, which is administered by the National Fish and Wildlife Foundation; and
2. The Salmon Recovery Funding (SRF) Board, which is administered by the Washington State Recreation and Conservation Office (Monica Walker interview 2008).

22 (28.9 percent) of the property owners and 5 (27.8 percent) of the conservation crewmembers responding to the survey said that they want to control invasive knotweed because it is rapidly taking over the stream banks. Responses expressed a sense of urgency in preventing further rapid and dense spread of invasive knotweed in riparian areas. One property owner noted, "It gets thicker every year; it's taking over the river, my yard, the world!" A conservation crewmember added, "We need to control it so it stops invading all of our rivers."

Additionally, 4 (22.2 percent) of the conservation crewmembers who responded to the survey felt it is important to control invasive knotweed because of its negative impacts on biodiversity. Only crew members specifically cited invasive knotweed's impact on "biodiversity" as a concern.

The 3 previously cited categories of responses could be broadly classified as concerns about invasive knotweed's impact on watershed health. Combining those results, 44 (57.8 percent) of property owners and 18 (100 percent) of conservation crewmembers responses about the importance of controlling knotweed related to the overall health of the watershed in which invasive knotweed is occurring.

14 (18.4 percent) of the property owners who responded to the survey think it is important to control invasive knotweed because they are concerned with how infestations may negatively affect the value of their properties. Some individuals talked about how the thickets of this tall plant obstructed their river views. Others were frustrated with how the infestations were encroaching on their gardens and open spaces.

5(6.6 percent) of property owners who responded to the survey think it is important to control invasive knotweed because it is too difficult to control on their own. These responses expressed a lack of knowledge, time, and materials necessary to effectively control invasive knotweed or difficulty in acquiring the permits or licenses that are required in order to apply herbicide in an aquatic ecosystem.

4 (5.3 percent) of the property owners who responded to the survey had responses that did not easily fit into any of the above categories. Some of these responses expressed general dislike for the invasive plant or uncertainty about why it is important to control. One notable property owner response acknowledged the negative impacts of knotweed, but expressed concern with control strategies.

> We realize that knotweed is a problem, but think it is too dangerous to try to eradicate it by chemical means. This is a danger to the honey bees and other important pollinators in the areas (Landowner Survey Results 2008).

I will discuss stakeholder views regarding chemical control of invasive knotweed in the following section. 9 (11.8 percent) of the property owners who responded to the survey did not respond to this question.

Herbicide Use for Invasive Knotweed Control

52 (68.4 percent) of the property owners who responded to the survey said that they had no hesitations about participating in the King County Knotweed Control Project. However, of the 24 (31.6 percent) who did have hesitations, 13 (17.1 percent) cited the use herbicides for treating invasive knotweed infestations as their main concern. However, reasons for concern with herbicide use varied. Like the individual in the previous section, some were concerned with the impacts that herbicides might have on wildlife and overall ecosystem health.

> One property owner commented, "Initially, I was concerned about chemicals to be used to control knotweed and the effects they may have on stream, fish, and other vegetation."

Others were concerned about how herbicide use might affect human health. Some property owners rely on wells and wanted to be assured that herbicide use would not contaminate their groundwater supply. Similarly, one property owner was specifically concerned about their honey bees ingesting chemicals and making the resulting honey supply dangerous to people. Others were more concerned with direct exposure:

> "I have small children who play in the yard, so chemical exposure is a concern."

15 (83.3 percent) of the conservation crew members who responded to the survey cited herbicide use as their reason for hesitation with participating in the King County Knotweed Control Project. While this percentage is significantly higher than that of property owners, it is important to point out that the conservation crew members had a hands-on relationship with herbicides in the control process. They were responsible for conducting nearly all of the glyphosate stem injection treatments that were described in the "King County Knotweed Control Methods" section; they did not conduct any of the backpack-administered herbicide spraying. Some crew members said that they did not feel safe administering herbicides. They were also a self-selecting group with a high level of environmental consciousness.

One conservation crew member mentioned that he was concerned with possible negative health impacts from spray paint. The stem injection method includes using spray paint to mark invasive knotweed canes after they have been treated. That

said, some of the conservation crew members cited concerns similar to those of property owners, such as impacts that herbicides might have on wildlife and overall ecosystem health.

Perceptions of an Effective Project

The King County Knotweed Control Project tracks annual progress of the King County Knotweed Control Project by conducting GPS surveys of new and previously treated sites in each project area. Collected survey data include gross infested area (ft^2) of each infestation site and net area of invasive knotweed within the given infestation. By looking at the change in treated net acres from year to year, one can assess the effectiveness of control. For example, on the Middle Fork of the Snoqualmie River, the project treated 13 acres of invasive knotweed during the first project year in 2006, only 2 net acres in 2008, and 1.79 in 2009 (Walker interview 2008, King County Noxious Weed Board 2009). Since the onset of project, the overall footprint of invasive knotweed has been reduced by 75 percent from along the Middle Fork of the Snoqualmie.

Table 6 displays an overview of the change in acres of treated areas within each of the King County Knotweed Control Project Areas. Noticeably, the South Fork Skykomish and the Middle Fork Snoqualmie are the only project areas that show a decrease in treated area. However, the project manager noted the circumstances behind this detail. Both the South Fork Skykomish and the South Fork Snoqualmie project areas received more time and funding for surveys and treatment in 2008;

the increase in gross area treated does not aptly reflect the treatment's effectiveness as compared to previous years. In the Green River Project Area, a previously undiscovered infestation of invasive knotweed in Soos Creek, a tributary of the Green River, is responsible for the increase in gross area treated (Walker interview 2008).

Table 6. King County Knotweed Control Project Area Treatment 2005-2008

Gross Acres Treated in the King County Knotweed Control Project Areas				
	2005	**2006**	**2007**	**2008**
South Fork Skykomish River	21.2	16.26	15.77	30.76
Green River	23.3	15.06	27.79	28.9
Middle Fork Snoqualmie River	**	27.47	16.06	6.37
South Fork Snoqualmie River	**	**	6.58	20.35
Cedar River	**	**	**	24
Total	44.5	58.79	66.2	110.38

The management goal established by the CWMA and the King County Knotweed Control Project is:

> To restore or enhance the quality of the riparian habitat so that healthy ecosystem functions can return. This is achieved through eradication of invasive knotweeds from riparian ecosystems in the watershed and encouragement of subsequent re-vegetation activities (Walker 2008).

When asked what deemed a project "successful", the project manager responded,

> I don't really know the answer to that. I've never really seen—except for the Middle Fork (Snoqualmie)—any end to it. So, I feel a project has been successful if I get a lot of knotweed controlled, if I spend my money wisely, if I can get a lot of people to buy into the project, and if people get excited and call me and want to participate. I wouldn't really base success on having it (invasive knotweed) completely eradicated, because that typically doesn't happen. I think we're good at making it (invasive knotweed) manageable, because I don't think we know, yet, what is ultimately effective (Walker interview 2008).

Although the official project goal specifically cites "eradication of invasive knotweed within riparian areas," the practical goal focuses more on reducing the level of infestation to manageable levels with greatly reduced impacts.

When asked if they were satisfied with the 2008 Knotweed Control Project efforts, 26 (34.2 percent) of the property owners who responded to the survey rated their satisfaction level as 5 (very satisfied). Those who responded with a 5 cited the helpful and informative staff as reasons for satisfaction. However, some of those same respondents were disappointed that the project had not reached their property yet (they are, likely, located downstream of the sites treated in 2008). In

fact, the dominating response of property owners who rated their satisfaction levels at 1(not satisfied) through 4 or "not applicable" described disappointment that the project had not, yet, reached their property.

When conservation crew members were asked to rate the effectiveness of the control efforts in which they had participated on a scale of 1 to 5 (1= not satisfied, 5= very satisfied), 5 people (27.8 percent) each responded with 3, 4, and "don't know yet". Only 3 (16.7 percent) rated their perceived effectiveness as a 5. Although this varied range does not provide a clear sense of crewmember perceptions of the project's effectiveness, no conservation crewmembers rated the efforts at less than 3. None of the crewmembers who responded to the survey had adverse opinions about the project's effectiveness. Also, similar to property owner responses, conservation crew members who rated project effectiveness with a 3, 4, or "don't know yet" explained that, at the time of the survey (September 2008), they could not yet see whether or not their efforts had successfully killed the invasive knotweed.

Discussion

Through analysis of written surveys and a semi-structured interview, this research has provided insight into the personal experiences and views of 76 landowners, 18 conservation crew members, and the project manager involved in the King County Knotweed Control Project. In summary, the qualitative data in this thesis suggest that the project stakeholders are concerned about the impacts of invasive knotweed because of its negative effects on the health of the watershed and its negative effects

on the value of privately owned property. Lack of previous knowledge about the impacts of invasive knotweed and proper control techniques, misgivings about working with King County, and concern about the negative impacts of herbicide are significant challenges that the King County staff needs to address in order to more effectively manage the Knotweed Control Project.

Greater utilization of key community members will play a significant role in the success of this project. Key community members can serve as on-the-ground liaisons with a working knowledge of their local landscape. Additionally, they can help to break down the government/community barrier. Cathy Lucero, program manager for Clallam County Noxious Weeds, accounts the benefits of empowering a key community member for knotweed management on the North Olympic Peninsula:

> Our approach was to have people who lived in the community on our crew. That was a big deal. One of things we were working towards was with a certain guy; he was working for the county, but he was part of the community. So, he would get into it and talk to people and would directly contact people that he knew, because it's a very small community there (on the North Olympic Peninsula). He would say, "You don't want the government out there, but you've got knotweed…so, lets work together to take care of it together or I'll teach you how to do it." That's been a good way to go for a small far-flung community. He couldn't get in the rivers and stuff, but he could get people engaged…(Lucero interview 2009).

When evaluating overall satisfaction with the project, a number of property owners expressed disappointment that control efforts had not reached their property

during the 2008 season after having received a project introduction letter and participation waiver at the beginning of the control season. Communicating the seasonal and long-term project expectations clearly at the beginning of the season and more frequently throughout the season would minimize such disappointment. This also illustrates the merit of creating a system for communicating up-to-date project progress.

Such a system could utilize an interactive web space like a blog. "Blog" is a combination of the terms "web" and " log", to denote a website that contains regular updates or posts of announcements of upcoming events, descriptions of past events, and commentaries on particular subjects or available resources. Posts are often displayed in reverse-chronological order. While blogs are usually maintained by an individual, they are interactive in nature, because site visitors can leave comments or messages in response to the posts (Blood 2010). By creating and regularly updating a blog that focuses on the King County Knotweed Control Project, the Project Manager could provide more detailed and current project information for landowners and interested parties throughout the project season. The interactive blog might also serve as a social networking area where interested parties could connect and become more involved in the project. Although individual contact via telephone, email, and mail should remain dominant, an interactive blog could greatly increase project transparency, stakeholder feedback, and timely communication, while reducing redundant tasks for the project staff.

Beyond improving communication with individuals already involved in the project, it is also essential to continue to build wider project support throughout the participating watersheds. One benefit to watershed management in western Washington and the Pacific Northwest is the importance of salmon species to the cultural and economic history of the region. The existence of an iconic regional symbol that is so closely connected and dependant on aquatic ecosystem health offers a great point from which to build a place-based group identity for collaborative watershed planning in the region. Forming place-based group identities through issue framing can foster long-term watershed stewardship (France 2005). For example, one regional non-profit organization has created the *Salmon-safe* certification program for small farms in the Pacific Northwest. Like organic certification, *Salmon-safe* certification offers market-incentives to promote ecologically sustainable agricultural practices by enabling farmers to sell their products with the *Salmon-safe* logo. Certified farms are required to minimize negative impacts on water quality while seeking to improve fish habitat (Salmon Safe 2003).

Current King County Knotweed Control Project messaging and media describe the negative impacts that invasive knotweed has on ecosystems and private property. While such detailed information is valuable, a simplified project message that links invasive knotweed control directly to the bigger goal of improved salmon habitat could frame the issue in a way that would broaden interest in the project and, eventually, build a place-based group identity. Such issue framing could be achieved

through the creation of media (i.e. posters and pamphlets) and messaging that starts with salmon habitat health as a segue into the importance of invasive knotweed control.

Both the stakeholder responses and the quantitative data that describe the infested areas that have been treated indicate that the King County Knotweed Control Project is making progress. Landowners and conservation crew members who participated in the surveys are generally supportive of and excited about the goal of eradicating invasive knotweed. Although the gross number of infested areas that have been treated have increased—rather than decreased— since the beginning of the project, this is a result of an increased footprint of project operations. In comparing the official project goals as determined by the King County Noxious Weed Control Board and that of the King County Knotweed Control Project Manager, it is apparent that it is time to stop, assess the project outcomes and experiences, and to adapt the project goals based on those assessments. More clearly defined goals would more effectively guide project priorities and day-to-day decision-making. Based on the project assessment, I have identified three recommendations:

1. Recruit, educate, and support a key community member from each of the project areas to build greater project support and involvement.

2. Build an interactive website to more effectively and efficiently communicate up-to-date project information to stakeholders.

3. Frame the project around the issue of salmon habitat improvement to build a place-based group identity and simplify project messaging.

Chapter Six. Conclusions

The King County Knotweed Control Project deviates from the prevailing weed management strategy of focusing on emerging weed populations that have not become significantly established in an area. Instead, the project is a trial of an alternative strategy for weed management—tackling a widespread invasive weed by using a cooperative watershed-scale approach. The outcome of this project could set a precedent for how widespread weed populations are managed in the future. Also, although CWMA managers and watershed-scale policy makers share a common goal of uniting community members across socio-political boundaries in the name of land stewardship, lessons learned in CWMAs have, yet, to be looked to inform opportunities for improving community participation in cooperative watershed-scale management. This study encourages interdisciplinary collaboration between CWMA managers and the broader community of watershed-scale policy managers.

The purpose of this thesis research was to conduct an assessment of the King County Knotweed Control Project using an interdisciplinary approach that includes both measurable gains or losses of acres of treated invasive knotweed and a qualitative look at stakeholder perceptions of the project.

GPS data show that the presence of invasive knotweed has been significantly reduced in all five project areas. Most significant is the 75 percent reduction of the weed in the Middle Fork Snoqualmie project area since the onset of the project in 2006 (King County Noxious Weed Board 2009). These measures indicate that the King County Knotweed Control Project is moving towards its goal of eradication of invasive knotweed in identified sensitive riparian areas in King County. However, the project will not be complete for a number of years. The project manager cited time as the key limiting-factor in the project (Walker interview 2009). In a period when competition for additional funding is challenging and time is limited, it is important to take steps towards improving project efficiency and stakeholder support. Based on careful analysis of the project manager interview and survey results from 76 landowners and 18 conservation crew members, I have identified 4 themes regarding stakeholder perceptions of the King County Knotweed Control Project:

- The Role of Education and Outreach;
- Why Invasive Knotweed Control Matters;
- Herbicide Use for Invasive Knotweed Control; and
- Perceptions of an Effective Project .

By exploring these themes, I determined that invasive knotweed management in King County will benefit most significantly from greater focus on community

education, outreach, and overall communication with project participants. Furthermore, I recommend that attention be paid to project messaging as a means for building a cohesive place-based group identity around the watershed-scale project.

Beyond the King County Knotweed Control Project

Watershed-scale land management of invasive knotweed demands near complete community support for project success. If one landowner along a river is unwilling to cooperate in knotweed control on his or her property, that inaction compromises successful eradication of the weed downstream. The recommendations made based on analysis of feedback from the project stakeholders focus on developing a place-based identity in order to build community-wide enthusiasm surrounding invasive knotweed control. However, long-term support must be maintained through regular and trusted communication. Although this was a single case study of the King County Knotweed Control Project, lessons derived from it can be applied more broadly to watershed-scale environmental stewardship. Watershed-scale weed management requires more than a few years and a few individuals to make a lasting impact on the health of an ecosystem; instead, it necessitates the long-term commitment of an entire community.

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Appendix I: Interview with Monica Walker – King County Knotweed Control Project Manager

February 5, 2009

What's the title of your position at King County and describe what that encompasses?

Monica: My official title is noxious weed specialist. That will be changing in May to aquatic—no, err, riparian noxious weed specialist….umm, so what I do –is the knotweed project manager for King County. I coordinate landscape-scale knotweed.

How long have you been doing that?

Monica: I've been doing that for 4 years now.

Is knotweed fulltime with your position?

Monica: It has not always been fulltime. It's been maybe 60% knotweed and 40% weed control specialist, which is surveying urban Seattle areas for noxious weeds that grow there—so it's very outside of knotweed.

How did the 60/40 work out?

Monica: It's a lot of work. Anything that had to do with my route in Seattle that was important to work on once the knotweed project took over in June didn't happen. So, that got lost—my route got lost because I had to focus on knotweed. Knotweed never got lost. Because it was externally funded, it was important there was no sliding on that b/c I had to work with other partners. My route did suffer.

This is a seasonal position---not all year long. Do you feel like it could be a year-long job?

Monica: I think it is an all year position…and it has to do with economics and funding and county council, but I do think that there is def. enough work for it to be year-round. I think a lot gets lost b/c its not year-round and I have to rely on other co-workers that are full-time to answers calls that come in when I'm gone, write grant proposals when I'm gone, deal with issues that happen when I'm gone…

What kind of "issues"?

Monica: I just had one, yesterday. A landowner on Roaring Creek—the MTSG Project that is planting willow stakes in conjunction with the knotweed control….the MTSG Crew and Restoration Project Manager went out and spent two days walking the property with the landowner, deciding where to plant, how to do things, and looking at the site. The landowner had initially said she didn't want our help planting, but after the recent floods she called and said "everything that we had planted got washed away and we would love your help." So, we set it up together, MTSG went out there and were going to spend 2 days planting willow stakes. The first day went great. They brought the crews out cokes and were happy they were there. The second day, the crews got there and she left—said she'd be back by 11am. Apparently, she went to visit with a neighbor who said, "Don't ever let DNR work for you, don't trust them, they just want something, they're going to ruin things." The landowner came back and kicked the crew off site.

Said, "You damaged this! I want you off." They asked what they had damaged and offered to fix it, but she wouldn't show it to them and kicked them off the property.

The MTSG PM called the landowner 2x and she wouldn't return her phone calls—just to find out what had happened and fix the situation. The landowner's husband called a half hour later and said that his wife was embarrassed to call and had overreacted, the neighbor had scared her. They apologized profusely and thanked them for everything that they had done and KC for the work we have done for them and apologized for the embarrassment.

Wow.

Monica:….so, putting out fires. And I'm not even working in the position this time of year and I have to deal with this—find sites for planting, put out fires, and deal with issues…and I'm not in the position and I'm not being paid for it. So, it is a full time job!

Will you talk a little bit about how the projects are funded?

Monica: Right. So each project…each river typically has its own funding from different project funders, different partners. Some of it overlaps…it can get a little bit confusing.

Um, the projects initially started with Forest Service Funding on the Green River. So, it was the USFS – Forest Health Protection funding---so, that's where the projects started. From there, we've had USFW on the Green River and some WSDA funding on the Green R. After that, we transferred some of the WSDA money to the MF Snoqualmie.

We also had Title II funds, which are RAC---I don't remember what R-A-C stands for….on the Skykomish with about $8000, which is nothing, but at least it got the project going. Title II, I think is federal…I thinks it's technically given to the Forest Service and the FS can dole it out how they want.

So, we've had lots of federal money and we've had WSDA and we've had King Conservation District money. Coming up, we just got two grants from Community Salmon Fund. It's new and it's big and it's exciting. Forest Service, USFW, WSDA, King Conservation District, and now Community Salmon Fund—that's the funding.

So, something like the Community Salmon Fund seems to be focused on salmon, so are there stipulations that come with the grand funding? How it should be spent, what it should be spent on?

Monica: Um….so that's a good question. USFW, I've applied for them in the Green River and the Skykomish---I have money from them in both rivers and the Green river definitely has salmon and the Skykomish has a block, but they catch and haul salmon upstream so it can be considered a salmon-bearing stream. There's not really a lot of limitations with USFW—if it's good for the environment, good for the riparian systems.

KCD, I haven't seen any—no, that's incorrect—it's salmon-based. They work off of plans that are, um, based on salmon recovery.

Forest Health Protection was not salmon-based at all.

Community Salmon Fund—yes. I have not spent that money yet, so I don't know how they are going to regulate it. I've heard that the invoicing process in getting reimbursed is difficult—you have to really be prepared to prove your match.

Are matching their funding?

Monica:….with other grants. Money for WSDA and grants from SPU doing work up in the Cedar River Watershed can match whatever they put it. Cascade Land Conservancy is now doing a project downstream (in the Cedar), so we can match that.

Did you apply for all of this grant funding?

Monica: Yes. You have to actively seek and actively apply for that funding every year.

Is any of the funding provided by King County Noxious Weeds?

Monica: No. Some of the match is. WSDA is really easy. They don't, as I'm aware, base it on salmon or require a full match, like in kind. That's how KC will match some of the grants—with in-kind work. My assistant's work last year was in-kind match. Um, anybody else who puts work into the project or our GPS units, our software, camera….anything like that is in-kind match. That's kind of our KC contributes---or my extra salary that's not covered by the grants.

How would you define a "successful" knotweed control project?

Monica: ..at the end of the year. I don't know the answer to that. I've never really seen—except for the MF—any end to it. So, I feel a project has been successful…if I

get a lot of knotweed controlled, if I can get a lot of people to buy into the project, if people get excited and call me and want to participate. I wouldn't really base success on having the project completed, because that typically doesn't happen…or I haven't seen it happen—or it hasn't happened since I've been PM. So, um,…success might be being able to control every site that I know about.

Would you considered the KC knotweed control project successful?

Monica: Yes.

What would you consider "effective" knotweed management? Is that the same thing as "successful"?

Monica: I don't know. Um, that might play into why projects aren't fully effective---because there's so much, we can't treat it all and getting that last 5% is not possible. So, maybe that's what I mean when I say I don't view it as success. I don't know how to view success, because I don't know how to view effectiveness. I'm successful b/c I spend my $ wisely, I get knotweed controlled…for the most part, I can control and the sites that I've known about treated every year. That's successful. I don't thing we know what is ultimately effective. I think we're good at making it manageable, but not to fully eradicate.

When you say "manageable", do you mean on a river-scale, site-by-site scale…?

Monica: On a river-scale. I think the Middle Fork Snoqualmie is—I was just looking at the data today. I think the first year we did knotweed work, I would consider it successful. We did 13 acres—net acres of knotweed that we treated—and this last

year in 2008, it was 2. So, that's successful and manageable. I don't know how to get it below that at this point. Um, but that's pretty successful.

What would you consider your major limiting factors in managing knotweed?

Monica: Time. The time that I have in the year to do the work and the time that crews give me. There's not enough people out there to do this work. And that is a limiting factor. I run out of time…which if find, I understand that they don't want to work with herbicide that much, which is fine, great, but…I need like 10 more crews to do the work in the allotted time we have to control it.

What have been your biggest challenges or hurdles?

Monica: umm…too, time. Landowners. And little things that come up that I don't expect—I was working on Soos Creek and we were working away and a landowner called and said he had bees. He asked what we were going to do about the bees because the plants were flowering and he makes knotweed honey. I didn't know what to do about that. Apparently, aquamaster is not going to harm bee or humans, but who wants to make honey that has chemical in it? So, I had to have the crews, after they injected, cut off all the flower heads of every plant—which, of course, slowed up the project until we figured out what to do. The landowner took his bees away—up to the mountains, but you get thrown these issue that you don't' expect that can stop or halt your project. Landowners are a huge problem—SOME of them, not all of them. They can hold up your project or can leave one parcel in the middle of your project area that you aren't able to control, which affects the success of your entire project. So, that can be an issue.

Cooperative Weed Management Area. All these projects are defined under that…how do you define CWMA in reference to this particular project?

Monica: I define it—and I think this is not necessary how it was meant, but I think we're going to get there—I believe it is defined as everybody—all stakeholders—within the project area working together. Um, to complete whatever you are working on together. How it has actually turned out---we see as cooperation—landowners allowing us to do the work. I think the idea is good; I'm not quite sure how to get the projects to be what a CWMA is. At this point, landowners can't get the resources, can't get the permits, the can't work w/ herbicide, they need special equipment. We do have some landowner stakeholder that have taken over control like Tacoma Public Utilities…and other large landowners. So, that's a CWMA. I don't think we're, umm, officially working as a CWMA would define itself. I think that's the goal, I think its what we want it to be, but right now, everybody letting us do work ---that is part of it. If they don't let us do the work, then that hinders the project. That sounds terrible—I might hear from the county about that one.

It sounds like a work in progress.

Monica: It's defiantly a work in progress.

Do you think that also has a lot to do with the nature of knotweed—it's just to manage than other plants managed under the guise of CWMA?

Monica: That could probably play into it. You need to get MPDS permits. Landowners aren't going to or aren't able to get that…they can treat knotweed on their own with

a supplemental label, but they can't be near the water and that's where the knotweed grows. So, how are they supposed to get that? So, we really need to come in as an agency that has these tools that a landowners doesn't to get these things done. So, that is probably why its taking the shape that it, versus what was originally intended. So, it's still a CWMA, they're working with us, allowing us, but not really participating.

When you say stakeholder, you're talking about the landowners…and there anything other stakeholders?

Monica: Mainly, well..in some cases…usually it's the landowners and that ranges from federal all the way down to private. Um, but there are some non-profits like MTGW and CLC who have done immense work in the upper watershed of the Snoqualmie. They're stakeholders, because they really care about keeping the weeds out and keeping the knotweed out, controlling the knotweed. So, you don't necessarily have to be a landowner.

In what capacity do stakeholders actively participate in the project…meetings, internet, list serves….mostly you making contact with them?

Monica: It's mainly, me making contact with them. We do have a newsletter that Sasha—our outreach specialist—puts out, um…so that usually goes to people that have usually been apart of—well, I don't know who she gets her list from, usually cities and agencies and a lot of private people too. Then, she advertises the projects are starting in the newsletter. We don't have a listserv. They could look on our website; there's lots of information –past years reports. Typically, where we have a

project going, I reach out to those landowners and request their participation—which means, "can we work on your property?"

Education and Outreach..is it a part of the knotweed management strategy?

Monica: It is. An important part. We hold and are going to start holding more meetings and trainings—workshops—to train landowners on the diff. knotweed control methods. WE also include training them on the use of the injection gun which allows them to check out a gun from the program to do work on their property. We advertise that through a large mailing to all people in a basin…then we held the workshop in those basins. At the end of the season, there was a naturescaping workshop that dealt w/ the knotweed and what to do in this coming year. We also hold municipal trainings so people who work in the municipalities can control their own knotweed. I think it's advertised mostly through those direct mailings and through the newsletter. ..and word of mouth.

Does any of your grant funding go towards that?

Monica: Yeah. Yes. USFW put $2000 towards outreach last year. I usually put in 60 hrs of Sasha's time towards in-kind match for grants. Some of its funded. Some not. That brochure I gave you—was funded by FW.

Has education/outreach always been a part of the knotweed program?

Monica: No. Its um, really taken…it took off. We've always done a little bit, but last year was the first year that we did direct mailings and invited landowners to come and learn what they could do. Letting them know where are projects are, and that

we can't necessarily help them b/c there's so much, but giving them the tools to help themselves or get a community group together to take it upon themselves has definitely taken off in the last few years .

Did you have a good response?

Monica: I think we did. I don't know. We sound out 2600 training announcements and we got around 40 people. So, it doesn't sound great, but I think that that's probably a good response.

What reasons—talking with the landowners and stakeholders—have they given for wanting to be involved?

Monica: They're concerned about the health of their river. They want to see the river. Mainly, the most common response—they can see it taking over and they can see that's its not creating a healthy environment for how a river system should be. That's the main response. Some people say, you know, I want access to my river, I want to see the river.

Do you notice certain characteristics in landowners that are more excited about being involved…or certain rivers where people are more receptive to it?

Monica: I don't know. I know the South Fork Snoqualmie people are SO excited about the project—probably tenfold for any of my other rivers. I don't know why? I honestly don't know why. There's no salmon. I don't know. I can't answer that question.

The Green River is just sort of …yeah, go ahead. The Middle Fork Snoqualmie we're fine. I don't know…the South Fork Snoqualmie is really excited, I don't know why. And

the Raging River….will hopefully…Mountains To Sound Greenway we're starting working on this year—they have salmon, that one makes a little more sense. I don't know.

H*ow do you feel landowners are most useful to you in helping the project?*

Monica: Allow me access. Not having to call them a day or two ahead before the crews are going to come, because it's so hard to judge. Um…yeah, allowing access when it happens. I understand, it's their private property. That makes the job much easier if they don't fight to hard on access issues.

Do you see any more active roles they can take on in the projects?

Monica: Good question. I've had two people on the Green River and one—this is useful…I don't know why I didn't mention it—she does hikes throughout the watershed and she would call me when she saw knotweed—which is GREAT! They can get to places that I can't, so that is very helpful…I didn't think of that. Sites I wouldn't know about with out her. There's another guy who's like, "I hunt and I fish and I'm always walking the stream, so if I see something, I'll tell you." So, that's very helpful. Them letting their neighbors know or getting their neighbors involved. The guy on the Cedar River who didn't want us anywhere near his property and his neighbor got him to come on board. They can help in that way—bring their neighbors on board, talk to their neighbors and let them know that we don't want anything, we just want to help get rid of this plant. I don't know if, seriously, doing any of the control would help b/c its not usually effective or fully effective when

they do that. But, I think getting communities together and agreeing on the importance of this is really useful.

Why do you think its not effective for them to do the control?

M: I think they don't fully know how or they don't have the ability b/c they can't control near the water, so they can't effectively control an infestation while being legally safe. So, that makes it harder. Sometimes, its easier for us to just come in a do it—we know its done right, we know we're not putting too much herbicide in.

What roles do landowners take on that impact the project in a negative ways?

Monica: I don't want to say anything they do isn't helpful..but, just the control…they're just not as effective. That's all. Sometimes its just harder, I don't want to send a crew in where they've already controlled and have them put in more herbicide when its not needed. Have they done anything, trying to help? Before people know what it is or how to control it, they're definitely a liability—I've seen times during a rafting survey—if they don't know what the plant is and there are trying to control it b/c they don't like it, I've seen people cut it and push it into the river. Then, obviously the creates problems downstream. So, I don't think people who know about the plant…they don't harm my project in any way. I think its just people who just don't know about it..um, that do, but not willingly or knowingly.

Additional feedback about community involvement in the project, or aspects about the project that people don't understand because they don't manage it?

Monica: It's a lot of coordination. You have to coordinate crews, landowners, preferences, and timing…herbicide…issues, skipping parcels. What frustrates me is that we know it's a top down approach, its not always possible. Sometimes we need to start at this property when we need to get permission or are waiting to get permission for something and then we move up. For people to criticize the project because of its not fully top down is frustrating. A lot goes into it…a lot goes into planning…its not perfect and it can't be perfect and we're all doing the best we can and…..so, I think that.

Where do you hear that criticism?

Monica: From the hired crews. Yeah.

Those that you contract to do the control?

Monica: Right. And I know that its because they want to do the best job and they know it's a top-down approach…so, they're like, "why are we controlling downstream when we haven't controlled upstream yet?" Um..I try and explain it every year …and it's the criticism that I get every year—that they didn't work top down. Skipped on property in the middle—they we didn't have time for. That's my frustration and I don't know how to let them know that its not always possible so they will understand and not be frustrated with the process.

Do you hear that from landowners too?

Monica: no.

Appendix II: Project Landowner Survey

Name (optional):

Contact information (optional):

When and how did you learn about invasive knotweed?

Why is it important to you to control knotweed?

Did you attend a 2008 Knotweed Informational Workshop? Which one?

How satisfied were you with the project this year (2008)? (1=not satisfied, 5=very satisfied) Explain.

1 2 3 4 5

What were your hesitations, if any, in participating in the project?

Feedback…

Appendix III: Project Field Crew Survey

What organization do you work for?

When and how did you learn about invasive knotweed?

Why is it important to you to control knotweed?

Did you attend the 2008 Knotweed Injection Training? **YES NO**

Was it useful? How could it be improved?

Rate the effectiveness of the control efforts this summer. (1-5; 1=not satisfied, 5=very satisfied) Explain.

1 2 3 4 5

What hesitations, if any, did you have about participating in the KC Knotweed Control project?

Feedback…