CLALLAM COUNTY INTEGRATED ROADSIDE WEED MANAGEMENT PLAN

DRAFT

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The Cover: photos, from top knapweed weevil (biological control agent) on meadow knapweed flower head photo credit Laura Parsons, University of Idaho; weed board staff digging tansy rosettes from county roadside; selective herbicide treatment for elk habitat restoration; distributing native blue wildrye grass seed post treatments; Forest Service sign indicating weed free forage requirements, pollinator-friendly forage packets distributed by county weed board through Washington State weed board program.

We'd like to thank the many reviewers whose valuable insights and suggestions are reflected in this document.

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CLALLAM COUNTY INTEGRATED ROADSIDE WEED MANAGEMENT PLAN

INTRODUCTION

Clallam County is a major landholder subject to Washington State weed laws RCW 17.10 and WAC 16-750 which mandate the control of specific non-native, invasive “noxious” weeds. An integrated roadside weed management plan is needed to help the County efficiently comply with its noxious weed control obligation on county roadsides.

The primary responsibility of the Clallam County road system is safety in the transport of people, goods, and services. Roadside weed management is a unique element within a general road maintenance program. Effective weed management involves understanding how plant communities are part of a dynamic process. Healthy, self-sustaining plant communities better compete with weed pressure. Therefore, the Integrated Roadside Weed Management (IRWM) plan shall support management practices that create naturally stable, sustainable plant communities over time.

The IRWM plan must be consistent with Clallam County’s long term goals for its road system including environmental and public safety considerations. The IRWM plan will strive for a balance of multiple, but compatible goals, such as reducing maintenance costs for weed control over time, while increasing environmental services. Other considerations will include protection and preservation of the natural environment, preserving and enhancing the scenic and habitat quality of the roadside, and being a good neighbor to adjoining property owners.

This document serves as the strategic plan for managing non-native invasive plants that infest county rights-of-way. It contains information on priority weed locations, and guidelines and procedures for best management practices in weed control. This plan is developed in compliance with Washington State Noxious Weed Law, Chapter 17.10 of the Revised Code of Washington, and modeled on the State of Washington’s Integrated Pest Management program as codified in Chapter 17.15 of the Revised Code of Washington. Specific County legislative direction upon which this plan is based is codified in Chapter _____ Clallam County Code (Appendix A).

Roadside weed management is an evolving process, and it is intended that this plan be annually evaluated and adapted over time based on input and technical updates from federal and state agencies, tribes, universities and local partners and cooperators. It is essential that the results of control activities are evaluated and adjusted as necessary to maximize efficiency and effectiveness. Best Management Practices (BMPs) for each weed program element with continued research and education will provide important information for ongoing Integrated Weed Management (IWM) treatments.

Clallam County is also requesting that local public and private entities with an interest in weed control provide input on the plan and cooperate in efforts where appropriate. Additional copies of the draft plan are available online: _____, hard copies can be provided upon request.

Please contact the County. at the numbers listed below for questions or comment

Cathy Lucero, 360-417-2442 or Ross Tyler, 360-417-2379

WHY CONTROL ROADSIDE NOXIOUS AND INVASIVE WEEDS?

Noxious weeds impact native ecosystems by reducing biodiversity, altering hydrologic conditions, altering soil characteristics, changing fire intensity and frequency, modifying successional pathways, competing for pollinators, displacing rare plant species, serving as reservoirs of plant pathogens, and by replacing complex native communities with simple non-native ones. Noxious weeds cause economic impacts. In general, noxious and invasive weeds are expensive to control and negatively impact agricultural and forestry production, property values, water flow and availability, and recreation opportunities. It is estimated that invasive plants cause about $123 billion in damages and losses to the U.S. economy annually (Harper-Lore, Johnson, and Skinner, 2007). Non native weeds cause an estimated $34 billion in losses to crops and pastures alone (Pimentel, McNair et al., 2001).

For these reasons, Washington State law requires the control of certain weed species. The purpose of the law is to limit economic loss and adverse effects to Washington's agricultural, natural, and human resources due to the presence and spread of noxious weeds in all terrestrial and aquatic areas in the state. The processes for regulation and control are defined in the Revised Code of Washington Chapter 17.10. and the Washington Administrative Code Chapter 16-750. All landowners, public and private, are required to control noxious weeds on lands they own.

Transportation rights-of-way are high priority locations for control of noxious weed species because they cross and link so many adjacent properties and land uses, and can act as conduits for the spread of weeds. Weeds often appear first along road corridors.

Clallam County must be a responsible steward of county owned land. It supports commerce and the economic viability of the agricultural community. The County also values environmental preservation. It has taken the lead on projects to restore ecosystem function. The County promotes tourism and recreational opportunities. All can be undermined by the spread of invasive plants. To meet its responsibilities, the County must ensure noxious and invasive weeds are effectively and efficiently controlled on its rights-of-way (Figure 1, A and B).

Figure 1A. The herb Robert monoculture shown here, dies back to bare ground, does not filter pollutants, is susceptible to erosion, and exudes chemicals to inhibit the germination of native species.

Figure 1B. A low growing, naturally sustainable plant community is compatible with right-of-way goals while providing environmental services and quality habitat.

INTEGRATED WEED MANAGEMENT

INTEGRATED WEED MANAGEMENT

Integrated Weed Management (IWM) is a coordinated decision making process that uses the most appropriate weed management methods and strategies, along with a monitoring and evaluation system, to achieve roadside maintenance goals and objectives in an environmentally and economically sound manner. This includes assessing potential non-target impacts that may occur as a result, and minimizing adverse effects through best management practices. The principles of IWM dictate that each weed problem is addressed from the perspective of all control options. The selected mix of control methods is the best treatment for the long term stability of the plant community. Stable plant communities become established when the desired plants are not disturbed by the control program for the undesired plants. The physical design of the roadside environment coupled with the sporadic occurrence of noxious weeds imposes restrictions on the selection of control methods.

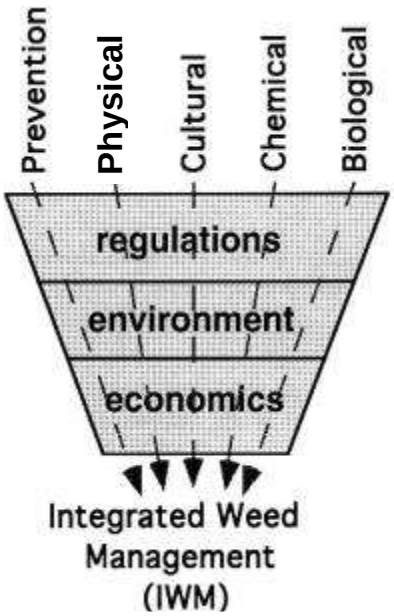

Figure 2. Factors influencing IWM program.

CHOOSING CONTROL METHODS

Weed control methods include biological, chemical, cultural, physical, and preventative. Each has its strengths and weaknesses influenced by regulations, environment and economics (Figure 2). A consideration of potential non-target impacts also plays a role. (See Appendix B for risk assessments)

Biological (such as releasing insect agents) and physical methods (such as mowing) use fewer labor resources. These are best for managing and slowing the spread of, but not controlling or reducing, widely dispersed weed infestations. Mowing is non-selective and can spread weed seeds or other viable propagules. Biological agents can be extremely selective, but require specific conditions. Both must be repeated indefinitely to suppress the weed population. Neither will eliminate populations of most weeds without using other techniques in combination.

Physical methods such as hand pulling or digging are labor intensive but can effectively control or eliminate small weed infestations of limited distribution. While highly selective, such methods are unlikely to control deeply rooted weeds or weeds with spreading root systems.

Herbicides can effectively and selectively control all sizes and types of weed infestations with a small, but knowledgeable workforce. Careful attention must be paid to minimize potential non-target effects and to follow all relevant regulations. See Appendix B for analysis of non-target impacts and risk assessment. Weather or site conditions can limit use.

Cultural and prevention practices are the most cost effective and efficient in the long term. These methods are more indirect and best used in tandem with the others. As current weed populations are eliminated, the goal is to shift control measures toward cultural practices such as use of native seed mixes and less disturbance of native shrub communities, as well as prevention practices such as weed-free material standards and cleaning equipment between job sites.

Use of the most effective method or combination of methods within an IWM decision-making framework will result in the greatest roadside service levels at the lowest life-cycle costs. Figure 3 demonstrates some of the feedback loops involved in an IWM strategy.

The IRWM Decision-Making Process

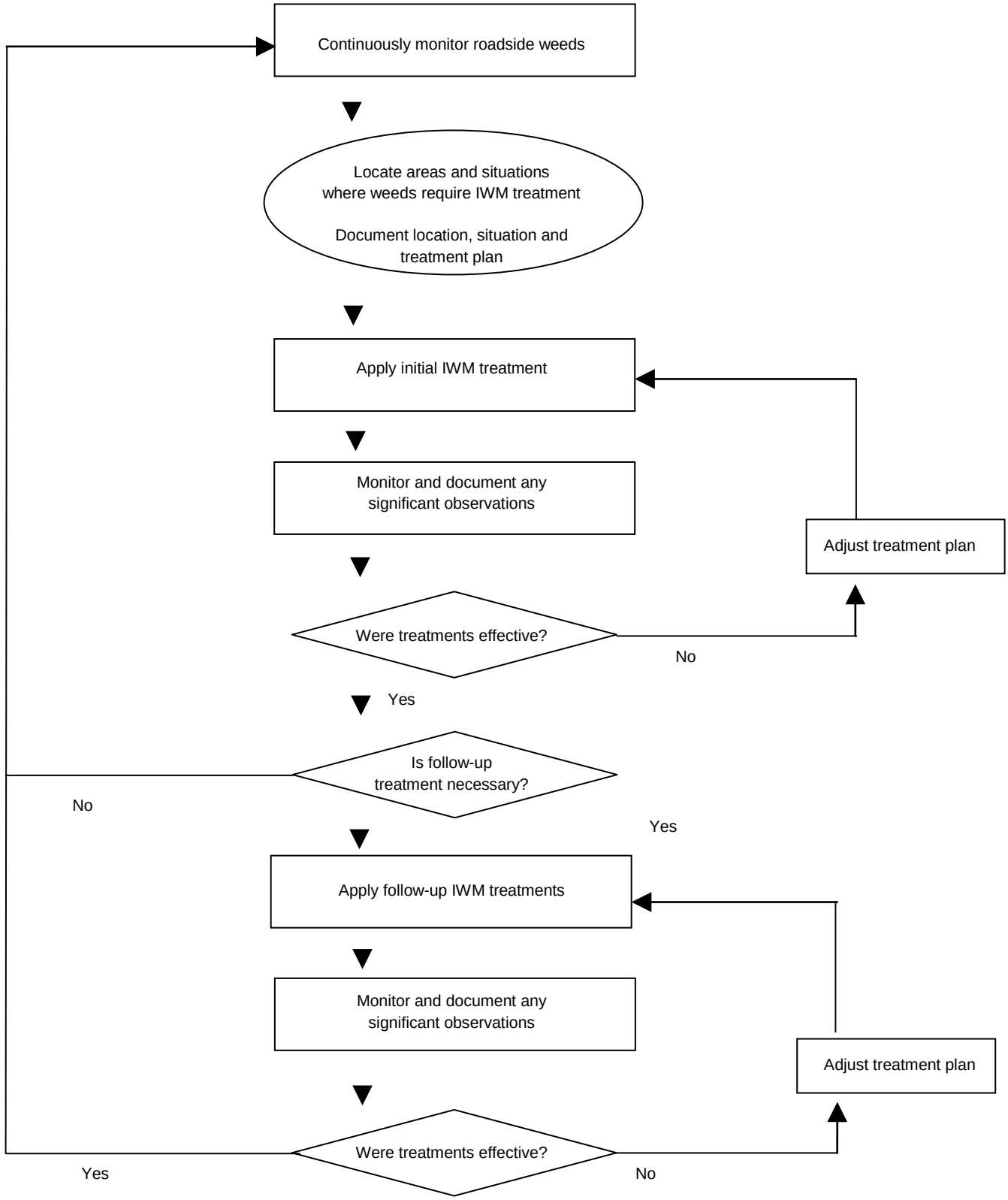

Figure 3. The continuing flow of monitoring, evaluation and adapting treatments occurring in an IRWM program (adapted with permission from WSDOT area management plans).

BIOLOGICAL WEED CONTROL

DESCRIPTION

Methods which use living organisms to inhibit a host plant's ability to survive or reproduce are considered biological controls. Insects, diseases, and foraging animals, such as goats and cattle, are examples of biological control organisms. Biological methods are typically applied only when weed infestations are so well established that total eradication is not practical or possible.

GENERAL USE CONSIDERATIONS

Insect biocontrol agents are routinely inexpensive to maintain, but their populations lag behind the development of the weed population. Careful testing and screening is done before releasing insect agents to ensure they will not also attack native or other desirable plants. Insect predators are intended to be very weed-specific, though insects are not available for many weeds. They are usually part of regional programs of which the roadside right-of-way is an incidental beneficiary. Livestock grazing has the same effect as mowing; it removes the top growth without disturbing the roots so perennial plants re-grow as soon as grazing pressure is removed. Grazing animals can suppress desirable bee and butterfly forage, create bare ground or otherwise disturb the shoulder making it prone to reinfestation and erosion. Measures must be taken to ensure that animals do not destroy desirable vegetation on adjoining land. Contiguous acres are usually needed for successful biological control. Biological controls can reduce populations, but can never result in eradication. The use of disease organisms as a form of biological control, is still very limited.

ROADSIDE APPLICATION

There are several limitations and hazards associated with using grazing animals on Clallam roadsides. Most importantly, many of the noxious and invasive weeds targeted for control are sporadically dispersed along the road system and not easy to selectively target by grazing animals. Biological control is applicable where host weeds are present in dense or continuous colonies. All available insect agents have been released or are present for control of noxious weeds within Clallam County (Table 1).

LIMITATION

Grazing: *not considered for use at this time*

- Grazing animals on narrow right-of-way pose a hazard to motorists
- Insufficient grazing area
- Creates bare ground
- Targeted species are distributed in such a way that makes grazing inefficient and less selective

Insects:

- Insect agent unavailable for many weeds
- Non-contiguous infestation or insufficient host density
- Minimal disturbance is required for insect population to grow to an effective level; often conflicts with routine mowing schedule
- Will not eliminate weed populations, only suppress them

Table 1. Insect biocontrol agents in Clallam County

Biological Agent	Latin Name	Target Weed	Comments
Bindweed gall mite	*Aceria malherbae*	Bindweed sp	Generally for field bindweed, but experimental use for hedge bindweed; best for hot, dry sites; these are new releases
Bull thistle seed head gall fly	*Urophora stylata*	Bull thistle	Seed feeder; not compatible with other control methods; may be present already
Canada thistle stem gall fly	*Urophora cardui*	Canada thistle	Metabolic sink, reducing vigor; not compatible with other control methods; three additional agents had been previously released (not by us!) for thistle control, but very detrimental to native thistle species.
Banded gall fly and knapweed seed head fly Lesser knapweed flower weevil and blunt nosed flower weevil	*Urophora quadrifasciata and U. affinus* *Larinus minutus and L. obtusus*	Knapweed, meadow	Flies often destroyed by seed weevils when both agents occur together Seed feeders
Knapweed root weevil Lesser knapweed flower weevil and blunt nosed flower weevil	*Cyphocleonus achates,* *Larinus minutus, and L. obtusus*	Spotted knapweed	Root weevil can be very effective, but limited distribution Seed feeders
Sap-sucking psyllid	*Aphalaris itadori*	Knotweed sp.	Experimental releases only in WA
Defoliating hemlock moth	*Agonopterix alstroemeriana*	Poison hemlock	Not effective, no longer distributed
Black-margined loosestrife beetle	*Galerucella calmariensis*	Purple loosestrife	Highly effective even in low density infestations, some non-target effects
Tansy flea beetle Cinnabar moth	*Longitarsus jacobaeae* *Tyria jacobaeae*	Tansy ragwort	Best on rosettes and seedlings; poor survival in wet areas; a Swiss ecotype was released in the hopes of increased survival A generalist that feeds on all plants in the *Senecio* genus, **distribution not recommended** -danger to native plants
Seed-feeding bruchid Seed-feeding weevil	*Exapion fuscirostre* *Bruchidious villosus*	Scotch broom	Seed eaters
Klamath weed beetle	*Chrysolina quadrigemina*	St. Johnswort	Feeds on ornamental and native species also; present; not well adapted to our climate

APPLICATION GUIDELINES

- Grazing may be possible under specific "Owner Will Control" option
- Release additional viable insect agents should they become available.

MAINTENANCE

None required at this time.

PHYSICAL WEED CONTROL

DESCRIPTION

Physical control includes both mechanized and manual methods. Mechanical methods use equipment to mow, cut, prune, scrape or cultivate in a manner which reduces, removes or prevents undesirable plant growth. A variety of machines are used in a roadside program, such as flail, reel, sickle, and rotary mowers, which come in different sizes, and graders, which are used to pull shoulders and remove sod buildup. Brush cutting is usually done with machines that are larger and heavier versions of rotary mowers. Mechanical methods are for larger scale general vegetation maintenance activities.

Manual methods include hand-held tools such as bladed weed-eaters, string trimmers, chain saws, brush hooks, hoes, and machetes; mechanical methods on a small scale, as well as grubbing and pulling weeds. Hand pulling is generally reserved for small or difficult to access sites or where greater selectivity is required. Repeat treatments are required for many species.

GENERAL USE CONSIDERATIONS

Mechanized equipment is typically used to non-selectively suppress undesirable or excessive vegetation growth on a large scale; not specifically to control weeds. Mechanical tools such as mowers do not affect the roots of plants, and cut plants often resprout in greater numbers. This is particularly true of weedy biennial and perennial forbs or shrubs. Many weeds respond to mowing by shorter regrowth and producing seeds on stalks below the blade height. Properly timed or frequent mowing can delay or prevent seed development during a growing season, but improperly timed mowing results in spreading propagules over a broad area. Sod scalping causes erosion potential and creates sites for weed invasion.

Weed suppression by mowers is temporary and must be repeated to achieve the desired effect. Without specific guidelines, mowing is non-selective in its effect on the plant community. Many desirable native plants grow more slowly than their weedy, invasive cousins. Desired and undesired plants are continuously reduced to the same height, the same starting point, with each mowing. Some weeds are spread by the mowing operation. Stable plant communities, an expressed objective of the county's roadside program, are not retained under heavy mowing pressure. Unless carefully timed, close mowing may be disastrous for ground nesting birds, animals, and pollinator forage. Mowing also has a large carbon footprint in comparison to other control strategies and machinery can leak hydraulic fluid and shed other hazardous substances into ditches and other sensitive environments.

Special considerations for this management option are necessary due to exposure to hazards such as noise, sharp power equipment and road traffic. Extra alertness is necessary. Protection for eyes, ears, hands, legs, and feet is required when using these tools. Alternative mechanical methods such as steam or flame have been investigated. Both steam and flaming work by destroying top growth and are best used when plants are first germinating, not when well established. Both have little effect on roots. Additionally, steam and flaming pose significant hazards for the operator and the environment and are very costly. These methods are not being considered for inclusion at this time.

Manual methods are commonly used for small infestations. This technique is effective in treating areas where obstructions prohibit mechanical methods. Hand pulling can be very selective and may be reserved for sites where extreme selectivity is critical and the infestation is small. Grubbing and hand pulling rely on moist soils and can be performed during inclement weather. These methods are labor intensive, slow, disturb the soil, and are usually expensive compared to other methods. As with other physical methods using mechanized equipment, manual treatments that do not extract all the roots of perennial plants will result in resprouting.

ROADSIDE APPLICATION

Physical control methods, both mechanical and manual, have been the preferred method for roadside vegetation management in Clallam County for many years. Mowing and brushing activities are an indispensable part of maintaining road safety by preventing line-of-sight obstructions, reducing fire hazard, preventing flooding, and ensuring biofiltration of hazardous runoff. Reach mowing is the practice of clearing vegetation, primarily brush and small trees, from the right-of-way. Work is accomplished with a rotary or flail mowing head attached to an extendable boom mounted to a tractor. This practice includes ditches and intersections. Clearing undesirable brush and trees from ditches encourages the growth of desirable grasses. This helps maintain the bio-filtration function of grass, resulting in cleaner runoff water.

The road department strives to make one complete mowing pass per year; more at intersections or critical locations. Right-of-way mowing and brushing can occur from spring to early fall when shoulder vegetation is actively growing and ongoing shoulder maintenance is required. Mowing does not normally reduce weed infestations, but can provide temporary suppression. It is best used in close coordination with other weed control methods. In general, perennial weeds like Canada thistle must be mowed at least three times per season or the weeds are invigorated.

The road department funds sheriff department-led chain gangs which provide a valuable manual workforce. Manual weed control activities will be incorporated into their assigned duties. Chain gangs will be the backbone of weed control activities that require a large labor force. They will be directed to work on large infestations of easily recognized weeds that can be effectively pulled such as flowering tansy ragwort and Scotch broom.

Under the IRWM plan, road shop supervisors will work closely with the environmental coordinator, noxious weed control coordinator, and right-of-way weed crew lead and coordinate with the mowing crew to ensure that all work is performed in accordance with Endangered Species Act and water quality requirements and state weed laws. Critical areas have been identified ensuring that mowers will know which areas and locations require special consideration. Appropriate guidelines have been developed for these locations. Changes and updates are done as necessary.

LIMITATION

- Mowing suppresses weed infestations; but does not control. Where control is desired, mowing is not recommended unless in combination with other control measure.
- Tough perennial weeds, especially those with extensive roots, are difficult to control using only physical means.
- Pulling or digging weeds is most effective when ground is soft.

APPLICATION GUIDELINES

- Avoid close mowing of desirable, native vegetation. Limit back slope mowing as much as possible. Avoid mowing the back slope in critical areas.
- Resurvey mowed roads to locate weed regrowth.
- Do not mow knotweed infestations; mowing encourages re-sprouting, may spread fragments capable of producing viable plants, and makes other treatments less effective. Consult crews responsible for weed control recommendations.
- Manual methods may be applied where practical and conditions favorable.
- Digging should be limited to individual plants or very small infestations.
- Limit digging of perennial weeds or those with deeply spreading roots unless they are newly established
- Pull and bag the heads of flowering plants. Dispose of appropriately.

Personnel

The mowing program is currently staffed with three employees who mow, as time allows, between other road maintenance duties. The road department funds two chain gangs that are comprised of up to five low-risk offenders overseen by a corrections officer. The chain gangs perform various tasks as directed by the road department. Weed Board staff digs minor regulated weed infestations as conditions and resources allow to help the County achieve compliance with law.

Training and Licensing

On-the-job training
Monthly safety trainings
Annual weed, native plant identification, and weed control training in conjunction with the Noxious Weed Control Program

Equipment

Various mechanical mowers and tractors with mowing attachments, weed whackers, chainsaws, weed wrenches, shovels, dandy diggers, and *hori-horis* (specialized digging tools).

Maintenance

- Regular maintenance and inspection of mowers and mower heads to minimize leaks or potential spills.
- Operators will be familiar with a spill prevention plan and carry spill kits.
- Ongoing training in critical areas issues for operators.
- Recurrent weed identification training for chain gang.
- Ongoing improvements in equipment.

PERFORMANCE MEASUREMENTS

- ♦ Number of weeds pulled
- ♦ Number of volunteer events
- ♦ Mowing – number of roadside pass miles. Pass miles count each shoulder mile mowed including those that are mowed more than once in a given year. The goal is to reduce this parameter while satisfying public, safety and regulatory responsibilities.

CHEMICAL WEED CONTROL

DESCRIPTION

Herbicide applications target specific noxious weeds or non-native and invasive species of special concern in our area that have been identified by the Clallam County Noxious Weed Board, state or federal agencies. Applications are made with herbicides selected for their effectiveness on the weed being targeted and may be applied using backpack sprayers or other handheld equipment as determined appropriate by the site conditions and/or the target weed.

GENERAL USE CONSIDERATIONS

Herbicide applications are a less physically, labor intensive means of controlling large weed infestations. Herbicides are the most effective way to control deeply rooted, persistent weeds. Properly applied herbicides can suppress weed germination and allow desirable vegetation to flourish with minimal effort. However, herbicides may not be appropriate under certain site or weather conditions, and require more complex decision making and staff training than most other control measures. In Washington all herbicides must undergo a registration process in addition to that required by the Environmental Protection Agency before they can be legally applied. Washington's pesticide laws may require an applicator be licensed.

Choosing an herbicide application requires carefully considering the level of weed infestation, economic impacts, and human and ecologic consequences. When a chemical measure is chosen, optimal effect is achieved through proper herbicide selection, timely application, proper application method, and the use of the effective rate of herbicide.

Herbicide use may differ depending on the setting. Spot applications of herbicides in a noxious weed control program are often used to control individual plants, while in agricultural settings, broadcast applications to entire fields are common. A limited number of chemicals are typically used for noxious weed management compared to those used in agriculture. In a successful weed management program, the amount of herbicide used on a particular site will decrease over time as the invasive plant population declines.

An herbicide's potential risk is assessed by the Environmental Protection Agency before the product is registered for use. A clear understanding of the risk of using a particular herbicide requires knowledge of the toxicity of the herbicide as well as the likelihood of exposure. Toxicity is a measure of how harmful any chemical compound is. It can be measured in many different ways and evaluated for many different biological systems. However, a chemical cannot have any effects on an organism without an exposure. Because noxious weed management with herbicides necessarily introduces chemicals into the environment, the challenge is to estimate the amount of exposure (the dose) for humans and different types of animals, as well as non-target plants. The presence of an herbicide in the environment poses less risk if the exposure for non-target organisms is sufficiently low that it is unlikely to have a negative impact.

An assessment of risk involves understanding the toxicity and likely exposure paths for various organisms that may be exposed to an herbicide. Risk assessments are used by project managers to identify those exposures that might be problematic. The project manager then uses this information to decide whether herbicides can be used without undue risk and to develop mitigation actions to reduce risks.

Several concepts are important in minimizing adverse effects. At a minimum, herbicide users should be familiar with:

1. The relative risk posed by the herbicide to the applicator and general public, and the anticipated exposure scenarios.
2. The types of wildlife and vegetation present, including endangered species. The invasive weed manager should learn enough about each species (life cycle, breeding habitat, food supply, shelter needs, etc.) to avoid impacts.
3. The relative risk posed by the herbicide to different wildlife and plant taxa that may be present and the anticipated exposure scenarios. Consideration should be given not only to the active ingredient, but also other compounds added to an herbicide formulation or added to the "tank mix" to be applied, such as surfactants.
4. The relative persistence of the herbicide in the environment, primarily in soil. Herbicide persistence is measured in terms of "half-life." One half-life is the amount of time it takes for the herbicide to break down to 50% of its original concentration in soil or water. As a general rule, it takes five half-lives for more than 97% of the herbicide to be fully degraded. Herbicide persistence is discussed in more detail in Appendix B.
5. The mobility of the herbicide in runoff water. Off-site movement in surface water and leaching to groundwater are both primarily influenced by the amount applied, the herbicide's water solubility and its tendency to adsorb to soils. Factors affecting herbicide mobility are discussed in more detail in Appendix B.

ROADSIDE APPLICATION

It is the explicit goal of this IRWM plan to minimize the use of herbicides whenever practicable, while shifting roadside vegetation to natural, self-sustaining, site-appropriate plant communities. Activities that create bare ground in the course of controlling weeds will be avoided, or be limited in duration, to prevent reinvasion by other weed species. Revegetation of bare ground with desirable plants will be promoted wherever opportunity exists.

Each species will have a Best Management Practice (BMP) specific to that species, developed and provided by the Clallam County Noxious Weed Program. Product label guidelines for timing and rates will be observed for best results. Herbicides may be used in conjunction with other practices, including biological and physical.

Most of the herbicides used in noxious weed control are of fairly low toxicity; however, not all herbicides have equal impacts. For example, some may pose greater risks to aquatic life and are not approved for use in aquatic settings. Others have long-lasting pre-emergent herbicidal activity that may restrict plant emergence or growth for several months after treatment. In areas that are to be re-vegetated soon after treatment, these herbicides may not be the best choice if their residues

remain biologically active in the soil after desirable plant species are seeded or transplanted.

Herbicide products chosen for this program are ones that maximize effectiveness, selectivity, and safety. Appendix B provides herbicide toxicity and possible exposure scenarios for wildlife. The analysis presented in the Cal-IPC document from which this information was reproduced, was based on the best available scientific data. Herbicide users are reminded of the need to keep in mind that risk analysis is a dynamic, ongoing process, as new data is generated on exposure potential and toxicity. Future studies or refined analyses may reveal risks that were previously unknown; alternatively, they may provide assurance that risks are actually lower than previously understood. With this in mind, invasive weed managers must stay informed about the latest technical developments about the chemical and non-chemical strategies they use.

The way in which herbicides are applied can enhance efficiency and safety goals. Spot, foliar treatments with backpack sprayers or even more selective hand held equipment (such as wick applicators or injectors) will be the most commonly used application method. Spot treatments can release or protect habitat for wildlife such as pollinators, song birds, and small mammals. Spot treatments reduce potential for offsite chemical drift. No broadcast treatments with mechanized equipment are being considered.

Herbicide applications to any particular site will be limited to one or two per season, depending on the weed target. The general treatment period for noxious weeds will be during the growing season when the weeds are in full leaf. Treating before bloom focuses on preventing seed production, treating after bloom focuses on herbicide translocation to the roots as the plant restores food levels in the roots. Late season treatments need to be timed so that green living leaf and stem growth is still present. Fall applications are effective for controlling germinating winter annuals, biennials in the rosette stage, and moving herbicide to the roots of established perennials.

All herbicides used by Clallam County are currently registered by the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Agriculture (WSDA). Application of herbicides is in accordance with WSDA standards and chemical labels. County employees who apply the herbicides are licensed by WSDA. In addition, these employees undergo continuous training to upgrade their expertise in the selection and safe application of herbicides. Herbicide labels, Safety Data Sheets (SDS), WSDA sensitive person list, a safety plan, and this document are kept in the office and in the weed control truck.

Herbicide Selection Process

Several factors contributed to selecting particular herbicides to control noxious weeds on Clallam County roadsides.

- **EPA Approved for Roadside Use --** All of the selected herbicides are fully labeled for use on roadsides and are registered for use in the state of Washington. The herbicide label does not have to list all the weeds, but the label does have to list roadsides or rights-of-way as a use site.
- **Effectiveness on Target Species –** AquaNeat and Polaris are very broad spectrum and will control most of the county's noxious weeds. Milestone, Transline, Element 3A, and 2,4-D are selective and very effective only on broadleaf plants. Fusillade II is effective only on grass species. Many of the targeted weeds have a perennial life cycle with persistent root systems. Effective control requires translocated herbicides that kill the roots. All of the selected herbicides translocate to the roots.
- **Selectivity –** Several of the herbicides were chosen because they selectively target broadleaf weeds, not grasses. This allows grass to be unaffected and to colonize space previously occupied by broadleaf weeds. The grass herbicide gives the program a selective chemical for controlling weedy grasses, such as reed canarygrass, in a mixed plant community.
- **Human and Environmental Safety --** All of the selected herbicides are relatively non-toxic to humans and wildlife. Some of the products are labeled for aquatic use so inadvertent occurrence in water is anticipated to have minimal effects on aquatic organisms. Most are labeled for use on grazed areas such as range and pasture. Most are labeled for use in maintaining wildlife habitat, fence rows, as well as rights-of-way. Some products require additional handling precautions by the applicator, but do not pose increased risk to the general public or the environment. For example, eye hazard when using Element 3A is a characteristic of the formulation, not the active ingredient. Further, a more applicator friendly formulation of this product (already available in other states) will be substituted as soon as it has completed registration for use in Washington.

Herbicide Product List

Clallam County proposes to use the following products for targeted herbicide applications:

AquaNeat® (aquatic formulation glyphosate)
Element® 3A (aquatic formulation triclopyr)
Fusilade II® (fluazifop-P)
Milestone® (aquatic formulation aminopyralid)
Polaris® (aquatic formulation imazapyr)
Transline® (clopyralid)
WeeDestroy AM-40® (aquatic formulation 2,4-D).

The chosen products are effective on known roadside weeds, offer the greatest weed selectivity, maximize worker and public safety (no wait, access when the spray has dried), and pose the lowest risk for wildlife and the environment (Table 2). See Appendix B for risk analysis.

The standard, minimum personal protection equipment (PPE) when using herbicides includes:

Long sleeved shirt, long pants
Shoes plus socks
Chemical resistant gloves made of any waterproof materials

(Any additional PPE requirements are shown in Table 2).

Table 2. Selected herbicide characteristics.

Chemical Name Product Name	Selec-tive	Aquatic Sites	Target Weeds	Personal Protection Equipment	Comments
2,4-D WeeDestroy AM-40	✓	✓	Broadleaf	Standard; eye protection + apron for mixing	Inexpensive, often used in mix; short residual
Aminopyralid[1] Milestone	✓	✓	Broadleaf	Standard	Moderate residual may help suppress seed germination; very low rates
Clopyralid Transline	✓		Broadleaf	Standard	Very selective; will not affect many native and desirable plants; long residual; low rates
Fluazifop-P Fusilade II	✓		Grasses	Standard + eye protection	For dry sites; reed canary-grass and annual grasses
Glyphosate AquaNeat		✓	All weeds	Standard	Minimal to no residual; protect desirable vegetation
Imazapyr Polaris		✓	All weeds	Standard	Long residual; protect desirable vegetation
Triclopyr amine Element 3A	✓	✓	Broadleaf, shrubs	Standard plus eye protection	Moderate residual

[1]Registered as a reduced risk pesticide under the EPA reduced risk pesticide program

Adjuvants are compounds added into an herbicide mix to improve efficacy. They perform various functions, including: enhanced plant uptake of the herbicide; better mixing of otherwise incompatible herbicides; increased adhesion of the spray to plant surfaces; and reduced spray drift. In many herbicide products, adjuvants are included as part of the pre-mixed formulation as purchased. Applicators can also add adjuvants to spray mixtures prior to application. Adjuvants include marker dyes, which are visible indicators of freshly treated weeds, include Blazon and Highlite (aquatic formulation).

Surfactants, or “surface active agents", are a type of adjuvant added to a mix to increase the dispersing, spreading, wetting, or other properties of the liquids. Surfactants disperse water droplets and help penetrate a plant’s waxy surface. (Table 3).

Some states require registration of adjuvants as pesticide products, but the US EPA does not, so relatively less is known about adjuvants compared to pesticide active ingredients. Acute toxicity information is often available, with some of these compounds being labeled as strong eye or skin irritants, but information regarding chronic toxicity is sparse. Washington State and European countries require environmental toxicology data on adjuvants.

For many pesticide products containing adjuvants as part of the formulation, the compounds are not explicitly identified on the label or the Safety Data Sheet. Unless they are on one of US EPA’s lists of more toxic chemicals, they do not have to be identified. The identity of these ingredients in a pesticide or adjuvant product is legally protected from full disclosure as “Confidential Business Information.”

Without more detailed information, it is not possible to conduct a comprehensive risk assessment on adjuvants, so they are not included in the risk charts shown as part of Appendix B, which focus on herbicidal active ingredients. However, at least one adjuvant is known to pose hazards to wildlife—the surfactant used in the original formulation of RoundUp®, polyoxyethyleneamine (POEA). This surfactant is more toxic to aquatic life than the active ingredient glyphosate—it has been included as a separate entry in the risk charts. Nonylphenol ethoxylates (NPEs), which are used in some adjuvants (and many consumer products), may be linked to endocrine disrupting effects. No products containing polyethoxylated tallowamine (POEA) or nonylphenol ethoxylates (NPEs) will be allowed for use in this program. Adjuvants with low toxicity to wildlife include modified seed oils, alkyl ethoxylates, and silicones. Liberate®, Competitor®, DyneAmic®, and Agri-Dex® (all aquatic formulations) are brand names of some adjuvants from these low toxicity categories and have been selected for use in this program. Research is developing on this subject and will be regularly added to updates for this program

Government agencies negotiate for favorable pricing and award a contract to a preferred provider for many goods and services. Herbicides will be purchased under state contract whenever possible to conserve tax dollars. Because the preferred provider may vary from year to year; different brand names than listed in the previous tables, with the same active ingredient may be substituted. New products or different formulations with the same active ingredient that are more user or environmental friendly, and cost beneficial will be substituted as they become available.

Table 3. Adjuvants used to enhance herbicide effectiveness.

Adjuvants	Aquatic use	Treatment effects	PPE	Comments
Competitor - vegetable oil Agri-Dex, -crop oil concentrate Dyne-Amic - nonionic surfactant Liberate - fatty acids	✓	Increases herbicide uptake	Standard	Used at low rates
Blazon - marker dye Highlite - marker dye	✓	No active effect	Standard	Highlights recently sprayed weeds; washable

A number of studies have shown non-synthetic products (or “natural”) are considerably less effective for controlling weeds, especially biennials or perennials, than synthetic ones. However, three of these products, acetic acid, clove oil, and limonene are the subject of an on-going study for control of the annual weed, herb Robert. Pending study results in 2016, one or more of these herbicides may be added to the herbicide product list for control of this or other annual weeds.

Application Methods

- **Foliar.** Applications to the plants' leaves are an easy way to control weeds with maximum amount of herbicide directed to the target plants and optimum up take by the plants for both herbaceous forbs and grasses.
- **Wiping Applicators.** Wiping applicators (also called rope wicks) rub the concentrated herbicide solution on the plant's leaf and stem surfaces. Because only the weeds tall enough to contact the rubbing surface are affected, nonselective herbicides can be used selectively to release low-growing plants or plants below the treatment height. Drift does not occur with wiping applicators so there is no potential exposure for adjacent crops and gardens.
- **Stem Injection.** Some species, such as knotweeds, have stems of sufficient size that herbicide can be injected directly into the stem. While this is an effective treatment, it is a very labor intensive treatment for treating dense stands. Only some herbicides are labeled for this application method.
- **Stem Injection/Spaced Cuts/Cut Surface/Cut Stump/Basal Bark.** Stem injection, spaced cuts, cut surface, cut stump, and basal bark are treatments often used for controlling tall growing woody plants. As the name implies, herbicide is applied to just the cut surface or the woody stem. The herbicide rate and carrier is adjusted according to the part of the woody plant being treated. Unlike foliar treatments done during the growing season, these treatments can be applied year round. These treatments are particularly effective for large butterfly bush and Scotch broom in excess of 1-2 inches in diameter.

Record Keeping

Thorough record keeping is maintained on a WSDA approved form (Appendix B), per State requirement for all herbicide applications. The record includes information about the treatment including location, chemical used, weather conditions, and applicator comments. Citizen inquiries pertaining to herbicide applications are recorded and addressed.

LIMITATION

Herbicides should not be used:

- When weather conditions do not permit
- Where landowners have a current "Landowner Will Control" agreement
- Special management areas may have specific control practices or limitations

APPLICATION GUIDELINES/STANDARD OPERATING PROCEDURES

- Use only EPA and WSDA approved herbicides.
- All applications supervised by licensed applicators.
- Observe strict compliance to product labels and to State and local regulations.
- Use personal protective equipment as directed on the herbicide product label.
- Carefully select products, rates, timing of application, and equipment to be used.
- Include marker dye to aid identification of treated areas.
- Follow all applicable notification protocols.
- Follow product label for use and storage.
- Apply only aquatically approved formulations within 50 feet of water.
- Treat only the noxious weed site
- Minimize drift injury by not spraying when wind exceeds 10 mph in direction of sensitive non-target plants.
- Use drift reduction agents or techniques as appropriate.
- Don't spray when drift cannot be controlled.
- Avoid application when rainfall is imminent.
- Conduct mixing and loading operations in an area where a spill would not contaminate an aquatic site or well head.
- Do not rinse spray equipment near bodies of water or sources of potable water.
- Be aware and protective of people, working equipment, sensitive crops and gardens, apiaries, endangered species, water and wells.
- Avoid direct applications to pollinators.
- Secure containers during transportation.
- Contain and clean up spills and request help as needed.
- Keep copy of product labels and SDSs in truck.
- Promptly respond to any public inquiries or direct them to the supervisor.
- Post treated areas and specify the duration of exclusion, if appropriate.
- Provide public educational information on the need for weed treatments.
- Coordinate weed management activities where joint use of a right-of-way exists.

Herbicide Notification Process

General public notice is provided annually in early spring. A Press Release (Appendix C) is provided to the local news media. Public Notice is posted on the County website. Both include general vicinity of areas to be treated, reference to the IRWM plan and how to obtain a copy, and information for entering into an Owner Will Control Agreement with Clallam County. Additionally, up to one week prior to weed treatments along county rights-of-way, an Herbicide Notice (Appendix D) is posted at intersections and at least every two miles of contiguous treatment. Information in the Herbicide Notice includes the names of the herbicides to be used, target weed species, approximate date of application, and the telephone number to contact for further information. Notices that are pre-posted are redated as to the actual date of application.

Staff

The IRWM program will be staffed with a licensed supervisor and two seasonal employees that will be licensed or operate under the direct supervision of the supervisor or licensed Noxious Weed Control Board staff.

Training and Licensing

Washington State Department of Agriculture Pesticide License "Public Operator"
Washington State University IPM Program Certification (Continuing Education)

Equipment

Equipment used: back pack sprayers, hand held-spray bottles and loppers, wicker wipe applicators, EZJect lance and injection guns for selected noxious weeds. A backpack sprayer is a self-contained unit (tank and pump) and is carried on the back of the applicator. The capacity of these sprayers is usually less than 5 gallons. The entire tank may be pressurized or only a small chamber that draws from the main tank. This equipment is useful for selective applications and spot treatments. Backpack sprayers are very adaptable to a wide range of nozzle configurations for treating foliage. The backpack sprayer is the major application device for roadside weed control in Clallam County.

Maintenance

- Regular maintenance and calibration of all spray equipment.
- Early detection of targeted weed infestations and ongoing site evaluations.
- Ongoing training of staff including yearly recertification credits.
- Ongoing improvement and updates of equipment and handling protocols.

PERFORMANCE MEASUREMENTS

- Number of projects completed.
- Area of weeds controlled.
- Public, interdepartmental, and agency weed control requests – number of requests, area of treatment, miles of road.
- Public satisfaction -- number of complaints (the lower the number, the better the performance)
- Survey goals -- area and number of miles inspected.
- Documentation, evaluation, and reporting

OWNER WILL CONTROL AGREEMENT

Property owners will have the option to keep the road right-of-way abutting their property weed free with or without herbicides. To do so, the property owner must enter into an Owner Will Control Agreement with the County and perform weed control as outlined in the Agreement.

When entering into an Owner Will Control agreement, property owners assume the county's responsibility under state laws RCW 17.10 and WAC 16-750 to control noxious weeds, which requires timely and often repeated control efforts during the growing season. The landowner would also assume any additional weed control responsibilities resulting from county policy.

Property owners participating in control agreements may also be interested in assisting with cultural control enhancements consistent with long-term roadside weed control goals. Such opportunities will be pursued as program resources and voluntary participation allow.

A sample Owner Will Control packet is included in Appendix F.

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CULTURAL WEED CONTROL

DESCRIPTION

Techniques that benefit the development and health of desirable, competitive plant communities are considered cultural weed control methods. Cultural methods, along with prevention, are the preferred method of weed control wherever possible. Examples include the use of mulch and soil amendments that improve soil fertility to stimulate growth of desired species or to alter soil pH to discourage undesired plants. Cultural weed control includes the planting or seeding of desirable species. Effective use of cultural methods must be conducted in close coordination with efforts to eliminate existing noxious weed sites.

GENERAL USE CONSIDERATIONS

Cultural control methods encourage natural, self-sustaining, site-appropriate plant communities to develop in the long term. Native plant materials are preferred because once established on appropriate sites they require few additional inputs to thrive and self-perpetuate. In addition to low maintenance, well established native plantings provide many environmental services, such as erosion control, biofiltration, pollinator and animal habitat. Native plantings have the potential to prevent undesirable weeds from becoming established by two mechanisms, competition and allelopathy. Competition is the interaction between plants for site resources such as space, nutrients, moisture, and light. Allelopathy occurs when one plant produces chemicals which inhibit the establishment and growth of others. The composition of plant communities on the roadside is likely to be a result of both mechanisms. Native wildflowers provide forage for pollinators and are aesthetically pleasing, while occupying the site to prevent or retard invasion by undesired noxious weeds.

ROADSIDE APPLICATION

The long term goal of this plan is to programmatically incorporate cultural practices into overall roadside management practices. Possible opportunities include: new construction, shoulders and ditches, locations under “Owner Will Control” agreements, post weed treatment, and other county land such as pits, trails, and parks.

Activities that enhance or create native or self-sustaining plant communities should be applied as broadly as possible. Cultural practices are best applied to disturbed or bare ground or after weed treatments have occurred. Controlling the noxious weeds may release native roadside plants but more active measures may be required. Clallam County has a unique opportunity to partner with Olympic National Park to develop and obtain native seed mixes and plant material through the Matt Albright Native Plant Center.

Activities to improve site conditions such as mulching or adding soil to increase successful desirable plant establishment will be considered as resources and materials are available. Such activities cannot interfere or conflict with the primary use and safety of county rights-of-way.

LIMITATION

- Revegetating activities must be postponed until weed infestation is adequately controlled.

- Plant selection must not conflict with roadside safety and maintenance considerations, public or animal health, and adjacent land use or values.
- Roadsides are a harsh environment for establishing many desirable plant species; amending soil may not be a viable option in many cases.

APPLICATION GUIDELINES

- Use native species wherever possible.
- Blend with adjacent landscaping.
- Choose low growing plants for foreslope that require less mowing
- Utilize weed-free, chipped materials on site to suppress weeds. Weedy brush may only be chipped and left on site if it is in early growth stages, and has no ripe seed.

Staff

WSU Master Gardener Coordinator, volunteers, Weed Crew

Training and Licensing

No licensing required
Native plant identification, biology, and habitat needs
Planting techniques
Use of GPS equipment

Equipment

Handheld GPS, hand tools

MAINTENANCE

Maintain/evaluate sites for first five years
Monitor periodically thereafter

PERFORMANCE MEASUREMENT

- ♦ Cooperative relationships with outside entities developed and maintained
- ♦ Planning documents developed
- ♦ Volunteer participation
- ♦ Area replanted
- ♦ Maintenance costs are reduced over time

PREVENTATIVE WEED CONTROL

DESCRIPTION

Preventative weed control refers to any control method that aims to reduce or prevent weeds from being established. Examples of preventative weed control would be using certified weed free materials such as road and shoulder base rock, gravel, straw, soil, or mulch material for construction and maintenance activities, and making sure equipment is cleaned before moving from one location to another.

GENERAL USE CONSIDERATION

Prevention is, by far, the most environmentally and cost-effective control strategy. In addition to the above mentioned best management practices, prevention includes actively surveying for and eradicating new invaders or small, newly discovered infestations as they are encountered.

ROADSIDE APPLICATION

Prevention is a top priority for this plan. Using certified weed-free materials whenever possible reduces or prevents introducing new weeds, and avoiding soil disturbance helps prevent creating an environment vulnerable to invasion. Road designs that are easier to maintain and incorporate weed prevention features can be very cost effective in the long term. Weed Board staff is available to advise and provide technical assistance to Road Department engineers at all stages in road construction.

Weed Free Materials. Since prevention is the foundation of noxious weed control, prevention should start with certified weed-free seeds, mulches, soil, and gravel. The North American Invasive Species Management Association has certification standards that involve inspection of sources and sites to determine they do not contain seeds or plant parts of invasive weeds. Inspection includes, but is not limited to, surrounding ditches, top soil piles, gravel/sand piles and pits, fence rows, roads, easements, rights-of-way, working areas, storage areas, and a buffer zone surrounding the area. Washington subscribes to these certification standards and Clallam County will apply these standards as widely as possible.

Clean Equipment. An important part of prevention is to not carry noxious weed seeds or plant parts from site to site. Before moving from or to a construction or maintenance project, clean the equipment. Remove hanging debris; wash off mud. Ensure that associated vehicles and crew are similarly inspected. These actions help stop the movement of weeds along the roadside corridor. Clean hand tools, boots and clothing as well.

Avoid Bare Ground. One of the problems of mechanical tools is scalping the soil. Whether it's by a grader, a mower, a bush hog, or a string trimmer, bare ground creates openings for the establishment of invasive weeds. Historically, when roadsides were disturbed, native plants from the soil seed bank or undisturbed adjacent land provided the seed source for the new native plants. In today's world, with human disturbances and inadvertent plant introductions, aggressive invasive plants are ready to occupy the available site. Covering bare ground with weed-free materials or seeding with desirable seed mix as soon as possible will suppress weed germination.

Design Controls. Adding new engineering standards that require less maintenance, such as favorable slope gradient, extending chip-seal edge, and incorporating native plantings in construction planning all help to prevent weed invasion.

EDRR. Eradication is a very realistic objective in the early stage of noxious weed establishment. Detecting new invaders or small weed patches and eliminating them at an early stage prevents costly intervention later. This form of prevention called Early Detection, Rapid Response (EDRR), is a preferred strategy for this program.
Both county employees and the general public can be an important part of the EDRR process. The components of EDRR are: 1) detection reporting, 2) identification confirmation, 3) rapid assessment, 4) program planning, and 5) rapid response. The general public will be encouraged to report suspicious plants, or new weed locations. The Clallam County noxious weed board has the resources to confirm the identity of suspicious weeds.

LIMITATION

- Roadways are exposed to all manner of weed pressure and completely preventing transportation and introduction of invasive plants is not possible.
- Routine maintenance activities will create some amount of bare ground.
- This control measure does not deal with established weed infestations.

APPLICATION GUIDELINES

- Incorporate prevention strategies programmatically into all aspects of planning and executing weed control activities and road maintenance.
- Develop native plant materials so that native seeds of desired plants are readily available.
- Limit activities that create bare ground.
- Where disturbance is expected, plan to revegetate with site appropriate plants. Identify the most favorable conditions for establishment.
- Inspect, evaluate weed invasion risk, and treat appropriately in response to emergency disturbances such as fire and flooding.
- Adopt a monitoring schedule to detect the presence of new invaders along roadsides or weed invasion of new construction.
- Incorporate EDRR strategy

Personnel

WSU Master Gardener Coordinator, volunteers

Training and Licensing

Cooperative training with WSDOT
Annual prevention and weed identification programs conducted by the Weed Board

Equipment

None determined at this time

PERFORMANCE MEASUREMENT

- ♦ A higher percentage of weed sites are small.
- ♦ Program costs are reduced over time.

2016 Work Plan

The focus of this work plan is the control of state-listed noxious weeds and invasive, non-native weeds of special concern on Clallam County rights-of-way. The integral precept of this IRWM plan is that all control techniques are potentially applicable to the solution of the problem.

With more than five hundred miles of county roads there are a variety of weed problems as well as control opportunities. Biological controls will continue to operate on roadsides through releases made elsewhere in the county. Additional releases will be made if new insect controls become available and are compatible with routine maintenance activities such as mowing, which is non-specific to and independent of weed control.

Physical controls will continue to be applied across the road system where effective and as resources allow. Scheduling chain gang weed control activities to be consistent with weed growth life-stage and as part of an overall strategy will greatly increase the efficiencies of using this labor force. Volunteers will be recruited for various projects, especially where adjacent infestations threaten county assets.

Chemical control is an important tool that is needed for specific weed problems. Great care has been taken in choosing which herbicides may be applied, and additional safeguards are included by ensuring only targeted, hand applications are allowed. Herbicide use is limited to specific locations which are listed in this plan based on surveys conducted in 2015.

Most importantly, cultural and preventative controls will be applied programmatically to sustain the progress made by all of the above mentioned control methods. Combined, these management practices will move us towards achieving a low maintenance, naturally stable, plant community.

High priority weed targets are identified and control options for an array of roadside weeds are summarized in the tables below. These are followed by specific tasks necessary to implement the 2016 work plan. Tasks are itemized under separate category headings. While listed separately, the tasks represent the best mix of control options chosen to address specific weed problems. The complete set of tasks is carefully designed to be implemented in tandem, not independently.

Identifying High Priority Weed Targets

Table 4 contains known roadside weeds for Clallam County. The table is arranged to show which weeds are the highest priority for control based on potential economic or environmental impacts and feasibility for control. The list is not comprehensive and will change as conditions change.

"Plant status" indicates one of several categories: a **noxious weed** (a prioritized legal designation including Class A, Class B and Class C weeds where control may be required under state law), a **non-native, invasive** plant capable of causing economic or environmental impacts, but not listed by the state, and **weedy**, so prevalent that it is generally considered naturalized or an aesthetic nuisance. Infestations of invasive, non-native species are more easily eliminated before they become established.

To be most efficient when deciding treatment priorities, where known, weeds are characterized as widespread or rare. The following abbreviations are used in the "status" column in Table 4:

ISSC = **I**nvasive **S**pecies of **S**pecial **C**oncern
NCR = **N**oxious, **C**ontrol **R**equired
NR = **N**oxious**, R**are
NW = **N**oxious, **W**idespread
WR = **W**eedy**, R**are
WW = **W**eedy**, W**idespread

Weeds are assigned to a "category" based on information in the "status" column. Weeds are categorized as follows:

Category 1 weeds are Class A, B designate, and selected B or C noxious weeds, additional noxious weeds and invasive species of special concern that are very limited in distribution, and newly discovered invaders that were previously unknown in the county (EDRR - early detection, rapid response). Category 1 weeds are the *highest priority* for control.

Category 2 weeds are noxious weeds that are widespread, but of particular concern to the general public or an affected public entity. Category 2 weed infestations will be added to the annual work plan in an effort to methodically reduce widespread weeds over time and to accommodate requests.

Category 3 weeds are those that are so widespread they are generally considered naturalized or a nuisance. These weeds are tolerated. Control is not considered feasible.

A list of roadside weeds, life cycle, growth form, category and status are in Appendix G.

Table 4. Known roadside weeds in Clallam County.

Common Name	Category	Status	Threat
alyssum, hoary	1	NCR	Aggressive invader in fields of forage crops; toxic to horses
bindweed, field	1	NR	Seriously interferes with agriculture
brome, ripgut	1	ISSC	Long seed awns cause injury to nose and eyes of grazing animals; known to occur in Clallam County, but not on roadsides; will be treated under EDRR protocol if observed.
butterfly bush	1	NR	Invades natural areas; dense stands crowd out native vegetation in riparian areas and interfere with natural succession
cheatgrass or downy brome	1	ISSC	Depletes soil moisture in early spring; fire hazard in summer; known to occur in Clallam County, but not on roadsides; will be treated under EDRR protocol if observed.
chicory	1	ISSC	Only found in the Dungeness Valley where it is starting to spread
cinquefoil, sulfur	1	NCR	Not readily grazed by livestock and wildlife; forms dense stands
comfrey	1	ISSC	Used medicinally for poultices; liver damage when ingested; can form dense stands; difficult to control once established

Common Name	Category	Status	Threat
fennel, common*	1	NCR	Dense stands exclude native vegetation
hawkweed, orange	1	NCR	Dense stands exclude other species; bitter and unpalatable, little forage for livestock and wildlife
herb Robert	1	N**	Spreads rapidly; displaces native herbaceous plants; allelopathic, inhibits the germination of small seeded forbs in forest understory
hogweed, giant	1	NCR*	Skin contact with sap causes severe dermatitis and blistering on people and animals
knapweed, diffuse	1	NCR*	Spreads seed by tumbling; prickly flower heads; unpalatable after early spring
knapweed, meadow	1	NCR	Outcompetes pasture species; degrades wildlife habitat; interferes with agriculture
knapweed, spotted	1	NCR	Allelopathic plant that can inhibit the germination of grasses; forms dense stands that exclude desired plants and wildlife
knotweed, Bohemian	1	NCR	Easily spreads by disturbance; dense colonies eliminate other plant species and can degrade fish habitat; causes structural damage to human structures
knotweed, giant	1	NCR	Easily spreads by disturbance; dense colonies eliminate other plant species and can degrade fish habitat; causes structural damage to human structures
knotweed, Japanese	1	NCR	Easily spreads by disturbance; dense colonies eliminate other plant species and can degrade fish habitat; causes structural damage to human structures
laurel, spurge	1	NR	Toxic to humans and animals; contact with plants can cause dermatitis
loosestrife, purple	1	NCR*	Dense stands eliminate other plant species; poor palatability; degrades wildlife habitat and hunting and fishing areas.
old man's beard	1	NR	Climbing growth smothers other plants, even trees
poison hemlock	1	NCR	Highly toxic to humans and animals; all parts of the plant are toxic; severe birth defects
ribbon grass	1	NR	Aggressive invader displaces other plants in wet sites; an ornamental form of reed canarygrass; may also be used as a source for psychedelic drugs
tansy ragwort	1	NCR	Poisonous to horses, cattle, and pigs; animals grazing tansy can produce tainted milk, may result in potentially toxic residue in honey
tansy, common	1	NR	Dense stands degrade forage value; toxicity issues for humans and livestock
teasel, common	1	NCR	Forms dense stands of prickly, unpalatable plants; degrades habitat and reduces accessibility
whitetop, hairy	1	NR	Monocultures displace desirable plants; unpalatable; can be toxic to cattle
wormwood, absinth	1	NR	Aggressive invader, will outcompete desirable forbs and grasses in pastures, fields and native grasslands; plants have a strong bitter taste and odor, may affect milk quality
blackberry, evergreen	2	NW	Dense canopies crowd out native species; impenetrable barrier

Common Name	Category	Status	Threat
blackberry, Himalayan	2	NW	Dense canopies crowd out native species; impenetrable barrier
broom, Scotch	2	NW	Forms dense stands; unpalatable; interferes with forest regeneration; fire hazard; scent can exacerbate human grass allergies; seeds are toxic to horses and livestock
burdock, common	2	WR	Forms large rosettes; hooked spines on seeds become entangled in fur of animals
canarygrass, reed	2	NW	Unpalatable unless young, dense stands crowd out native plants; especially difficult to control; serious wetland invader; can stop the process of succession in riparian sites, impedes tree seedling establishment
carrot, wild	2	NW	Damages agricultural commodity as it may cross pollinate with domestic carrot, seriously degrading the quality of commercial carrot seed production
iris, yellow flag	2	NR	Toxic to humans and animals; displaces vegetation at wet margins of ditches, ponds, and lakes; plant resins can cause skin irritation in humans
peavine, everlasting	2	ISSC	Forms dense thickets; can be toxic to livestock; seeds poisonous; seriously interferes with forest regeneration
thistle, bull	2	NW	Aggressive competitor, unpalatable for cattle
thistle, Canada	2	NW	Aggressive competitor, unpalatable; decreases forage; host species for several agricultural pests
bindweed, hedge	3	WW	
buttercup, creeping	3	WW	
catsear, common	3	NW	Crowds out palatable forage species
clover, various	3	WW	
daisy, oxeye	3	NW	Livestock avoid grazing; milk from dairy cows has unpleasant flavor
dandelion, common	3	WW	
horsetail	3	WW	
orchard grass and other pasture grasses	3	WW	
St Johnswort, common	3	NW	Causes photo-sensitization when grazed; toxic at all stages of growth

*No active sites, but previously documented; **Insufficient distribution information

Table 5 shows general guidelines for year-round treatments of the listed noxious weeds and invasive weed species of special concern. It is intended as a basic reference framework from which decisions are made for weed treatments from available options. Seasonal variables are considered and addressed as they become evident. Changes to the Clallam County Noxious Weed List or species that appear on county right-of-way may make adjustments necessary.

Table 5. Recommended control treatments for Clallam County roadside noxious weeds.

Noxious Weed	Fall	Winter	Spring	Summer
Category 1 Weeds				
alyssum, hoary	Foliar herbicide treatment	Manual removal/digging	Manual removal/ digging; foliar herbicide treatment	Foliar herbicide treatment; clip flower heads
bindweed, field	Foliar herbicide treatment	Plants die back - no action	Foliar herbicide treatment	Foliar herbicide treatment
butterfly bush	Herbicide treatment - cut stump or foliar	Manual removal/ digging; mowing; cut stump treatment	Manual removal/ digging; herbicide treatment - cut stump or foliar	Manual removal/ digging; herbicide treatment - cut stump or foliar
canarygrass, reed	Foliar herbicide treatment	Plants die back - no actions	Foliar herbicide treatment	Foliar herbicide treatment
cinquefoil, sulfur	Foliar herbicide treatment	Plants die back - no action	Manual removal/ digging; foliar herbicide treatment	Foliar herbicide treatment
fennel, common	Manual removal/ digging; foliar herbicide treatment for fall regrowth	Manual removal/ digging;	Manual removal/ digging; foliar herbicide treatment	Manual removal/ digging; foliar herbicide treatment
hawkweed, orange	Foliar herbicide treatment	Plants die back - no action	Foliar herbicide treatment	Foliar herbicide treatment
herb Robert	Foliar herbicide treatment	Plants die back - no action	Manual removal; foliar herbicide treatment	Manual removal; foliar herbicide treatment
hogweed, giant	Manual removal/ digging;	Plants die back - no action	Manual removal/ digging; foliar herbicide treatment; clip flower heads	Manual removal/ digging; foliar herbicide treatment
knapweed species	Manual removal/ digging;	Manual removal/ digging;	Foliar herbicide treatment (rosette stage)	foliar herbicide treatment; biological control
knotweed species	Foliar herbicide treatment or injection	Plants die back - no action	Mowing for sight distance issues	Foliar herbicide treatment or injection (late summer)
laurel, spurge	Foliar herbicide treatment	Plants die back - no actions	Foliar herbicide treatments	Foliar herbicide treatments
loosestrife, purple	Manual removal/digging;	Plants die back - no action	Manual removal/digging;	Manual removal/ digging; foliar herbicide treatment; clip flower heads; biological control
old man's beard	Foliar herbicide treatment if prostrate; basal stem treatment	Basal stem treatment	Foliar herbicide treatment if prostrate; basal stem treatment	Foliar herbicide treatment if prostrate; basal stem treatment
poison hemlock	Manual removal/ digging; foliar herbicide treatment for fall regrowth	Manual removal/ digging;	Foliar herbicide treatment (rosette stage)	Manual removal/ digging; foliar herbicide treatment; clip flower heads; biological control
tansy, common	Foliar herbicide treatment	Plants die back - no action	Manual removal/ digging; foliar herbicide treatment	Foliar herbicide treatment

Noxious Weed	Fall	Winter	Spring	Summer
tansy ragwort	Manual removal/ digging; foliar herbicide treatment for fall regrowth	Manual removal/digging	Manual removal/ digging; foliar herbicide treatment (rosette stage)	Manual removal/ digging; foliar herbicide treatment; clip flower heads; biological control
teasel, common	Foliar herbicide treatments	Plants die back - no action	Manual removal/ digging; foliar herbicide treatment	Foliar herbicide treatment
white top, hairy	Foliar herbicide treatments	Plants die back - no action	Foliar herbicide treatments	Foliar herbicide treatments
wormwood, absinth	Mowing for sight distance and seed prevention; herbicide treatment - cut stump, basal bark	Mowing for sight distance; herbicide treatment - cut stump, basal bark	Manual removal/ digging; mowing for sight distance; herbicide treatment - foliar, cut stump, basal bark	Mowing for sight distance; herbicide treatment - foliar, cut stump, basal bark
Category 2 Weeds				
blackberry species	Foliar herbicide treatment; mowing for sight distance issue	Mowing for sight distance issues	Foliar herbicide treatment; mowing for sight distance issue	Foliar herbicide treatment; mowing for sight distance issue
broom, Scotch	Manual removal /digging; mowing for sight distance issues; cut stump treatment	Manual removal/ digging; mowing; cut stump treatment	Manual removal/ digging; cut stump and foliar herbicide treatment	Manual removal/ digging; cut stump and foliar herbicide treatment; clip flower heads; biological control
iris, yellow flag	Foliar herbicide treatment	Plants die back - no action	Foliar herbicide treatment	Foliar herbicide treatment
peavine, everlasting	Foliar herbicide treatments	Plants die back - no action	Foliar herbicide treatments	Foliar herbicide treatments
thistle, bull	Foliar herbicide treatment to rosettes	Plants die back - no action	Manual removal/ digging; foliar herbicide treatment	Manual removal/ digging; foliar herbicide treatment; clip flower heads
thistle, Canada	Foliar herbicide treatment	Plants die back - no action	Foliar herbicide treatment	Foliar herbicide treatment; clip flower heads

TASKS

Biological

- Identify release appropriate sites adjacent to County right-of-way.
- Coordinate with WSU Extension and the Noxious Weed Control Board for releases as they become available.
- Assist with research projects where possible.

Physical

- Create a contact list to be shared between departments.
- Coordinate mowing schedule with weed treatments to avoid incompatible treatments.
- Provide mowers with map of planned weed treatment areas.
- Clearly mark areas, communicate location to field crews.
- Schedule and oversee six weeks of chain gang time for large pulling projects.
- Support volunteer opportunities for weed pulling projects as appropriate.

- Create ***Report It!*** forms so that road crews can report weed infestations.
- Discourage mowing of desirable native vegetation wherever possible.
- Collaborate with mowing personnel to update mowing practices.
- Consult on road standards that maximize mowing effectiveness in regard to weed control.

Cultural

- Identify opportunities to use native plantings in the early stages of projects in the County's transportation plan
- Develop roadside environmental typing system.
- Compile list of plant material sources and needs from other government entities.
- Seek grant opportunities to implement pilot projects.
- Foster partnership with Olympic National Park Matt Albright Plant Material Center to requisition native plant augmentation suitable for roadside needs.
- Compile roadside appropriate list of native or desirable grasses, forbs, and shrubs from a literature search, WSDOT and Federal Highway system, and other entities with large right-of-way management responsibilities.
- Partner with experts from local, state and federal agencies and entities including but not limited to Clallam County Noxious Weed Control Board, Clallam County Parks, Washington State University Extension, WSU Master Gardeners, local chapters of Bee Keepers, the Native Plant and Audubon Societies, The Nature Conservancy, Conservation Districts, Olympic National Park, Olympic National Forest, USFW Marine Refuge System, Makah, Quileute, Lower Elwha Klallam, and Jamestown S'Klallam Tribes, and others who have an interest in developing local native seed and plant resources for use in government projects.
- Encourage landowners with "Owner Will Control" agreements to undertake adjacent roadside enhancements consistent with developing a low maintenance, self-sustaining plant community to prevent weed invasion. Include roadside appropriate list in "Owner Will Control" packet as it becomes available.

Preventative

- Develop rock and gravel source weed management protocols.
- Inventory, develop and implement weed management plans for all county quarries, storage areas, and spoil disposal sites.
- Adopt weed free material requirements for all county projects.
- Develop clean equipment standards and requirements for all county projects.
- Provide inspection services for all privately sourced material for county projects that may be weed-contaminated.
- Compile a list of sources that meet weed-free standards.
- Facilitate annual department weed and native plant identification training in cooperation with Weed Board staff. Supply field crew with identification booklets. Provide plant identification services for field crew in cooperation with Weed Board Staff.

Chemical

- Implement project list based on tables 6 and 7, control requests, and planned reduction of Category 2 weed sites.
- Complete treatment records.
- Enter data into Clallam County Noxious Weed Control Program (CCNWC) database.
- Monitor at least 10% of all treatments, retreat as needed and as resources allow.
- Conduct a weed inventory on at least 25% of all county roads annually.
- Identify, document, and map additional species, location, size, and density.
- Identify and compile a list of high priority infestations for following year. Create map.
- Identify and compile a list of sites for revegetation appropriate opportunities.
- Support four, volunteer-based projects either on or adjoining county property that protect county property from weed infestations. This may include monitoring, road-typing for revegetation, and revegetation projects.
- Compile locations and instructions for special management areas. Include and update field maps as frequently as needed.
- Promptly respond to all public inquiries. Address any public concerns regarding applications.
- Manage "Owner Will Control" agreements.
- Develop on-line self-serve, “Owner Will Control” application process and forms.
- Maintain current list and map of “Owner Will Control” locations for both the office and field use.
- Develop on-line, self serve, weed control request application process and forms.
- Develop on-line, ***Report It!*** process and forms.
- Compile annual report summarizing accomplishments, effectiveness, and recommendations for the subsequent year. Brief the Road Department and County Commissioners by December 31.
- Draft IRWM plan and submit to the Clallam County Noxious Weed Control Board and Road Department Supervisor for approval prior to the Weed Board’s first meeting of the year. At its first meeting, the Weed Board holds a public hearing to approve the annual County Noxious Weed Control List. Submission of the IRWM plan should occur 20 days before the meeting, and should be posted online and made available to the public upon request. Advertise the plan to allow the public to provide feedback. The finalized plan and a map of proposed treatment locations should be posted online and made available to the public upon request.

APPLICATION LOCATIONS

In 2015 Weed Board staff surveyed approximately 50% of county roads using a standard protocol. The work plan addresses treatment locations and proposed herbicide use in very specific details.

Table 6 and Table 7 list the roads proposed for herbicide treatment in the 2016 growing season for east, central, and west Clallam County. Table 6 includes roads which contain the worst infestations of four noxious weeds species, collectively knapweeds and knotweeds, which are required for control under state law (Category 1). These weeds have not been successfully controlled through mowing or other control practices. Adjacent roads, which are just beginning to be infested, may be included as well. A total of 3.4 acres comprised of these four weed species was specifically identified during a recent survey and is included for control in this table. Maps of these roads are presented in Appendix G. Additional category 1 or 2 weeds found on the roads listed in Table 6 or Table 7 may also be treated as time and resources allow. All other roads or locations containing Category 1 or Category 2 weeds will only be considered for inclusion in this year's work plan by request from an affected owner or entity or as an Early Detection Rapid Response (EDRR) to a newly discovered infestation of less than 100 square feet.

Table 6. Roads selected for herbicide treatment in 2016 by county location.

Road	Target Weed	Acres	Total Miles Surveyed	Comments
East Clallam County				
Palo Alto Rd.	Meadow knapweed	0.04	8.3	Burnt Hill is source of meadow knapweed on all vicinity roads. I patch teasel, 43 of tansy
Happy Valley Rd	Meadow knapweed Spotted knapweed	0.97 0.03	5.4	3 patches teasel, I patch of tansy
River Rd	Spotted knapweed Meadow knapweed	0.04 0.57	1.4	2 patches tansy
Johnson Cr. Rd.	Meadow knapweed	0.11	0.75	
Easterly Rd.	Meadow knapweed	0.01	0.25	
W. Washington St.	Spotted knapweed	0.10	1.0	Likely source on vicinity roads. 2 patches of poison hemlock,
Subtotals: 6 roads	**2 weed species**	**1.87**	**17.1**	
Central Clallam County				
Olympic Hot Springs Rd	Meadow knapweed	0.460	3.4	Source of vicinity infestations. I patch herb Robert
Little River Rd.	Meadow knapweed	0.330	3.8	
Black Diamond Rd.	Meadow knapweed	0.015	4.6	1 patch herb Robert
W. Lauridsen Blvd.	Meadow knapweed	0.080	0.9	
W. Edgewood Dr.	Meadow knapweed	0.090	1.7	I patch tansy
Lower Elwha Rd.	Meadow knapweed	0.002	2.4	
Laird Rd.	Meadow knapweed	0.003	0.4	
W. Lyre River Rd.	Meadow knapweed	0.190	1.3	Likely source of vicinity infestation
E Lyre River Rd.	Meadow knapweed	0.040	1.4	3 patches herb Robert
Gossett Rd.	Meadow knapweed	0.004	1.4	
Farrington Rd.	Meadow knapweed	0.006	0.8	3 patches of tansy

Road	Target Weed	Acres	Total Miles Surveyed	Comments
Whiskey Creek Beach Rd.	Meadow knapweed	0.004	0.9	5 patches of tansy
E. Beach Rd.	Meadow knapweed	0.300	0.6	
Fisher Cover Rd.	Meadow knapweed	0.040	0.7	
Sub totals:14 roads	**I weed species**	**1.56**	**24.3**	
West Clallam County				
W Lake Pleasant Rd.	Bohemian/Giant knotweed	0.002	1.00	
Charlie Creek Rd.	Bohemian knotweed	0.002	0.25	
Hoko-Ozette Rd	Bohemian knotweed	0.008	18.00	tansy ragwort, Scotch broom increasing
Sub totals: 3 roads	**2 weed species**	**0.012**	**19.3**	
Totals: 23 roads	**4 weed species**	**3.44 ac**	**60.7 miles**	

In 2015 a group of WSU Master Gardeners (MG) conducted windshield surveys encompassing approximately 26 miles of Old Olympic Highway and selected adjacent roads (Table 7). The purpose of the survey was to establish a baseline distribution of Scotch broom, Canada thistle, and bull thistle. If treatments are approved in this demonstration area, the group pledged to intensely monitor treatment results.

Master Gardener survey protocols differed from the Weed Board's; measuring gross distribution in road segments, not square feet. The MGs kept paper records documenting locations and other information which were later transferred to a GIS layer. Additional species and infestation (square feet) where Weed Board roadside surveys over lapped have been included in Table 7.

- Patch lengths come from MG surveys
- Patch size comes from Weed Board surveys
- 'Number patches' is number of times a patch of each weed species was noted on that road. Appendix H contains all roadside weed locations documented in 2015 surveys.

Table 7. Thistle-Scotch broom demonstration project conducted by Master Gardeners.

Road	Weeds	Patch length (ft)	Patch size (ft^2)	# Patches	Miles Surveyed
Cameron Road	Canada thistle tansy ragwort	 30	 45	2 1	1.8
Cays Road	Bohemian knotweed Canada thistle Scotch broom	 70 5	90	2 3 6	2.8
Finn Hall Road	bull thistle Canada thistle	751 4,054		8 11	2.5
Gehrke Road	Canada thistle Scotch broom	140 30		2 1	0.9
Gunn Road	Scotch broom			1	0.9
Heuslein Road	bull thistle Canada thistle	 70		5 9	1.4

Road	Weeds	Patch length (ft)	Patch size ($ft^{2)}$	# Patches	Miles Surveyed
Kitchen-Dick Road	bull thistle			2	3.2
	Canada thistle	150		6	
	teasel		298	7	
	meadow knapweed		1	1	
	Scotch broom			1	
	spotted knapweed		153	3	
Lewis Road	bull thistle			4	1.1
	Canada thistle			4	
	Scotch broom			1	
Matson Road	bull thistle	10		1	0.5
	Canada thistle	2108		6	
	Scotch broom	300		1	
Old Olympic Highway	bull thistle			7	5.9
	Canada thistle	75		13	
	field bindweed		250	1	
	meadow knapweed		13	2	
	Scotch broom			3	
	spotted knapweed	50	5	2	
Shore Road	bull thistle			1	0.9
	Canada thistle			3	
Spring Road	bull thistle			2	0.6
	Canada thistle			2	
Vautier Road	Canada thistle			2	0.6
	Scotch broom	200		1	
	spotted knapweed			1	
Woodcock Road	bull thistle	50		5	3.2
	Canada thistle	130		14	
	meadow knapweed			2	
	poison hemlock		1	5	
	Scotch broom	200	1,480	4	
Totals: 14 roads	**9 weed species**	**8,318 ft.**	**2,246 ft^2 0.05 acre**	**158 patches**	**26.2 miles**

APPENDICES

Appendix A Chapter _____ Clallam County Code

Appendix B Non target Impacts and Risk Assessment

Appendix C Sample Record keeping forms

Appendix D Sample Press Release and Public Notice

Appendix E Sample Herbicide Notice

Appendix F Sample Owner Will Control Packet-Draft

Appendix G Roadside weed life cycle, growth form, category and status

Appendix H Focus area maps of target roads

Appendix I Known roadside weed locations

Appendix J References

Appendix A Chapter _____ Clallam County Code

Still Under Consideration At This Time

Appendix B Non-Target Impacts and Risk Assessment

Not only must a roadside weed control strategy be effective and efficient, but it must consider potential adverse impacts to non-target plant and animal species and include measures to mitigate those impacts to the greatest extent possible.

Any potential impacts to humans, pets, livestock, wildlife, desirable plants and the environment from noxious weed and invasive plant removal on roadsides are of concern to the project managers. Every control method has benefits and costs. For example the disturbance caused by workers and mowing or excavation equipment which allows weeds to proliferate can be more significant than impacts from herbicides. Hand removal may result in trampling and soil disturbance. Although all control methods pose some level of risk, potential risks associated with herbicide will receive the greatest scrutiny. Best management practices that reduce or mitigate potential herbicide impacts to non-target organisms will be incorporated into all aspects of the work plan.

Important background information regarding the types of animals that may be impacted by noxious weed and invasive plant control in a roadside setting has been synthesized from the California Invasives Species Council (Cal-IPC) 2015 manual titled, *Best Management Practices for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management* and presented below. The full document is available at www.cal-ipc.org. Such information is vital to making informed decisions on ways to mitigate or avert potential effects where possible; especially when making control choices in regard to herbicide selection, application methods and timing. Although the Cal-IPC manual's focus is on wildlands, many of the same types of animals may be found living near if not on, county roadsides and should therefore be considered.

Organisms that are endangered or under threat of becoming endangered receive special protection under The Endangered Species Act. An Information for Planning and Conservation (IPaC) Trust Resource report of threatened and endangered plant and animal species found in Clallam County was provided by the US Fish and Wildlife Service. These species are included in Table 8.

Insects

Insects are a diverse class of animals that are part of the food web on which many vertebrate species depend. Butterflies, bees, wasps and even mosquitoes pollinate plants that then provide fruits and seeds for other animals. Flies and beetles eat rotting debris, which helps recycle nutrients in the ecosystem. Aphids and many other soft-bodied insects suck the juices of plants and are themselves a high-protein food for other insects, reptiles, amphibians, birds and mammals.

Most insects are so small and so intimately connected to vegetation that it is difficult to avoid spraying them directly, along with the invasive plants being treated. Honeybees are routinely tested for sensitivity to herbicides and are broadly representative of other insects. While most herbicide active ingredients used in wildland weed management pose very low toxicological risks to invertebrate species, some of the inert ingredients in formulated herbicide products may pose a greater risk. For example, some oil-based emulsifiable concentrate formulations may be harmful to soft-bodied adult or larval insects like aphids or caterpillars. The Taylor's checkerspot butterfly is the only endangered insect listed in Clallam County. No roadside habitat for the Taylor's checkerspot butterfly has been identified.

Reptiles and Amphibians

Lizards, snakes, turtles, frogs, newts and salamanders are frequently residents of areas where invasive plant management is planned. These species can be exposed to herbicides through direct sprays and

spray drift, and through consuming herbicide-contaminated water, prey, or plants. Amphibians may be especially vulnerable, since they spend a portion of their life cycle as aquatic organisms and often only need small puddles or seasonal streams for growth. The inert ingredients in a formulated herbicide product may be as important to evaluate as the active ingredient in terms of the risk they pose to amphibians. No endangered or threatened reptiles or amphibians have been identified in Clallam County.

Fish and Aquatic Invertebrates

Fish and aquatic invertebrates are often more sensitive to herbicides than terrestrial animals because of their physiology or the increased exposure potential that may result from herbicide movement into aquatic sites. Aquatic species can be exposed to herbicides through direct spray, spray drift, spills or surface runoff. Though few commonly-used herbicide active ingredients are highly acutely toxic to aquatic organisms, toxic effects can result from the exposure to other ingredients in formulated products, such as surfactants. With the current suite of herbicides typically used in invasive plant management, bioaccumulation of herbicides in fish tissue is not a problem, since these herbicides are typically metabolized and/or excreted fairly quickly. A number of fish species (salmonids and trout) found in Clallam County are listed as threatened or endangered and many creeks and rivers are the subject of habitat restoration projects intended to help restore these stocks to healthy population levels.

Mammals

Deer, coyotes, mountain lions, wood rats, gophers, and mice are just a few of the mammals that may populate or feed on animals that populate typical roadsides. Pets, such as dogs and cats, with their owners or wandering freely, might be exposed in a more limited manner. Animals may be exposed to herbicides through contaminated food or water, as well as direct sprays, spray drift, and contact with treated vegetation. The toxicity of herbicides to mammals has been better studied than for most other species because they are used as surrogates for human toxicity assessments. Studies on mammals allow for evaluation of a wide variety of parameters, including reproductive, developmental, and neurological effects in exposed populations, as well as effects on blood chemistry, organ weights, and body weight gain or loss.

The most abundant mammals on a typical roadside area are rodents. They are small enough and abundant enough that they may be directly sprayed or exposed to drift during an herbicide application, particularly with ground spray equipment.

Deer and other herbivores may browse on treated vegetation. Once the vegetation is dead, it becomes less attractive to eat; however, in situations where a selective herbicide is used that kills only broadleaf plants or only grass plants, the treated, but unaffected plant species may pose a dietary exposure risk.

Fishers, while not currently listed as an endangered species, have received special management consideration and have been reintroduced into Clallam County in Olympic National Park. No county roadside habitat has been identified.

Birds

Potentially impacted birds include large carnivorous birds like hawks or ospreys, herbivorous species like geese and ducks, small insectivorous birds, and small fruit and seed-eating birds. All of these species can be exposed to herbicides through their food and drinking water. The highest risks are typically for birds eating sprayed vegetation since that is often the target of the application, and the

likelihood of being exposed is higher than for those species eating contaminated prey. In general, the herbicides used to control invasive plants do not pose significant acute toxicity risks to birds when used under typical use scenarios; however, less is known about chronic and reproductive effects. To minimize risk, applications during nesting season should be avoided if possible. Several federally listed bird species are found in Clallam County, but there are no habitat listings for county right-of-way.

Plants

All types of plants may be affected by weed control activities. Because herbicides are designed to kill plants, an applicator's ability to distinguish desirable plants from weeds is critical. Certain native plant species are protected under state or federal laws. The most current data set (as a GIS shapefile) was obtained from the Natural Heritage Program which is managed by the Washington State Department of Natural Resources. It contained general locational information of rare, threatened and endangered plant species. It was reviewed for species and sites that warrant special management consideration on Clallam County roadsides. Pink fawn lily, which is noted as sensitive (a non regulatory status) was found in the vicinity of six county roadsides. No noxious weed infestations have yet been documented in close proximity to these pink fawn lily sites, but all shall be noted and continue to be under special consideration. Whitebark pine which is a candidate for federal listing is known to exist in Clallam County, but no sites have been identified on county right of way. No rare, endangered or threatened species were identified on county roadsides in the DNR Natural Heritage Program dataset.

Table 8. Species in Clallam County with potential for special management consideration

Common Name	Populations Present /Habitat	Population Identified on County Roadside?	Listing Status
PLANT			
Pink fawn lily	Yes	In vicinity of Walgren Rd, Grant Rd,Pavel Rd, River Breeze Wy, W. Lake Pleasant Rd, Hoko-Ozette Rd.	State-Sensitive, (non regulatory)
Whitebark pine	Yes	none	Fed Candidate
BIRD			
Streaked Horned Lark	Yes	none	Fed-Threatened
Marbled murrelet	Yes/plus habitat overlap	none	Fed-Threatened
Northern spotted owl	Yes/plus habitat overlap	none	Fed-Threatened
Short-tailed Albatross	Yes	none	Fed-Endangered
Yellow-billed Cuckoo	Yes	none	Fed-Threatened
FISH			
Bull Trout	Yes/plus habitat overlap	Indirect	Fed-Threatened
Dolly Vardon	Yes	Indirect	Fed-Threatened
INSECT			
Taylor's checkerspot butterfly	Yes-FS, private, ONP, DNR/ plus habitat overlap	None-possible potential habitat?	Fed-Endangered
MAMMAL			
Fisher	Yes, reintroduced in ONP	None	Fed-Threatened
HABITAT OVERLAP ONLY			
Chinook	Habitat designation	Indirect	Threatened
Chum	Habitat designation	Indirect	
Sockeye	Habitat designation	Indirect	
Killer whale	Habitat designation	Indirect	

Risk Charts

The herbicide risk charts, tables, and text that follow have been reproduced with permission from the publication: Cal-IPC. 2015 *Best Management Practices for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management.* Cal-IPC Publication 2015-1. California Invasive Plant Council, Berkeley, CA. The charts include the most common herbicides used by wildland managers for invasive plant management and include those chosen for use on Clallam County roadsides (see Table 2). Fluazifop, which would be allowed for use under this plan, was not included in the Cal-IPC risk charts because the data needed to conduct the analysis was not available at the time the risk charts were completed.

Wildlife

The risk charts provide information on the comparative risk of each herbicide to each type of wildlife from selected exposure scenarios. A summary of the methods used to generate these charts follows, and refers the reader to the primary sources for more detail. Each chart summarizes potential risk for a specific exposure scenario and is based on a risk assessment model developed by the USFS. See the spreadsheet of calculations on the PRI website for detailed information on risk charts. Using the spreadsheet, you can modify application rates to assess changes in risk profiles. It is important to note that many of the scenarios are “worst case” and do not represent typical real-world situations. The assumptions for each scenario, with a description about how they relate to typical real-world situations are listed on the risk charts.

Risks that fall outside an acceptable zone should prompt the land manager to consider steps to mitigate the risk.

Risk to Wildlife Depends on Both Toxicity and Exposure

Risks to wildlife are dependent on the herbicide’s toxicity to that particular taxonomic group and the animal’s exposure to the herbicide. Toxicity is described using Toxicity Reference Values (TRVs), which represent the dose of herbicide generally assumed to be without adverse effects. Lower TRVs indicate a more toxic herbicide for the particular taxonomic group. The TRVs used to develop the risk charts for the different wildlife taxa are summarized in below.

An important determinant of exposure is the herbicide application rate. For the risk charts, the application rates were set to half of the maximum application rate as indicated on the herbicide’s product label. This “half- max” application rate was used to better approximate typical wildland herbicide applications. For example, invasive plant management typically involves portions of acres to be spot treated, but not entire acres. Alternatively, entire acres might be treated via broadcast spray, but at rates below maximum allowable rates. Since application rate is directly proportional to risk, the risk values at maximum application rates would simply be twice the values shown in the charts (likewise, lower rates would have proportionally less risk)—with the exception of spills, where application rate is not relevant. Table 9 provides the application rates used to estimate exposure for each herbicide in terms of pounds of the active ingredient (or the acid equivalent of the active ingredient) and the equivalent rate per acre for the formulated product.

While hazard assessment for most chemicals typically involves investigating the relationship between increasing exposure and increasing observed adverse effects in laboratory studies, some chemicals may have the potential to cause impacts at very low doses.
Examples of this are the endocrine disrupting chemicals (EDCs), which can interfere with an animal's endocrine (hormone) system, potentially at very low exposure levels. Certain chemicals such as the plasticizers found in plastic bottles are suspected to be EDCs. At the present time, there is no evidence that any of the herbicide active ingredients used in invasive weed control are EDCs. The US EPA studied glyphosate and 2,4-D through their Endocrine Disruptor Screening Program and determined that no convincing evidence exists that either substance disrupts estrogen, androgen, or thyroid pathways. Studies have not been conducted for the other herbicides discussed in this manual, but none are on the European Union list of suspected endocrine disruptors.

Hazard Quotients Defined

The Hazard Quotient (HQ) is a measure of risk and is defined as the ratio of the predicted exposure to a Toxicity Reference Value (TRV) for the particular type of wildlife being assessed. HQ values >1 indicate that exposure exceeds the "No Effect" level, and wildlife may be at risk of adverse effects. For these exposure scenarios, action should be taken by the land manager to reduce exposure.

Table 9: Half-Maximum Application Rates Used in Risk Charts

Herbicide Active Ingredient	Half-Max Application Rate (lbs AE or AI per acre)	Half-Max Application Rate (rate per acre)
Aminopyralid	0.055	3.5 oz of Milestone®/acre
Chlorsulfuron	0.061	1.5 oz of Telar®/acre
Clopyralid	0.125	0.335 pints Transline®/acre
Glyphosate	4.0	3.5 quarts RoundupProMax®/acre (with surfactant) 4 quarts Aquamaster®/acre (no surfactant)
Imazapyr	0.75	3 pts Habitat®/acre
Triclopyr BEE	4.0	4 quarts Garlon 4®/acre
Triclopyr TEA	4.5	1.5 gals Garlon 3®/acre
2,4-D	2.0	4 pts Weedar®/acre

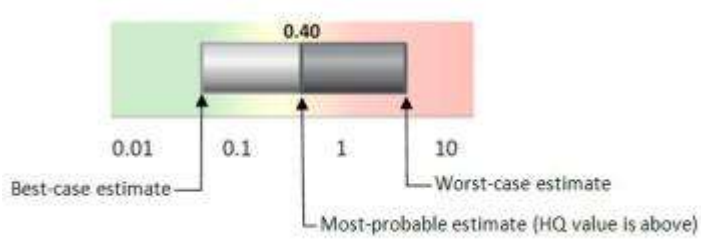
AE = Acid Equivalent; AI = Active Ingredient.

**Fluazifop (Fusilade®) is the one widely-used active ingredient not included in the risk charts because USFS risk analysis was completed after the risk charts were developed*

How to Read the Risk Charts

In the risk charts that follow, risk is expressed as a Hazard Quotient (HQ), which is the ratio of the predicted exposure to a Toxicity Reference Value (TRV), a level of exposure that is anticipated to be without adverse effects.

Each bar on the chart shows a range of estimated risk for a specific exposure scenario based on three estimates of exposure—best-case (low exposure), most-probable (the most likely exposure), and worst-case (high exposure). Each estimate is based on a set of assumptions, such as the amount of herbicide residue on food (such as foliage, fruits, and insects) and the amount of food eaten or the amount of runoff into a water body. Factors used to estimate exposure specific to each scenario are listed in the caption for each chart.



The **best-case risk estimate** is at the left end of each bar and assumes the lowest exposure. The **most-probable risk estimate** (HQ=0.40 in the example above) is located at the point at which the bar changes color from light gray to dark gray, and assumes the most likely exposure. The **worst-case risk estimate** is at the right end of the bar and assumes worst-case exposures.

The background of each risk chart is color-coded, with a HQ in the green zone indicating low risk, an HQ in the yellow zone indicating that anticipated exposures are approaching a level of concern, and an HQ in the red zone indicating that the predicted exposure will exceed the TRV, and adverse effects may result. Because wildlife TRVs are derived from No Observable Adverse Effect Levels (NOAELs), a bar in the red zone does not necessarily mean that harm will occur, but risks that fall in this zone should prompt the land manager to consider steps to mitigate the risk. The further the bar is into the red zone, the more likely it is that adverse effects will occur. The BMPs in Section 3 describe steps that can be taken to reduce risks when HQ values risk calculations exceed a level of concern.

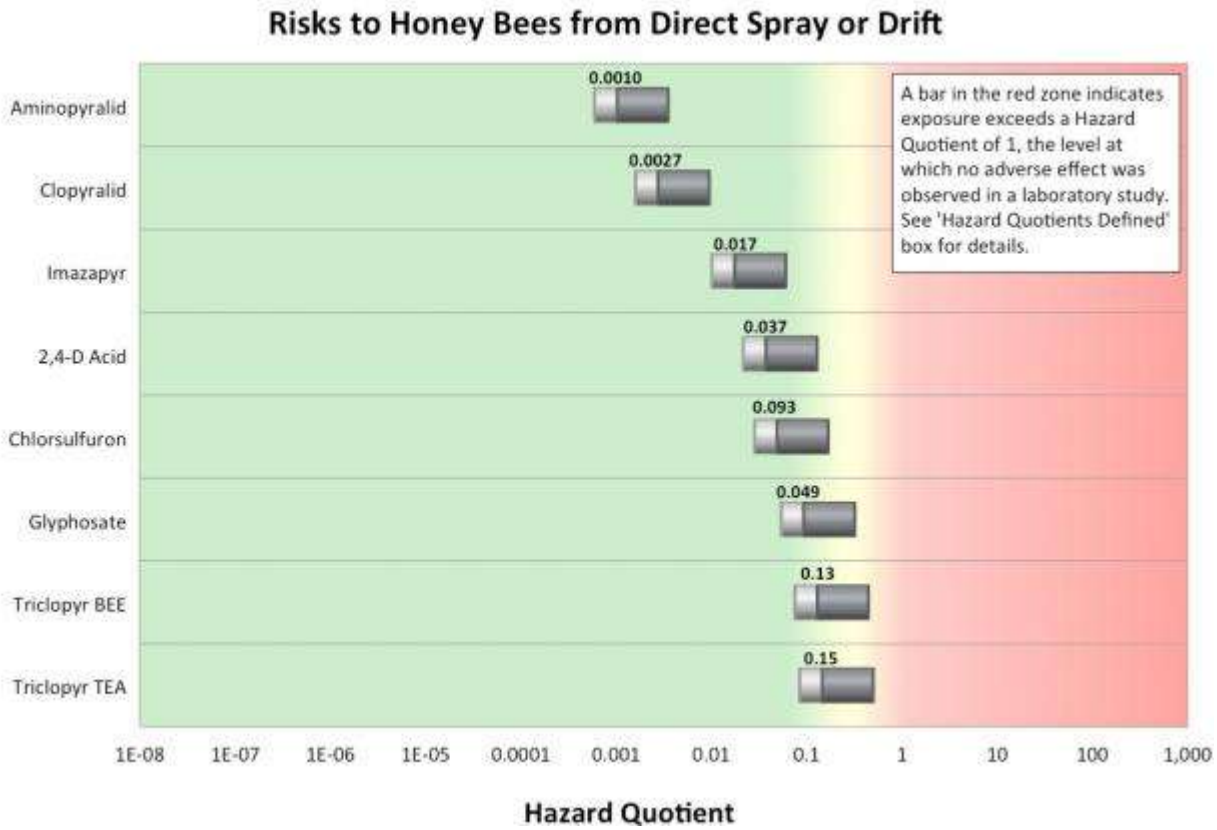
The scale of the charts is logarithmic, which allows for the display of values that differ by many factors of ten. The logarithmic scale also visually compresses the bars and skews plots slightly to the right—for example, a HQ value of 0.5 is not exactly in the middle between 0.1 and 1, but slightly to the right of the halfway point.

Overview of Risks to Wildlife from Use of Common Herbicides

Overall, the risk estimates shown in the charts demonstrate that for the majority of the most-probable acute exposure scenarios, the herbicides pose low risks to wildlife. An exception to this involves fish and aquatic invertebrates exposed to glyphosate formulations that contain certain higher-toxicity surfactants such as polyethyleneamine (POEA). These products cannot be legally applied directly to water, and applicators should also use caution when making applications near aquatic sites, such as ephemeral pools that may be used as breeding areas for amphibians and insects. Using glyphosate products that do not contain POEA in these settings can reduce the potential for impacts.

A second example of risks that may exceed the level of concern under the most-probable exposure scenarios involves products that contain either triclopyr BEE or triclopyr TEA. In these cases, the HQ values can exceed the level of concern for chronic exposure scenarios when large, herbivorous mammals consume vegetation that contains residues of these herbicides.

With regard to the worst-case (highest) exposure level scenarios, 2,4-D acid, glyphosate/surfactant combinations and triclopyr BEE and TEA can all pose risks that exceed the level of concern. These scenarios include both acute and chronic exposures for aquatic invertebrates, fish, mammals and birds.



Taxa: Adult stage honey bees are used as a surrogate for all terrestrial insects.

Assumptions: Terrestrial application of herbicide at half of the maximum rate on a representative product's label (see Table 9); 50% of the bee's body surface is covered with herbicide; 100% of herbicide is absorbed; the distance between the bee and the sprayer is 0-10 feet.

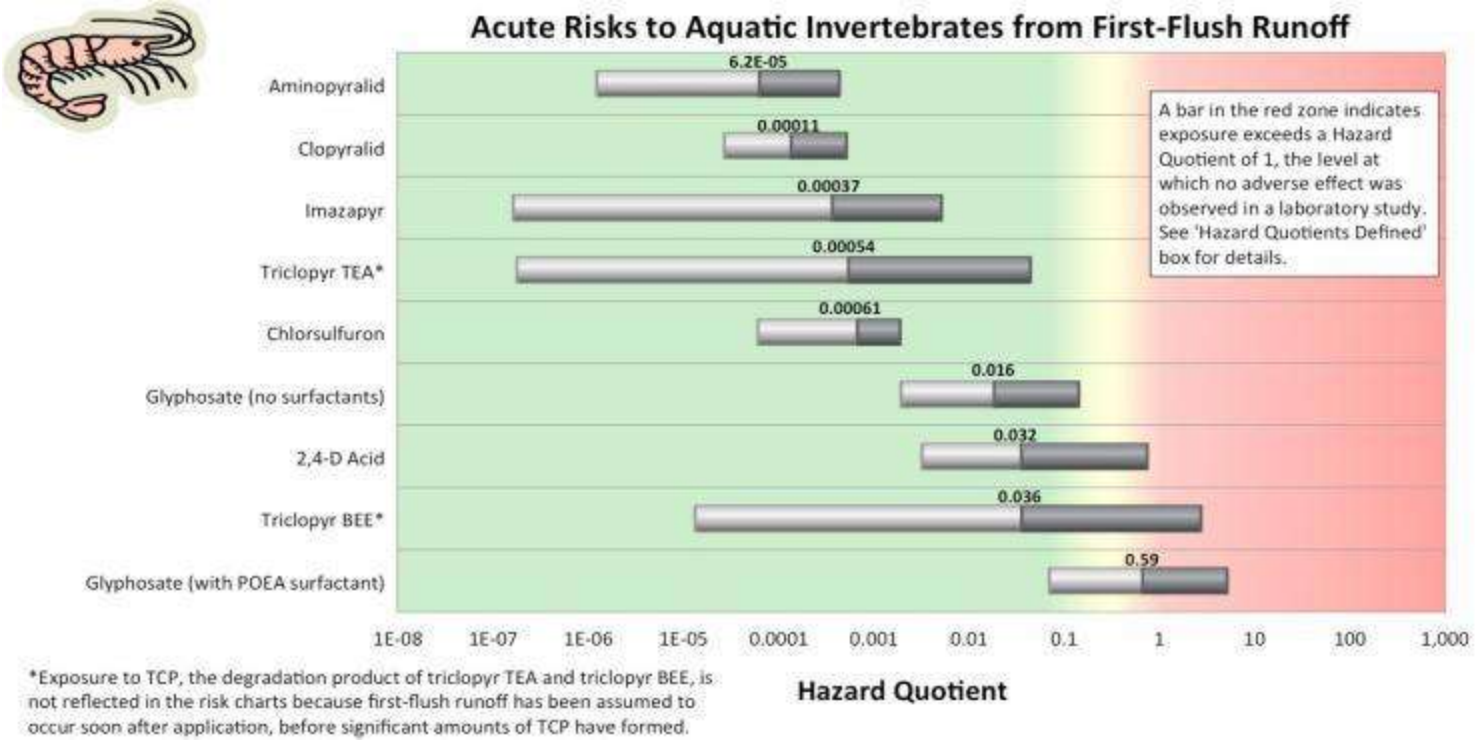
Likelihood: Most likely with spray-to-wet applications on blooming plants or those with extrafloral nectaries.

Mitigation: Do not apply to blooming plants. Apply early in the morning or close to sunset when insects are less active. Use low-volume applications and reduce the amount applied per acre.

Risk calculated as a function of: The inherent toxicity of the herbicide to honey bees; the amount of active ingredient sprayed; and the distance between bee and applicator. Risks in this chart do not account for potential toxicity of any surfactants that are part of the product formulation or added to spray mixtures.

Methodology and sources: See description following risk charts and PRI website, where you can access a spreadsheet for adjusting application rates and other variables.

Reading the chart: For each bar, the labeled central value is the most likely estimate. The right end of the bar assumes worst-case conditions for all underlying variables; the left end of the bar assumes best-case conditions. Mitigation is advised if risk enters the red zone.



Taxa: Aquatic invertebrates.

Assumptions: Terrestrial application of herbicide at half of the maximum rate on a representative product's label (see Table 9); 10-acre treatment with no buffer zone between treatment area and water body.

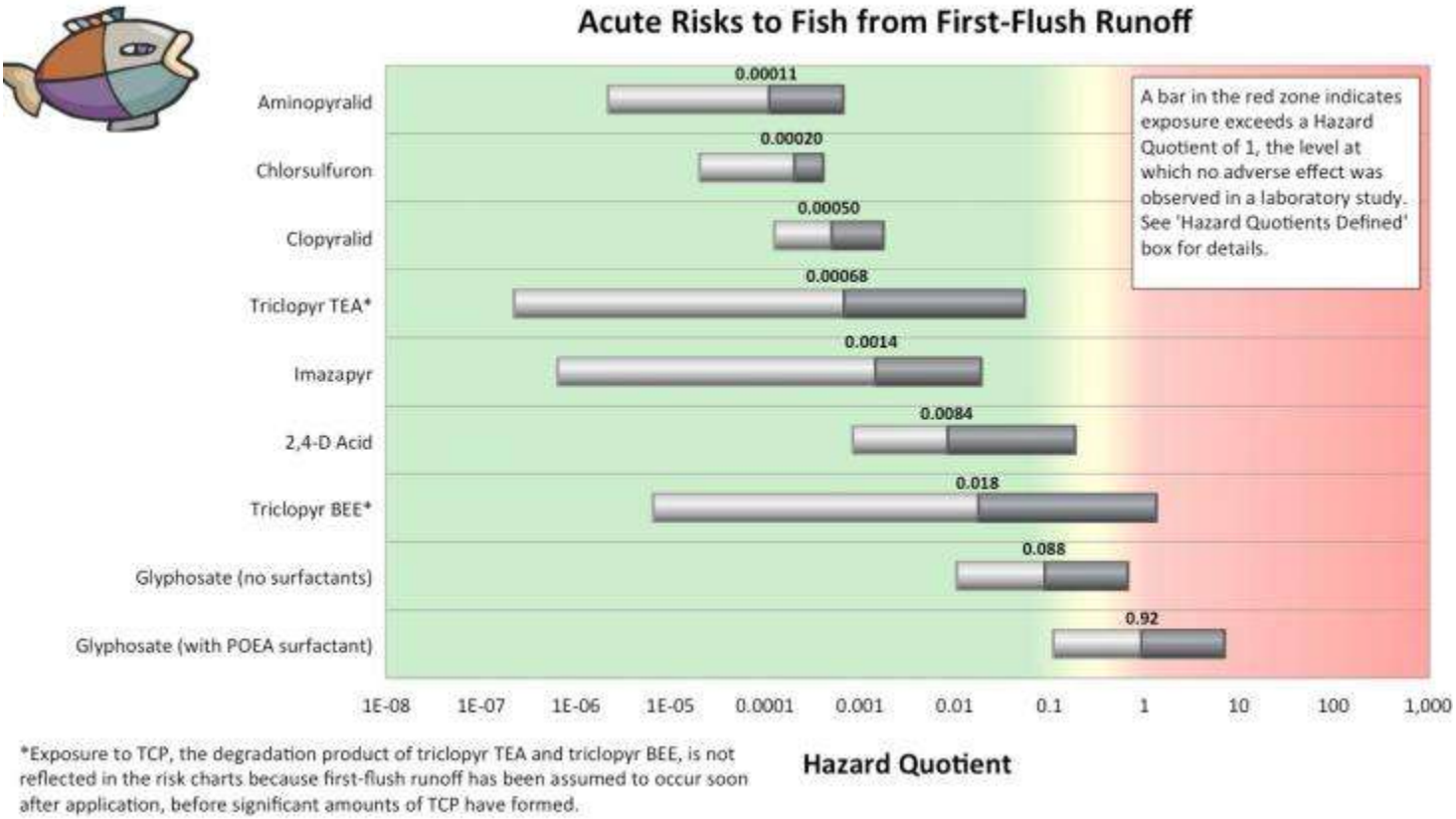
Likelihood: Buffer zones may be required on some water ways and are common practice when using herbicides not approved for aquatic use. Dry season applications can result in long intervals before a rain event, resulting in lower residues for runoff.

Mitigation: Use low-volume applications and reduce the amount applied per acre. Use buffer zones (see Bakke (2001) to help gauge effective buffer distances). Make applications during the dry season to avoid runoff. For applications near waterways, consider using herbicide formulations intended for use in aquatic systems.

Risk calculated as a function of: The inherent acute toxicity of the herbicide to aquatic invertebrates; herbicide characteristics that affect transport through soil to water (water solubility, ability to adsorb to soil); soil type; and the application rate. Herbicide degradation is not considered, as the estimate is for runoff occurring soon after the application. Except for glyphosate with the POEA surfactant, risks in this chart do not account for potential toxicity of any surfactants that are part of the product formulation or added to spray mixtures.

Methodology and sources: See description following risk charts and PRI website where you can access a spreadsheet for adjusting application rates and other variables.

Reading the chart: For each bar, the labeled central value is the most likely estimate. The right end of the bar assumes worst-case conditions for all underlying variables; the left end of the bar assumes best-case conditions. Mitigation is advised if risk enters the red zone.



Taxa: Fish are also used as a surrogate for amphibians.

Assumptions: Terrestrial application of herbicide at half of the maximum rate on a representative product's label (see Table 9); 10-acre treatment with no buffer zone between treatment area and water body; rain within 24 hours of application.

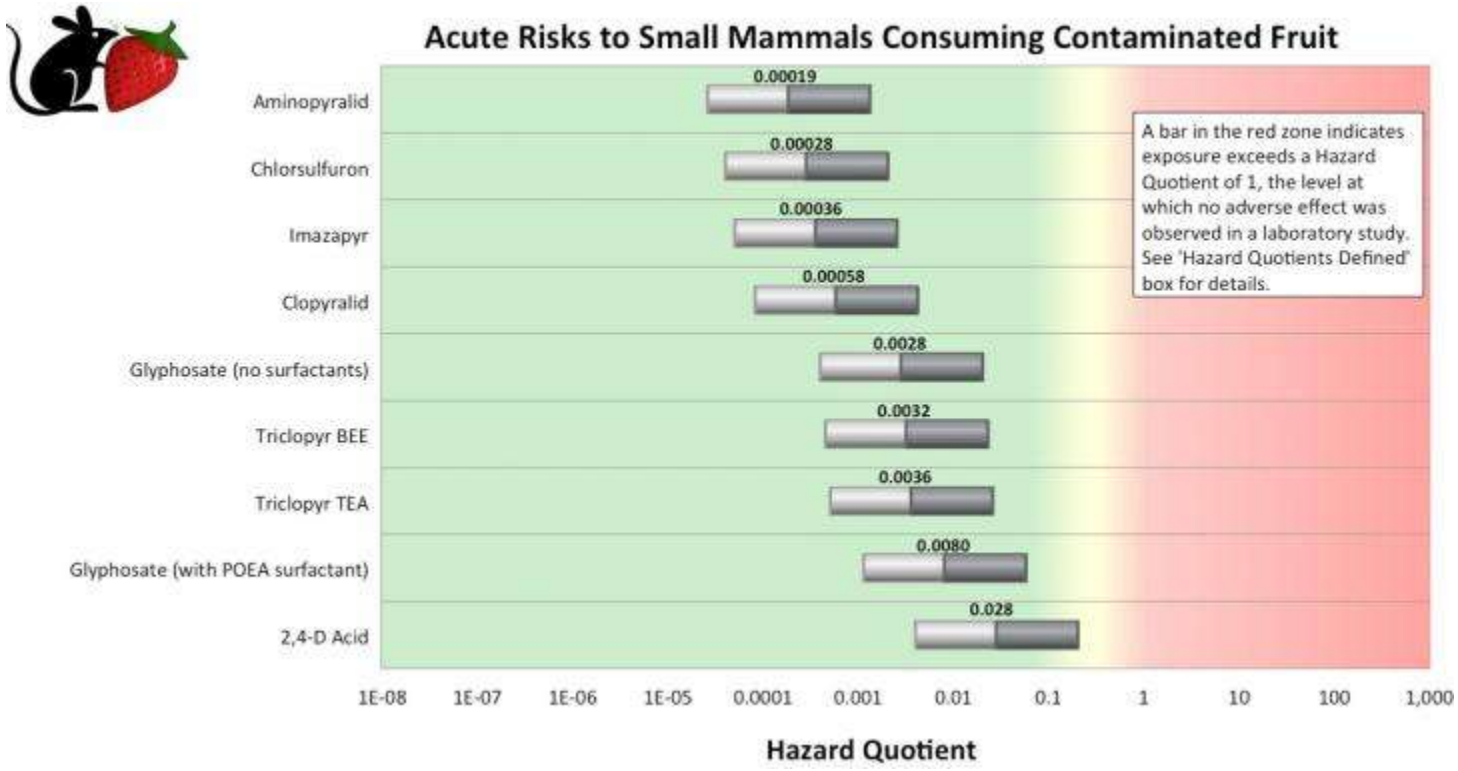
Likelihood: Buffer zones may be required on many water ways and are common practice when using herbicides not approved for aquatic use. Dry season applications in California will result in a long interval before a rain event, resulting in lower residues for runoff.

Mitigation: Use low-volume applications and reduce the amount applied per acre. Use buffer zones (see Bakke (2001) to help gauge effective buffer distances). Make applications during the dry season to avoid runoff. For applications near waterways, consider using herbicide formulations intended for use in aquatic systems.

Risk calculated as a function of: The inherent acute toxicity of the herbicide to fish; herbicide characteristics that affect transport through soil to water (water solubility, ability to adsorb to soil); soil type; and the application rate. Herbicide degradation is not considered, as the estimate is for runoff occurring soon after the application. Except for glyphosate with the POEA surfactant, risks in this chart do not account for potential toxicity of any surfactants that are part of the product formulation or added to spray mixtures.

Methodology and sources: See description following risk charts and go to PRI website where you can access a spreadsheet for adjusting application rates and other variables.

Reading the chart: For each bar, the labeled central value is the most likely estimate. The right end of the bar assumes worst-case conditions for all underlying variables; the left end of the bar assumes best-case conditions. Mitigation is advised if risk enters the red zone.



Taxa: Small mammals.

Assumptions: Terrestrial application of herbicide at half of the maximum rate on a representative product's label (see Table 9); 10-100% of diet is contaminated.

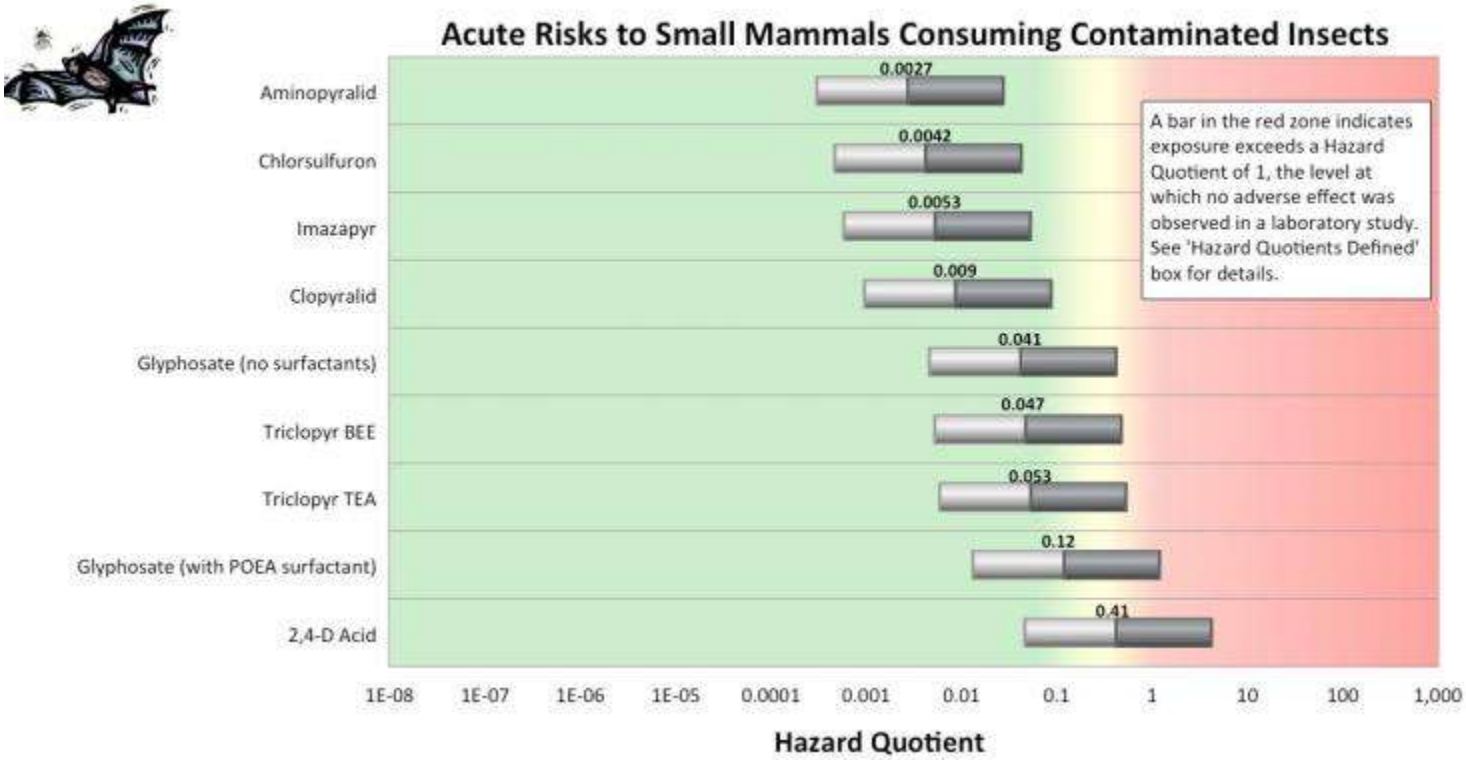
Likelihood: Under spot applications it is possible that a significant portion of a small mammal's diet could be contaminated. With broadcast applications over any sizable area (unusual for wildland management) contamination is likely for some small mammals.

Mitigation: Use low-volume application and reduce the amount applied per acre. If possible, don't treat large contiguous areas all at once. Avoid contamination of plants used as food sources by small mammals.

Risk calculated as a function of: The inherent acute toxicity of the herbicide to mammals; the residue rate of herbicide on fruit (which is proportional to the application rate). Except for glyphosate with the POEA surfactant, risks in this chart do not account for potential toxicity of any surfactants that are part of the product formulation or added to spray mixtures.

Methodology and sources: See description following risk charts and go to PRI website, where you can access a spreadsheet for adjusting application rates and other variables.

Reading the chart: For each bar, the labeled central value is the most likely estimate. The right end of the bar assumes worst-case conditions for all underlying variables; the left end of the bar assumes best-case conditions. Mitigation is advised if risk enters the red zone.



Taxa: Small mammals.

Assumptions: Terrestrial application of herbicide at half of the maximum rate on a representative product's label (see Table 9); 10-100% of diet is contaminated.

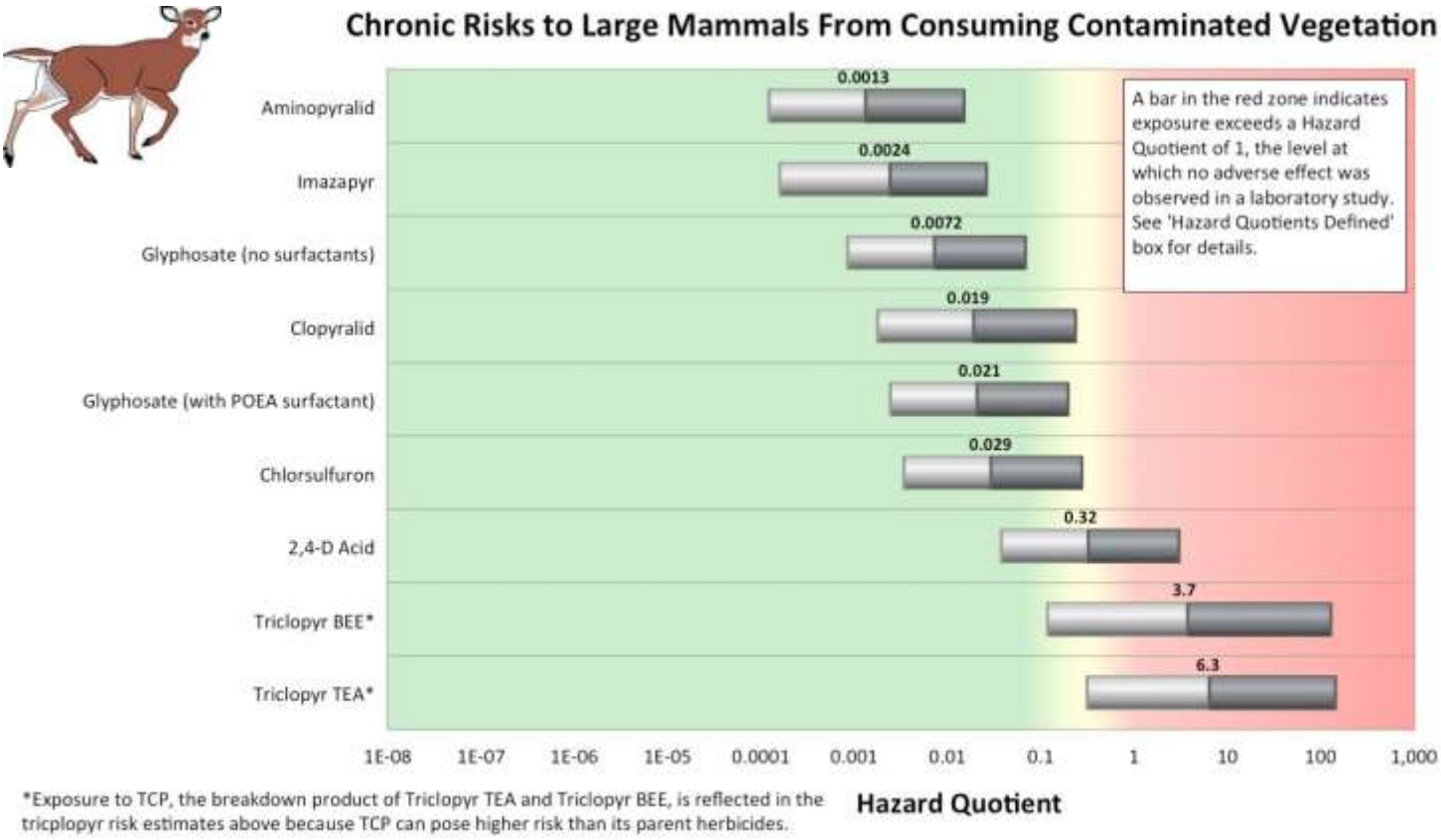
Likelihood: Under spot applications it is unlikely that a significant portion of a small mammal's insect-based diet could be contaminated. With broadcast applications over any sizable area (unusual for wildland management) contamination is possible for some small mammals.

Mitigation: Use low-volume applications and reduce the amount applied per acre. If possible, don't treat large contiguous areas all at once. Avoid treating plants when feeding by insects is likely, if known.

Risk calculated as a function of: The inherent acute toxicity of the herbicide to mammals; the residue rate of herbicide on insects (which is proportional to the application rate). Except for glyphosate with the POEA surfactant, risks in this chart do not account for potential toxicity of any surfactants that are part of the product formulation or added to spray mixtures.

Methodology and sources: See description following risk charts and go to PRI website, where you can access a spreadsheet for adjusting application rates and other variables.

Reading the chart: For each bar, the labeled central value is the most likely estimate. The right end of the bar assumes worst-case conditions for all underlying variables; the left end of the bar assumes best-case conditions. Mitigation is advised if risk enters the red zone.



Taxa: Large mammals.

Assumptions: Terrestrial application of herbicide at half of the maximum rate on a representative product's label (see Table 9); 10-100% of diet is contaminated for several months.

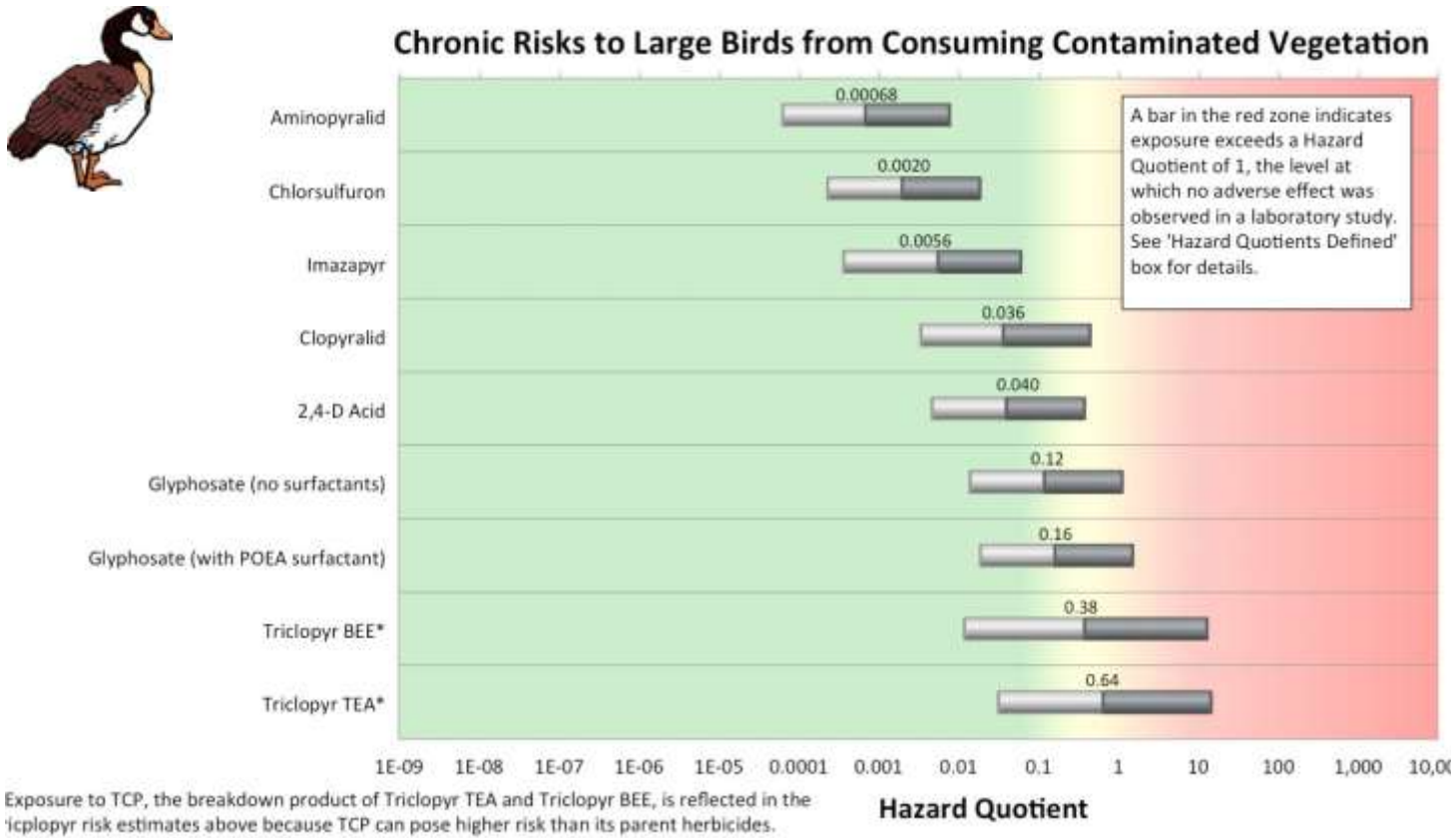
Likelihood: Under spot applications it is unlikely that a significant portion of any large mammal's diet would be contaminated. With broadcast applications over any sizable area (unusual for wildland management) consider the feeding range of the wildlife relative to the treatment area.

Mitigation: Use low-volume applications and reduce the amount applied per acre. If possible, don't treat large contiguous areas all at once. Avoid contamination of plants known to be used as food sources by large mammals.

Risk calculated as a function of: The inherent chronic toxicity of the herbicide to mammals; the residue rate of herbicide on vegetation (proportional to the application rate). Except for glyphosate with the POEA surfactant, risks in this chart do not account for potential toxicity of any surfactants that are part of the product formulation or added to spray mixtures.

Methodology and sources: See description following risk charts and go to PRI website, where you can access a spreadsheet for adjusting application rates and other variables.

Reading the chart: For each bar, the labeled central value is the most likely estimate. The right end of the bar assumes worst-case conditions for all underlying variables; the left end of the bar assumes best-case conditions. Mitigation is advised if risk enters the red zone.



Taxa: Large birds.

Assumptions: Terrestrial application of herbicide at half of the maximum rate on a representative product's label (see Table 9); 10-100% of diet is contaminated for several months.

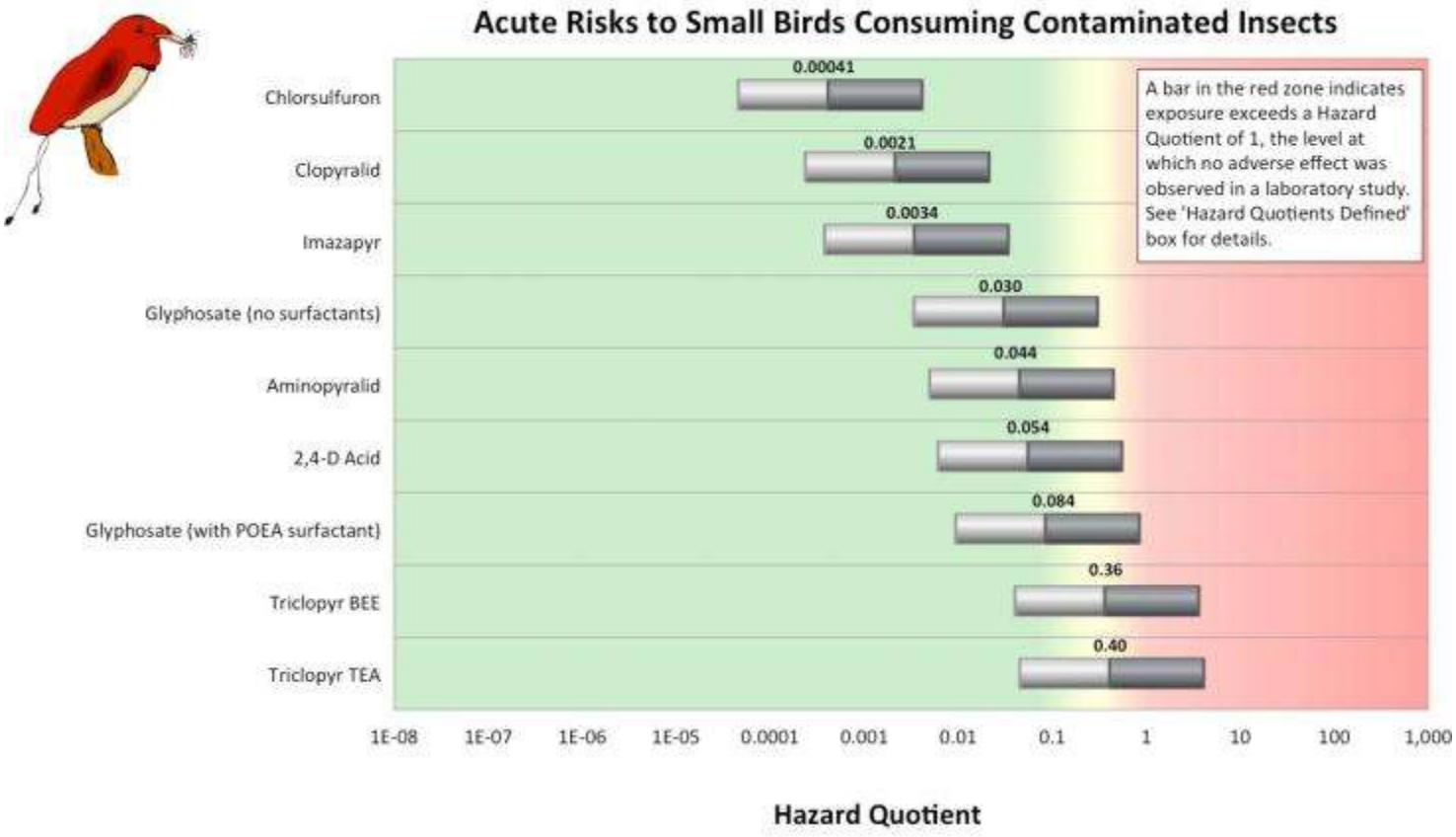
Likelihood: Under spot applications it is unlikely that a high portion of any bird's diet would be contaminated. With broadcast applications over any sizable area (unusual for wildland management) consider the feeding range of the wildlife relative to the treatment area.

Mitigation: Use low-volume applications and reduce the amount applied per acre. If possible, don't treat large contiguous areas all at once. Avoid contamination of plants known to be used as food sources by birds. Avoid treatments during nesting season.

Risk calculated as a function of: The inherent chronic toxicity of the herbicide to birds; the residue rate of herbicide on vegetation (which is proportional to the application rate). Except for glyphosate with the POEA surfactant, risks in this chart do not account for potential toxicity of any surfactants that are part of the product formulation or added to spray mixtures.

Methodology and sources: See description following risk charts and go to PRI website, where where you can access a spreadsheet for adjusting application rates and other variables.

Reading the chart: For each bar, the labeled central value is the most likely estimate. The right end of the bar assumes worst-case conditions for all underlying variables; the left end of the bar assumes best-case conditions. Mitigation is advised if risk enters the red zone.



Taxa: Small birds.

Assumptions: Terrestrial application of herbicide at half of the maximum rate on a representative product's label (see Table 9); 10-100% of diet is contaminated.

Likelihood: Under spot applications it is unlikely that a high portion of any bird's insect-based diet would be contaminated. With broadcast applications over any sizable area (unusual for wildland management) consider the feeding range of the wildlife relative to the treatment area.

Mitigation: Use low-volume applications and reduce the amount applied per acre. If possible, don't treat large contiguous areas all at once. Avoid treating plants when insects are feeding. Avoid treatments during nesting season.

Risk calculated as a function of: The inherent acute toxicity of the herbicide to birds; the residue rate of herbicide on insects (which is proportional to the application rate). Except for glyphosate with the POEA surfactant, risks in this chart do not account for potential toxicity of any surfactants that are part of the product formulation or added to spray mixtures.

Methodology and sources: See description following risk charts and go to PRI website, where you can access a spreadsheet for adjusting application rates and other variables.

Reading the chart: For each bar, the labeled central value is the most likely estimate. The right end of the bar assumes worst-case conditions for all underlying variables; the left end of the bar assumes best-case conditions. Mitigation is advised if risk enters the red zone.

Risk Assessment Methodology

The methods used for estimating risk are based closely on USFS risk assessment methodology (link), in which three estimates are calculated for the exposure (dose) received as a result of various herbicide use scenarios. Each dose estimate is based on a set of best-case, most-probable, or worst-case assumptions based on exposure parameters appropriate to that scenario. The dose estimates are then compared to Toxicity Reference Values to assess risk if the scenario were to occur.

Exposure estimates were calculated using the risk assessment spreadsheets developed by Syracuse Environmental Research Associates (SERA) for the USFS and the Bureau of Land Management (BLM), published between 2007 and 2014. A full description is available in the report "Preparation of Environmental Documentation and Risk Assessments." Risk assessments for each of the herbicides discussed here are also downloadable from the USFS site. A detailed explanation of the methods used to estimate risk in this report is also available in Chapter 2 of the "2010 Marin Municipal Wastewater District (MMWD) Herbicide Risk Assessment." However, some parameter values and methods used for the risk estimates above differ from the *2010 MMWD Herbicide Risk Assessment*. Each of these changes is discussed below. Finally, the PRI website provides detailed information on how the risk charts were developed and allows users to modify application rates to assess changes in risk profiles.

Modifications to USFS Risk Estimation Methods

Several modifications to USFS/SERA default values were made for this evaluation:

TRVs: Toxicity Reference Values (TRVs) based on LD_{50} or LC_{50} transformed to "No Effect" levels by incorporating an additional uncertainty factor of 20, the methodology used by US EPA to adjust TRVs for assessment effects to endangered species. This transformation ensures that all TRVs are based on "No Effect" levels and allows direct comparison of herbicides. This change has been incorporated into the more recent USFS herbicide risk assessments, and PRI updated the older risk assessments to include this change.

Percent of diet contaminated: In more recent versions of the USFS/SERA herbicide risk assessments, the percentage of an animal's diet assumed to be contaminated was modified to 10% (best-case), 30% (most-probable) or 100% (worst-case). PRI applied the same change to herbicides not yet adopted by USFS, to ensure an "apples to apples" comparison between herbicides. Residue rates assumed for herbicides onfood (fruit, vegetation and prey) were based on the most up-to-date values from USFS/SERA (WorksheetMaker 6.0). The caloric error factor, which was introduced in recent versions of USFS/SERA worksheets, was not utilized here.

Herbicide Residue Rates: USFS changed the residue rates used in the latest version of their risk calculation spreadsheets for estimating exposures from consumption of contaminated fruit, insects and vegetation. This change lowers the best-case predicted dose for wildlife from consumption of contaminated food. In the new versions of the spreadsheets, a new lower residue rate was introduced that is equivalent to the following:

Best-case residue rate = Most-probable rate x (Most-probable rate ÷ Worst-case rate)

These values were incorporated into the calculations for all of the herbicides to ensure comparison of equivalent value.

Insect Contamination Rate: The USFS changed the mass of a honey bee from 93 mg to 116 mg and the surface area from 2.66 cm^2 to 1.42 cm^2 in the more recent herbicide reviews. The net effect is to reduce the estimated dose received by the honey bee. These values were incorporated into the calculations for all of the herbicides to ensure comparison of equivalent values.

Toxicity Reference Values Used to Estimate Risk

Toxicity Reference Values (TRVs) are given in terms of mg of acid equivalent (AE) or active ingredient (AI). NOAEL is the No-Observed-Adverse-Effect Level.

Table 10. Toxicity reference values used to estimate risk

Receptor (units)	Herbicide	TRV Used	USFS TRV	Endpoint
Honeybees (mg/bee)	2,4-D Acid	1075	1075	NOAEL
	Aminopyralid	1075	1075	NOAEL
	Chlorsulfuron	25	25	NOAEL
	Clopyralid	909	909	NOAEL
	Glyphosate	860	860	NOEC
	Imazapyr	860	860	NOAEL
	Triclopyr BEE	620	620	NOAEL[b]
	Triclopyr TEA	620	620	NOAEL[b]
Birds, acute (mg/kg body weight)	2,4-D Acid	415	415	NOAEL
	Aminopyralid	14	14	NOAEL
	Chlorsulfuron	1686	1686	NOAEL
	Clopyralid	670	670	NOAEL
	Glyphosate	1500	1500	NOAEL
	Imazapyr	2510	2510	NOAEL
	Triclopyr BEE	126	126	NOAEL[b]
	Triclopyr TEA	126	126	NOAEL[b]
Birds, chronic (mg/kg body weight)	2,4-D Acid	76	76	NOAEL
	Aminopyralid	184	184	NOAEL
	Chlorsulfuron	140	140	NOAEL
	Clopyralid	15	15	NOAEL
	Glyphosate (no surfactants)	58	58	NOAEL
	Glyphosate (with POEA)	43	43	NOAEL
	Imazapyr	610	610	NOAEL
	TCP[c]	116	116	NOAEL[b]
	Triclopyr BEE	7.5	7.5	NOAEL[b]
	Triclopyr TEA	7.5	7.5	NOAEL[b]
Mammals, small (mg/kg body weight)	2,4-D Acid	25	25	NOAEL
	Aminopyralid	104	104	NOAEL
	Chlorsulfuron	75	75	NOAEL
	Clopyralid	75	75	NOAEL
	Glyphosate	500	500	NOAEL
	Imazapyr	738	738	NOAEL
	Triclopyr BEE	440	440	NOAEL[b]
	Triclopyr TEA	440	440	NOAEL[b]

Receptor (units)	Herbicide	TRV Used	USFS TRV	Endpoint
Mammals, large (mg/kg body weight)	2,4-D Acid	5	5	NOAEL
	Aminopyralid	50	50	NOAEL
	Chlorsulfuron	5	5	NOAEL
	Clopyralid	15	15	NOAEL
	Glyphosate	500	500	NOAEL
	Imazapyr	738	738	NOAEL
	TCP[c]	12	12	NOAEL[b]
	Triclopyr BEE	0.4	0.4	NOAEL[b]
	Triclopyr TEA	0.4	0.4	NOAEL[b]
Fish (mg/liter of water)	2,4-D Acid	4.8	95.6	$LC_{50} \div 20$
	Aminopyralid	50	50	NOEC
	Chlorsulfuron	30	30	NOEC
	Clopyralid	5[a]	103	$LC_{50} \div 20$
	Glyphosate (no surfactants)	0.5	0.5	NOAEC
	Glyphosate (with POEA)	0.048	0.048	NOAEC
	Imazapyr	10.4	10.4	NOAEC
	TCP[c]	0.18	0.18	NOAEC[b]
	Triclopyr BEE	0.091	0.091	NOAEC[b]
	Triclopyr TEA	20	20	NOAEC[b]
Aquatic Invertebrates (mg/liter of water)	2,4-D Acid	1.25[a]	25	$LC_{50} \div 20$
	Aminopyralid	89	89	NOEC
	Chlorsulfuron	10	10	NOEC
	Clopyralid	23.1	23.1	NOEC
	Glyphosate (no surfactants)	2.7	2.7	NOAEC
	Glyphosate (with POEA)	0.075	0.075	NOAEC
	Imazapyr	41	41	NOAEC
	TCP[c]	0.55	0.55	NOAEC[b]
	Triclopyr BEE	0.045	0.045	NOAEC[b]
	Triclopyr TEA	25	25	NOAEC[b]

[A] *To ensure comparison of equivalent endpoints between herbicides, all* TRVs *values expressed as LC_{50} or LD_{50} values were translated by either USFS or PRI to "No Effect" levels by incorporation of an uncertainty factor of 20, similar to that used by US EPA to protect endangered species. This practice was only recently incorporated into the USFS methodology, so PRI implemented these changes for the herbicides reviewed by USFS prior to the change.*

[b] *For triclopyr and TCP toxicity to mammals, USFS used allometric parameters that correct the NOAEL for the amount of food and water consumed, based on body weight and size, to adjust for differences between the test species and the taxa to which the TRV is applied.*

[c] *TCP is the primary degradation product of triclopyr. Because triclopyr must degrade before any TCP is produced, only the chronic scenarios of large mammals and birds eating vegetation involve potential exposure to TCP. The other scenarios are acute events, where triclopyr has not yet degraded to form TCP. Chronic exposure to treated vegetation will result in exposure to a combination of the parent compound and TCP, which degrade at similar rates. The risk bars are based on the TRV for the more toxic (lower value) of the two to produce a more protective risk estimate. For both mammals and birds, the risk charts are based on the TRV for triclopyr acid, since it has the lower value.*

Herbicide Half-Life

Herbicide half-life is a measure of persistence in the environment. Herbicides that are persistent in the soil environment continue to have herbicidal activity and cause adverse effects on the ecosystem until the concentration drops below a level that is toxic to plants. The range of half-lives for the herbicides in soil under aerobic conditions—in the presence of oxygen and microbes—can vary by a factor of ten or more for each herbicide. Exposure to sunlight can accelerate decomposition of some herbicides. The longest half- lives are typically relevant under arid conditions where microbial degradation rates are low. Anaerobic degradation is usually slower than aerobic degradation. In general, glyphosate is expected to be less persistent than other herbicides considered in this assessment, while imazapyr and aminopyralid are among the most persistent. Triclopyr BEE and TEA rapidly degrade or dissociate to triclopyr acid, so the persistence of triclopyr degradates—triclopyr acid and TCP— is most relevant to triclopyr applications. Organic herbicides such as clove oil, pelargonic acid, and limonene have very short half- lives (a few days to a week), which limits their potential for exposure.

Figure 4 shows the range of half-lives for the herbicides in soil under aerobic conditions. In the plot, herbicides are arranged in order of the Central value of their measured half-life. The Upper, Lower and Central values on Figure D-1 are based on a review of the academic literature and the values used by government agencies, including US EPA, USFS, California Department of Pesticide Regulation (DPR), and the Oregon Department of Environmental Quality (ODEQ) (see PRI website for more information).

The Central values for the herbicides used in the plots (except for 2,4-D and aminopyralid) in Figure D-1 are the half-life values used by USFS in its risk assessments as the Central half-life estimate in soil, with the values for 2,4-D from DPR's environmental fate review and for aminopyralid from US EPA's risk assessment. Lower and Upper values used in the figure are taken from US EPA's risk assessments or from DPR's or ODEQ's environmental fate documents summarizing the available literature studies. Half-lives vary depending on test conditions, and comparable studies conducted under the same test conditions were not always available for every herbicide. When soil values were unavailable, the half-life on fruit was used.

Figure 4 is intended to provide as much as possible an "apples-to-apples" comparison of aerobic soil half- lives. However, imazapyr does not degrade in soil under aerobic conditions, so a field dissipation half-life (5.9 years) is used, in order to provide a numerical point of comparison to other herbicides. Note that half-lives of herbicides in water or in anaerobic sediments (such as wetlands) may be different than the aerobic soil half- lives presented in Figure 4 For most pesticides, the anaerobic half-life (in the absence of oxygen) is longer than the aerobic half-life. Sunlight and processes that dissipate herbicides in the environment like rainfall runoff, absorption by plants, or irreversible binding to soils can also alter the persistence of a chemical in the treated area.

Figure 4 shows the total range of half-lives observed for the different chemicals. Half-life values used by the USFS in their worksheets are those used to produce the charts and are more narrowly constrained to reflect half- lives under the most common conditions.

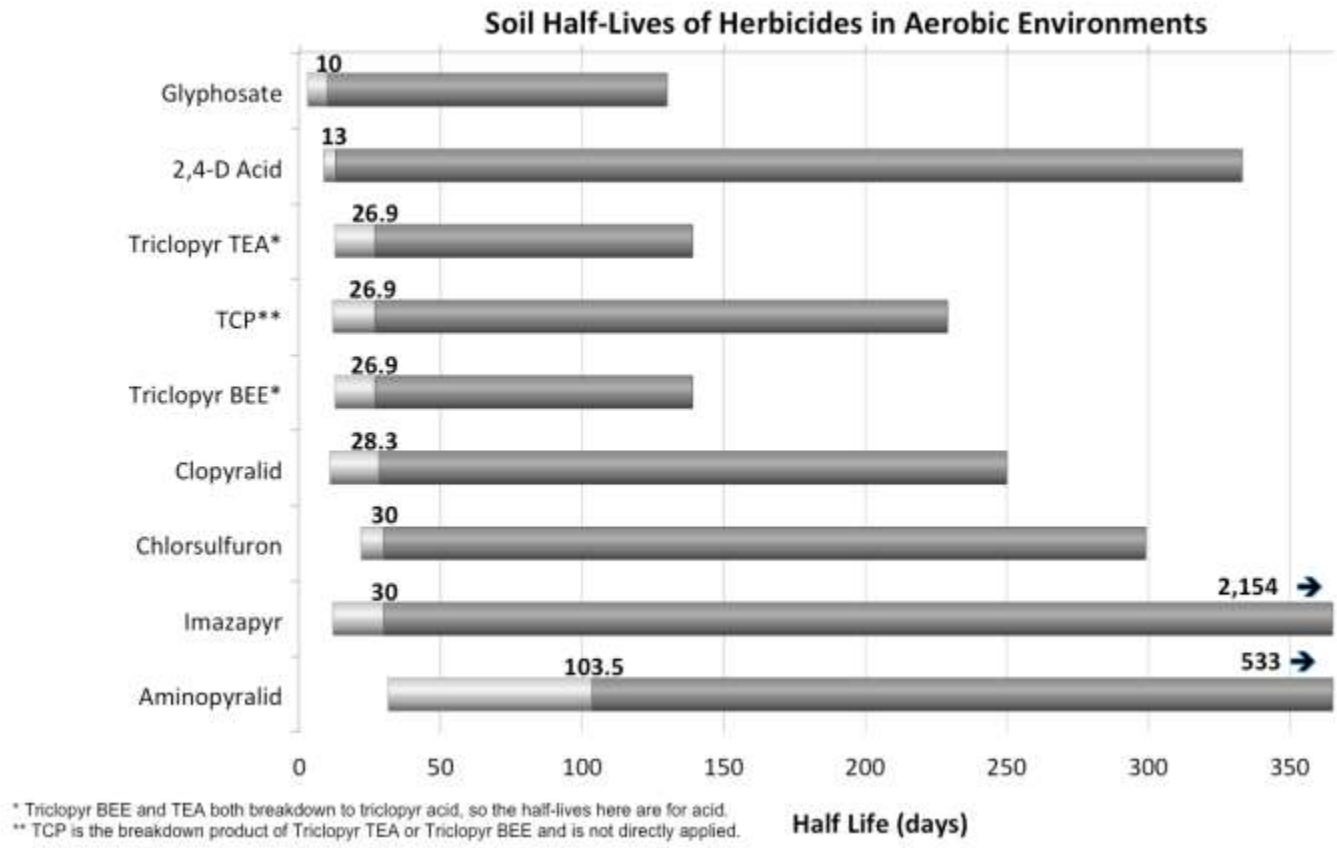


Figure 4: Comparison of the range of herbicide half-lives under aerobic conditions in soil. The high end of the range is typically under arid conditions where microbial degradation rates are low. Exposure to sunlight can accelerate decomposition and shorten the half-life of some herbicides. Sources are described after Table 10. For aminopyralid, see EPA Fact Sheet 2005. For imazapyr, see EPA 2007 Appendix A Imazapyr Effects Determination for the CA Red-legged frog.

Water Contamination Rates

Water contamination rates are a measure of how much of an applied herbicide will run off of the treated area into nearby water bodies. Maximum or peak concentrations of herbicides in water bodies receiving runoff are typically observed when rainfall or irrigation occurs soon after treatment, before the herbicide has degraded substantially. The concentration of herbicide in this "first-flush" runoff may potentially impact aquatic organisms and terrestrial animals that make contact with or drink contaminated water. The potential of herbicides to move off-site in runoff water depends on water solubility, half-life, and the ability of the herbicide to bind to soil. The site characteristics are relevant too, as different soil types bind to herbicides differently. Bare or impermeable soils are much more prone to runoff than vegetated areas; sandy soils are susceptible to leaching that may result in groundwater contamination.

The risk charts use the USFS method (based on the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) model) to estimate the concentration of each herbicide in water for an application to 10 acres, no buffers along the edge of the treated area, and rainfall after the application based on averages for a variety of sites. The range of water contamination rates is based on the range of site variables such as soil type and chemical properties. Use of buffer zones around water bodies will reduce water contamination.

Water contamination rates are measured in units of milligrams of herbicide per liter per pound of herbicide applied per acre (mg/L per lb/acre). Actual herbicide concentrations in the receiving water body will depend on how many pounds of active ingredient are applied to land that drains to the water body. Use of herbicides with application rates of fractions of a pound per acre (see Table 9) will generally result in lower concentrations than herbicides with higher application rates. Predicted concentrations in the receiving water bodies for the half-maximum application rates for each active ingredient are shown in Figure 5. These concentrations were used to estimate the risks displayed in the charts for aquatic species and for animals drinking the water.

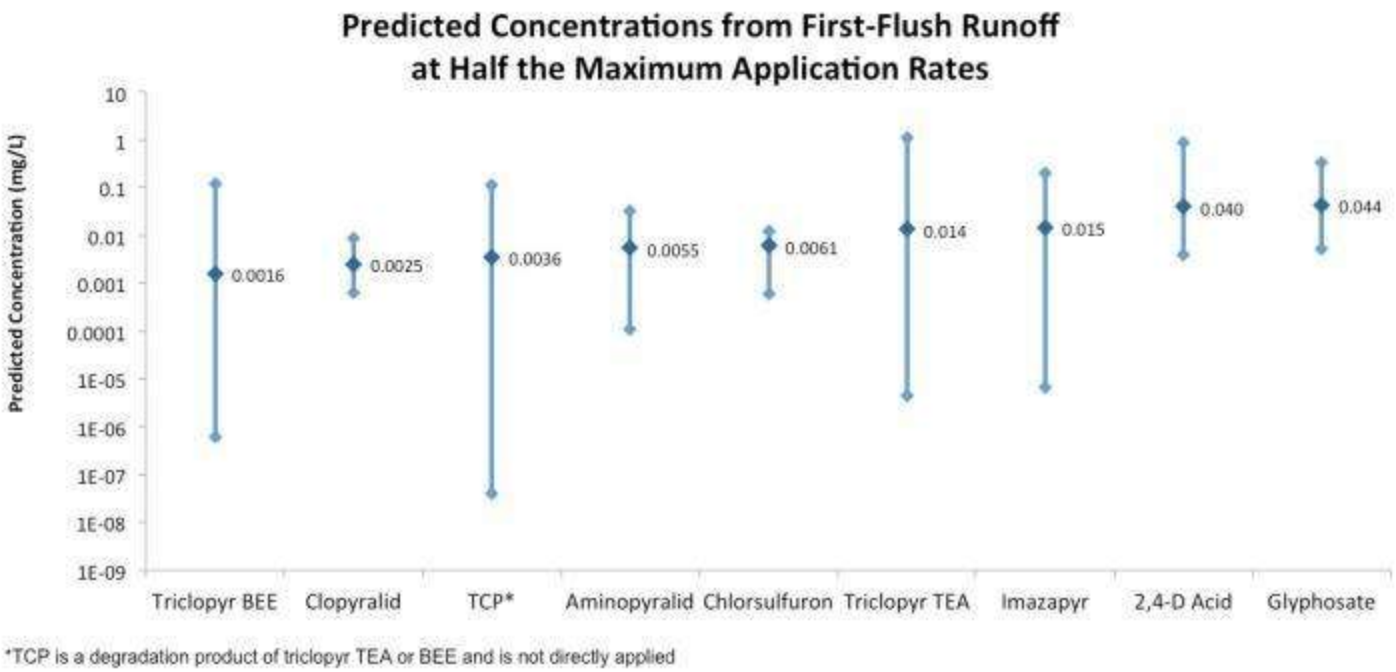


Figure 5: Comparison of the range of predicted concentrations in peak runoff after terrestrial application at half-maximum application rate. Factors affecting predicted concentrations include application rate, water solubility, half-life, and the ability of the herbicide to bind to soil (Koc). Use of buffer zones near surface waters will help to reduce water contamination. Source: "Estimated Water Contamination Rates" in USFS risk assessment worksheets at www.fs.fed.us/foresthealth/pesticide/worksheets.shtml.

Appendix C Sample Record keeping forms

Treatment Form-Front

2015
Herbicide/Manual Treatment Data Form

Project ID # or Name:	Project Complete? **Y** or **N** (add notes)
	High Priority for next year? **Y** or **N**

Name of Entity for whom Treatment was applied: Clallam County

Road Name:_____ City: _____ State: _____ Zip: _____

Min and Max Address or Begin and End Mile Post _____

GIS Road Segment (if known) _____ Total Miles Treated:_____

General Activity Fields

Work Force: Crew Members Present:

Site/Inventory Fields

Start Date	Stop Date	Acres examined for weeds	Treatment Site (circle one)	**Total Manual Infested Area Treated: (DO NOT lump plants together)**
			Road edge/ROW Trail Pit Admin Site Other	**ACRES**

Weeds Treated (Just the PLANTS code is OK)	**Infested Area Treated** (DO NOT lump plants together)	% of area examined for weeds infested with this species (lump plants together – use cover classes 1 - 9 listed below)	**M**anual/**H**erbicide or **S**urvey
	acres		
	acres		
	acres		
	acres		
	acres		

† **Cover Classes: 1** = Trace, **2** = 1 – 3%, **3** = 3 – 5% **4** = 5 – 10%, **5** = 10 – 25%, **6** = 25 – 50%, **7** = 50 – 75%, **8** = 75 –%, **9** = 95 – 100%
Note: Cover classes are meant to be *approximations only*.

All Licensed Applicators: Name and License # _____

Firm Name: _____ Phone # _____

Firm Address: _____ City: _____ State: _____ Zip: _____

Application Date	Time Start	Time Stop	Temp (F)	Wind Speed (MPH)	Wind Direction	Cloud Cover	Remarks – Weather forecast

Application Area (acres)	Total Volume of Mix Applied (gal)	Diluent	Special comment
		Water	

Product Name	EPA Registration #	Amount of herbicide used (oz)	Herbicide Applied/Acre or other measure	Concentration Applied

Was this application made as a result of a permit? Yes No
If yes, Permit # _____

WA State NPDES Acres:

Notes:

Page 2

Clallam County
Weed Treatment Monitoring

Examiner name:_____

Evaluation Date:_____

Ref #	
Project # and Name	
<u>From "Comments":</u> **Road name with BMP & EMP** **–OR-** **Min and Max Address**	
Date(s) of treatment	
Herbicide or Manual treatment (circle one)	

Weeds Treated (Scientific name or code)	**Infested Area Treated (acres)**	**Cover class from "% area examined for weeds infested with this species"**	**Percent efficacy of treatment (use codes on next page)**

Do you think this treatment area is a high priority for retreatment next year? Yes / No

Please provide comments on the next page, if you have any.

Instructions: All information on page 1 of this datasheet comes from the "Herbicide/Manual Treatment Data Form", except for:

- **Examiner name**
- **Evaluation Date**
- **Percent efficacy of treatment**

For Percent efficacy of treatment, enter the code that best approximates the percent of the population that was eradicated:

Code	% Efficacy	Rating	Description
0	0	No effect	No effect can be detected on the target species population
03	1 – 5	Failure	Little to no effect can be detected on the target species population.
15	6 – 25	Poor	Treatment killed less than a quarter of the target species population.
35	26 – 50	Marginal	Less than half of the target species population was controlled.
65	51 – 75	Fair	Over half of the target species population was controlled.
85	76 – 90	Good	Treatment was successful in killing most of the target species population
95	91 – 99	Excellent	Over 95% of the target species population has been killed with the treatment.
100	100	Complete	Not a single individual of the target species population was found after a complete survey of the site. The infestation was eradicated.
UN	UNK	Unknown	Treatment efficacy/success cannot be determined.

Comments:

Appendix D Sample Press Release and Public Notice

March 1, 20__

PUBLIC NOTICE

Clallam County is beginning the year 20__ Integrated Roadside Weed Control program which may include spot treatments of herbicide to control specific noxious weeds and invasive species of special concern along selected portions of county right-of-way. Approximately _____ miles of road are scheduled for treatment this year. Notices indicating which herbicide has been applied, the application date, and the target weed species will be posted onsite. The Integrated Roadside Weed Management Plan, which contains information about target weeds, locations, and treatment methods can be viewed online at _____ or contact the county for further information at 360-417-2442.

Property owners who do not wish to have their adjoining right-of-way treated with herbicide have the option of keeping the right-of-way abutting their property weed free by applying for an Owner Will Control Agreement with Clallam County. Forms can be obtained online at _____ or by contacting the county at (360) 417-2442.

NOTICE

Herbicide(s) will be applied to the Clallam County right-of-way any time from/ on :
(check herbicides that apply)

_____, 2016
(when pre-posting, correct date to correspond to actual treatment date)

to spot treat noxious weeds, which threaten agriculture, native vegetation, and habitat in this area:

- ❑ Milestone
- ❑ Element 3A
- ❑ Transline
- ❑ Polaris
- ❑ AquaNeat
- ❑ Weed Destroy AM40
- ❑ Fusilade II

Targeted Weed Species include, but are not limited to:

NO USE RESTRICTIONS ARE IN PLACE

Avoid contact with treated vegetation until spray has dried.

FOR MORE INFORMATION CONTACT:

(Applicator to list a number for a contact that can explain the treatment to the caller)

_____ Phone Number:_____

Or Clallam County Noxious Weed Control Program at (360) 417-2442

Appendix F Sample Owner Will Control Packet-Draft Agreement Sample

INCOMPLETE

- Liability form- must be reviewed by legal, *in development*
- Control Recommendation Form-*in development*
- Option cultural roadside enhancements-*In development*

OWNER WILL CONTROL

By entering into this agreement, owner will agree to control noxious weeds and other weeds of concern as described in Appendix __ of this agreement on county right-of-way adjacent to owner's property located at _____.

For the purpose of this agreement, 'control' will consist of complete removal of all above ground biomass and as much of the root system as is feasible of weeds listed in your packet, as well as any additional weeds of concern as determined by the county.

If noxious or other weeds of concern are observed on right-of-way adjacent to above named address, County will notify property owner of their presence. Property owner will then have ten (10) days to completely remove weeds as required by this agreement. If owner fails to control weeds in that timeframe, this agreement will be terminated and weeds will be controlled as determined by the County, including by the use of herbicides.

If the Owner will Control agreement is terminated as described above, property owner may apply to reenter into a new Owner will Control agreement the following calendar year.

This agreement is valid from the date signed by both parties until December 31 of the same year. County will mail applications for the following year to all current signees of this agreement. As treatments may begin as early as late February, property owners who wish to enter into a new Owner will Control agreement are required to return signed agreements by January 31st, or within 30 days of receiving the agreement, whichever is later.

_____ _____

Property Owner Date

_____ _____

County Representative Date

Sample Failure to Control Warning

County Logo
223 E Fourth St, Suite 15
Port Angeles, WA 98362

Date

RE: Failure to fulfill 'Owner will Control' agreement

Dear Property Owner,

You entered into an Owner will Control agreement with Clallam County Road Department regarding noxious and invasive weeds on the county roadside adjacent to your property.

Crews were recently in your area and found the roadside adjacent to your property has not been maintained as required by the terms and conditions of the agreement (see enclosed).

You have ten (10) days from date of this letter to control weeds as outlined in the Owner Will Control agreement. If the right-of-way is not adequately maintained as described in the agreement the agreement will be immediately terminated and weeds of concern will be controlled as determined by the County, including by the use of herbicides.

If the Owner will Control agreement is terminated as described above, you may still apply to reenter into an Owner will Control agreement for next calendar year.

If you have any questions, please call _____ at _____

Or email us at:_____

This is the only notice you will receive regarding this matter.

Sincerely,

County Representative
Clallam County Roads Department

Enclosed: Owner Will Control agreement

Appendix G Roadside weed life cycle, growth form, category and status

Common Name	Scientific Name	Life Cycle[1]	Growth Form	Threat	Cate -gory	Status
alyssum, hoary	*Berteroa incana*	A, B, P	Forb	Aggressive invader in fields of forage crops; toxic to horses	1	NCR
bindweed, field	*Convolvulus arvensis*	P	Forb	Seriously interferes with agriculture	1	NR
brome, ripgut	*Bromus rigidus*	A	Grass	Long seed awns cause injury to nose and eyes of grazing animals; known to occur in Clallam County, but not on roadsides; will be treated under EDRR protocol if observed.	1	ISSC
butterfly bush	*Buddleia davidii*	P	shrub	Invades natural areas; dense stands crowd out native vegetation in riparian areas and interfere with natural succession	1	NR
cheatgrass or downy brome	*Bromus tectorum*	A	Grass	Depletes soil moisture in early spring; fire hazard in summer; known to occur in Clallam County, but not on roadsides; will be treated under EDRR protocol if observed.	1	ISSC
chicory	*Cichorium intybus*	P	Forb	Only found in the Dungeness Valley where it is starting to spread	1	ISSC
cinquefoil, sulfur	*Potentilla recta*	P	Forb	Not readily grazed by livestock and wildlife; forms dense stands	1	NCR
comfrey	*Symphytum officinale*	P	Forb	Used medicinally for poultices; liver damage when ingested; can form dense stands; difficult to control once established	1	ISSC
fennel, common*	*Foeniculum vulgare*	P	Forb	Dense stands exclude native vegetation	1	NCR
hawkweed, orange	*Hieracium aurantiacum*	P	Forb	Dense stands exclude other species; bitter and unpalatable, little forage for livestock and wildlife	1	NCR
herb Robert	*Geranium robertianum*	A, B	Forb	Rapid spreading; displaces native herbaceous plants; allelopathic, inhibits the germination of small seeded forbs in forest understory	1	N**
hogweed, giant	*Heracleum mantegazzianum*	B, P	Forb	Skin contact with sap causes severe dermatitis on people and animals	1	NR*
knapweed, diffuse	*Centaurea diffusa*	B, P	Forb	Spreads seed by tumbling; prickly flower heads; unpalatable after early spring	1	NCR*
knapweed, meadow	*Centaurea x moncktonii*	P	Forb	Outcompetes pasture species; degrades wildlife habitat; interferes with agriculture	1	NCR
knapweed, spotted	*Centaurea stoebe*	B	Forb	Allelopathic plant that can inhibit the germination of grasses; forms dense stands that exclude desired plants and wildlife	1	NCR
knotweed, Bohemian	*Polygonum x bohemicum*	P	Subshrub	Easily spreads by disturbance; dense colonies eliminate other plant species and can degrade fish habitat; causes structural damage to human structures	1	NCR
knotweed, giant	*Polygonum sachalinense*	P	Forb	Easily spreads by disturbance; dense colonies eliminate other plant species and can degrade fish habitat; causes structural damage to human structures	1	NCR
knotweed, Japanese	*Polygonum cuspidatum*	P	Subshrub	Easily spreads by disturbance; dense colonies eliminate other plant species and can degrade fish habitat; causes structural damage to human structures	1	NCR
laurel, spurge	*Daphne laureola*	P	Shrub	Toxic to humans and animals; contact with plants can cause dermatitis	1	NR
loosestrife, purple	*Lythrum salicaria*	P	Forb	Dense stands eliminate other plant species; poor palatability; degrades wildlife habitat and hunting and fishing areas.	1	NCR*
old man's beard	*Clematis vitalba*	P	Forb - vine	Climbing growth smothers other plants, even trees	1	NR
poison hemlock	*Conium maculatum*	B	Forb	Highly toxic to humans and animals; all parts of the plant are toxic; severe birth defects	1	NCR

Common Name	Scientific Name	Life Cycle[1]	Growth Form	Threat	Cate -gory	Status
ribbon grass	*Phalaris arundinacea*	P	Grass	Aggressive invader displaces other plants in wet sites; an ornamental form of reed canarygrass	1	NR
tansy ragwort	*Senecio jacobaea*	B	Forb	Poisonous to horses, cattle, and pigs; animals grazing tansy can produce tainted milk, may result in potentially toxic residue in honey	1	NCR
tansy, common	*Tanacetum vulgare*	P	Forb	Dense stands degrade forage value; toxicity issues for humans and livestock	1	NR
teasel, common	*Dipsacus fullonum*	B	Forb	Forms dense stands of prickly, unpalatable plants; degrades habitat and reduces accessibility	1	NR
whitetop, hairy	*Lepidium appelianum*	P	Forb	Monocultures displace desirable plants; unpalatable; can be form toxic to cattle	1	NR
wormwood, absinth	*Artemisia absinthium*	P	Shrub	Aggressive invader, will outcompete desirable forbs and grasses in pastures, fields and native grasslands; plants have a strong bitter taste and odor, may affect milk quality	1	NR
blackberry, evergreen	*Rubus laciniatus*	P	Subshrub	Dense canopies crowd out native species; impenetrable barrier	2	NW
blackberry, Himalayan	*Rubus armeniacus*	P	Shrub	Dense canopies crowd out native species; impenetrable barrier	2	NW
broom, Scotch	*Cytisus scoparius*	P	Shrub	Forms dense stands; unpalatable; interferes with forest regeneration; fire hazard; scent can exacerbate human grass allergies; seeds are toxic to horses and livestock	2	NW
burdock, common	*Arctium lappa*	B	Forb	Forms large rosettes; hooked spines on seeds become entangled in fur of animals	2	WR
canarygrass, reed	*Phalaris arundinacea*	P	grass	Unpalatable unless young, forms dense stands that crowd out native plants; especially difficult to control; serious wetland invader; can stop the process of succession in riparian sites, impedes tree seedling establishment	2	NW
carrot, wild	*Daucus carota*	B	Forb	Damages agricultural commodity as it may cross pollinates with domestic carrot, seriously degrading the quality of commercial carrot seed production	2	NW
iris, yellow flag	*Iris pseudacorus*	P	Forb	Toxic to humans and animals; displaces vegetation at wet margins of ditches, ponds, and lakes; plant resins can cause skin irritation in humans	2	NR
peavine, everlasting	*Lathyrus latifolius*,	P	Forb - vine	Forms dense thickets; seeds can be toxic to livestock; seriously interferes with forest regeneration where it invades from edges of timber units	2	ISSC
thistle, bull	*Cirsium vulgare*	B	Forb	Aggressive competitor, unpalatable for cattle	2	NW
thistle, Canada	*Cirsium arvense*	P	Forb	Aggressive competitor, unpalatable; decreases forage; host species for several agricultural pests	2	NW
bindweed, hedge	*Calystegia sepium*	P	Forb - vine		3	WW
buttercup, creeping	*Ranunculus repens*	P	Forb		3	WW
catsear, common	*Hypochaeris radicata*	P	Forb	Crowds out palatable forage species	3	NW
clover (several)	*Trifolium spp.*	P	Forb		3	WW
daisy, oxeye	*Leucanthemum vulgare*	P	Forb	Livestock avoid grazing; milk from dairy cows has unpleasant flavor	3	NW
dandelion, common	*Taraxacum officinale*	P	Forb		3	WW
horsetail	*Equisetum*	P	Forb	Large quantities poisonous to livestock	3	WW
orchard grass	*Dactylis glomerata*	P	Grass		3	WW
St Johnswort, common	*Hypericum perforatum*	P	Forb	Causes photo-sensitization when grazed; toxic at all stages of growth	3	NW

[1] A - annual; B - biennial; P - perennial

ISSC = **I**nvasive **S**pecies of **S**pecial **C**oncern, **NCR** = **N**oxious, **C**ontrol **R**equired**,** **NR** = **N**oxious**,** **R**are **NW** = **N**oxious, **W**idespread
WR = **W**eedy**,** **R**are, **WW** = **W**eedy**,** **W**idespread

Appendix H Focus area maps of target roads

Maps 1, 2 and 4-7show known weed infestations targeted for control on and around roads identified in Table 6.

Map 3 shows known infestations of bull and Canada thistle as well as Scotch Broom that are targeted for control on and around roads identified in Table 7.

East Clallam County

Map 1. Diamond Point Focus Area
Map 2. Happy Valley-Palo Alto Road Focus Area
Map 3. Thistle –Scotch Broom Demonstration Focus Area-Contains

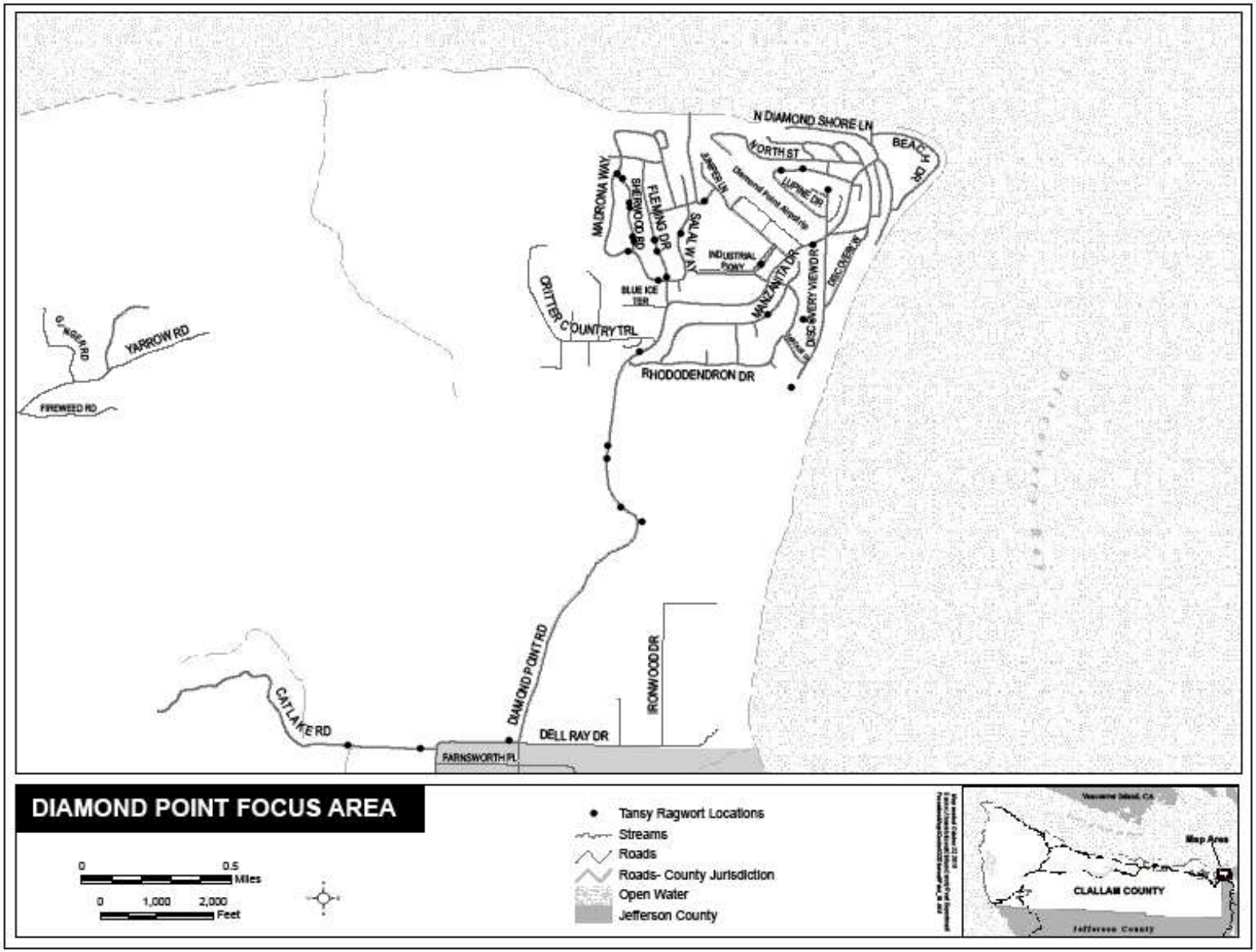
PA/Central Clallam County

Map 4. Black Diamond/Lauridsen Blvd. Focus Area
Map 5. Lake Sutherland/East Beach Focus Area
Map 6. Whiskey Bend/Lyre River Focus Area

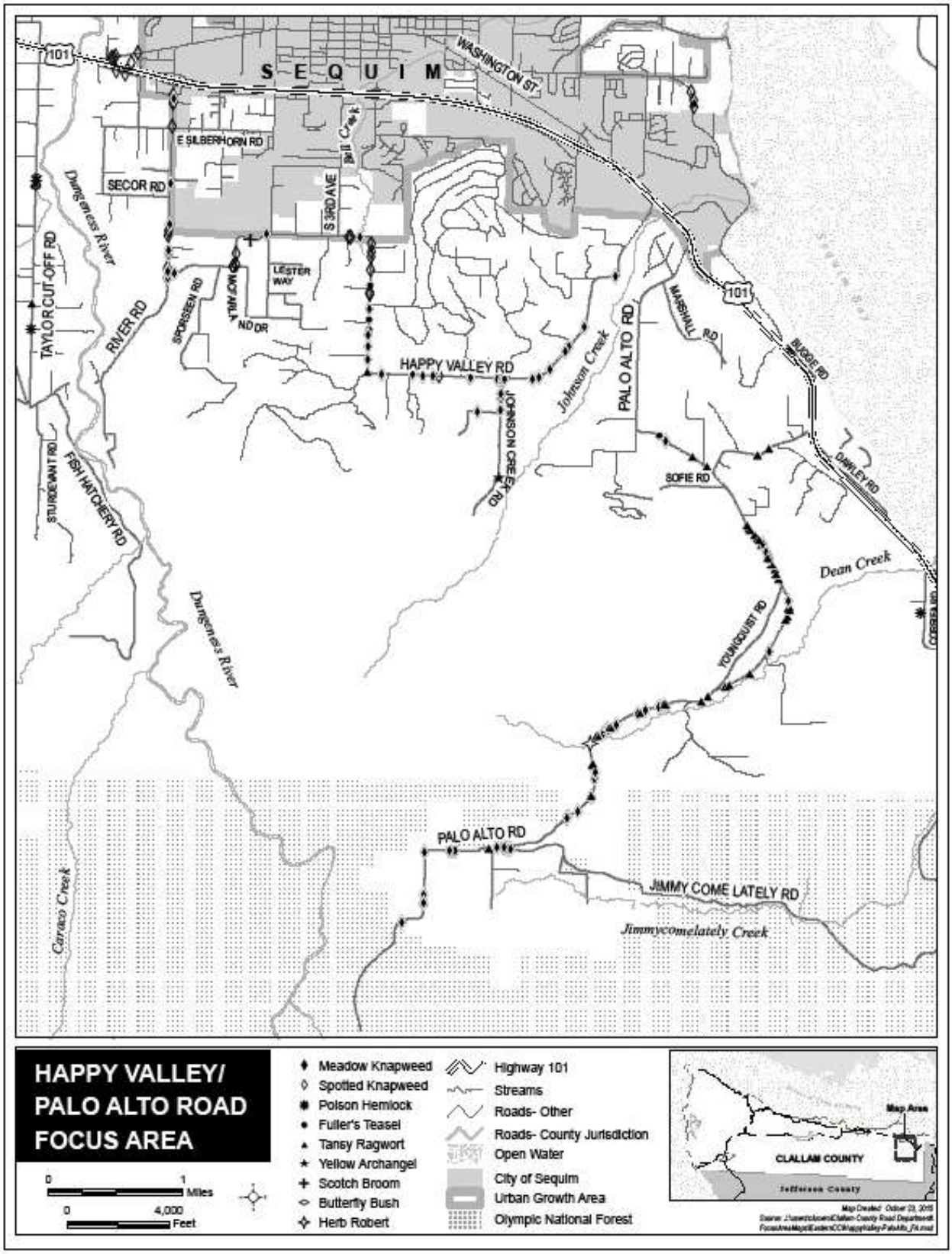
West Clallam County

Map 7. Lake Pleasant Focus Area

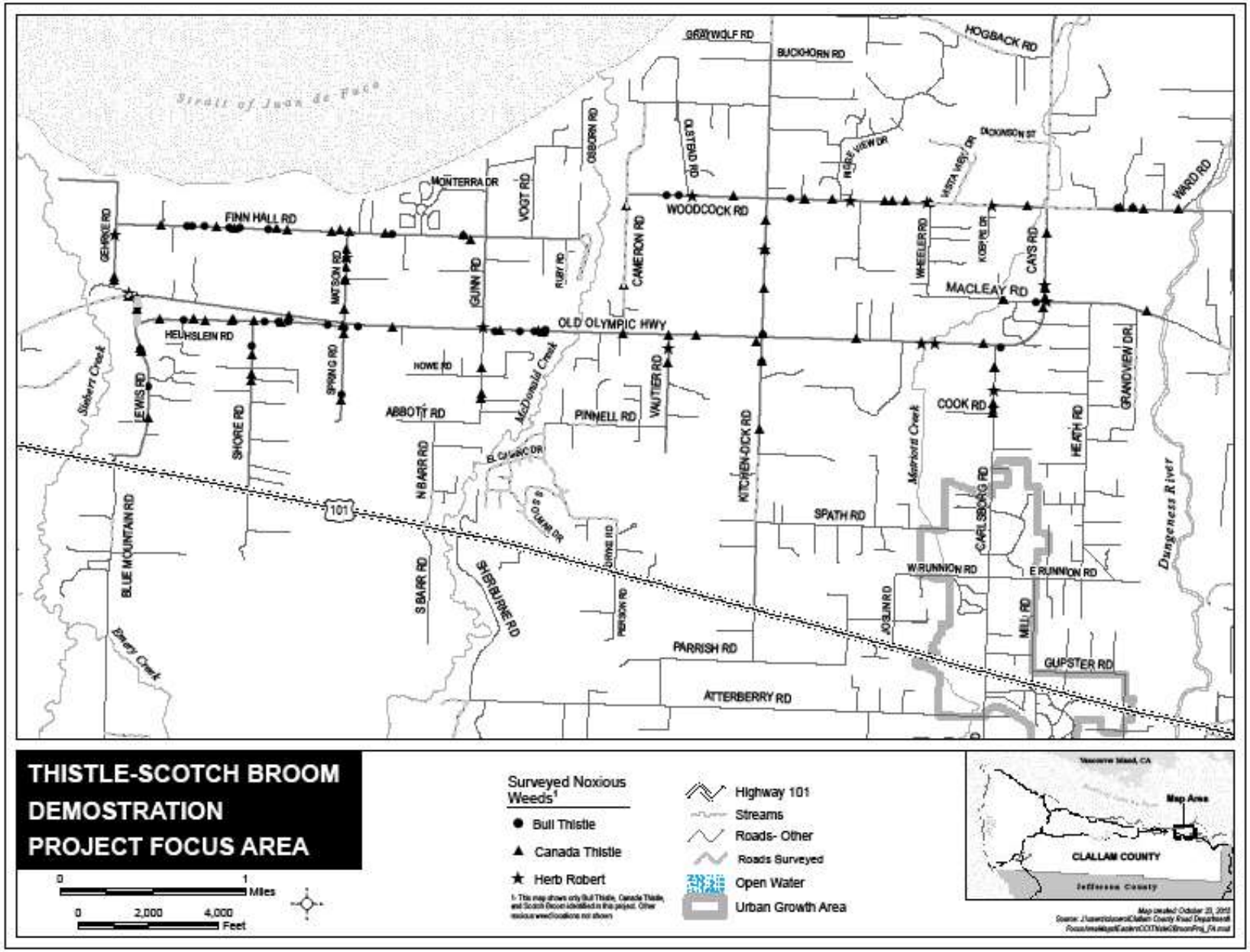
Eastern Clallam County
Map 1.Diamond Point Focus Area



Map 2. Happy Valley-Palo Alto Road Focus Area

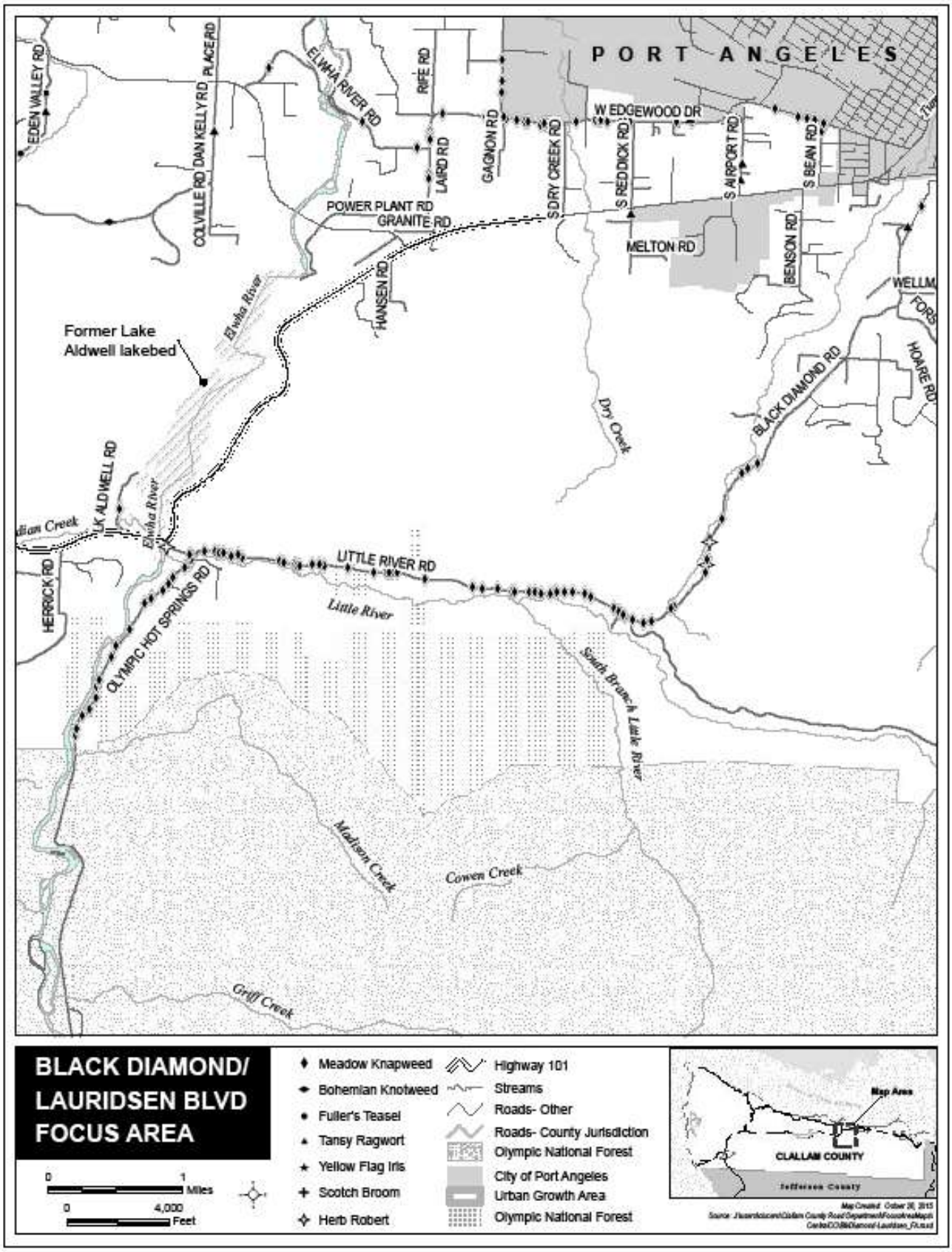


Map 3. Thistle –Scotch Broom Demonstration Focus Area

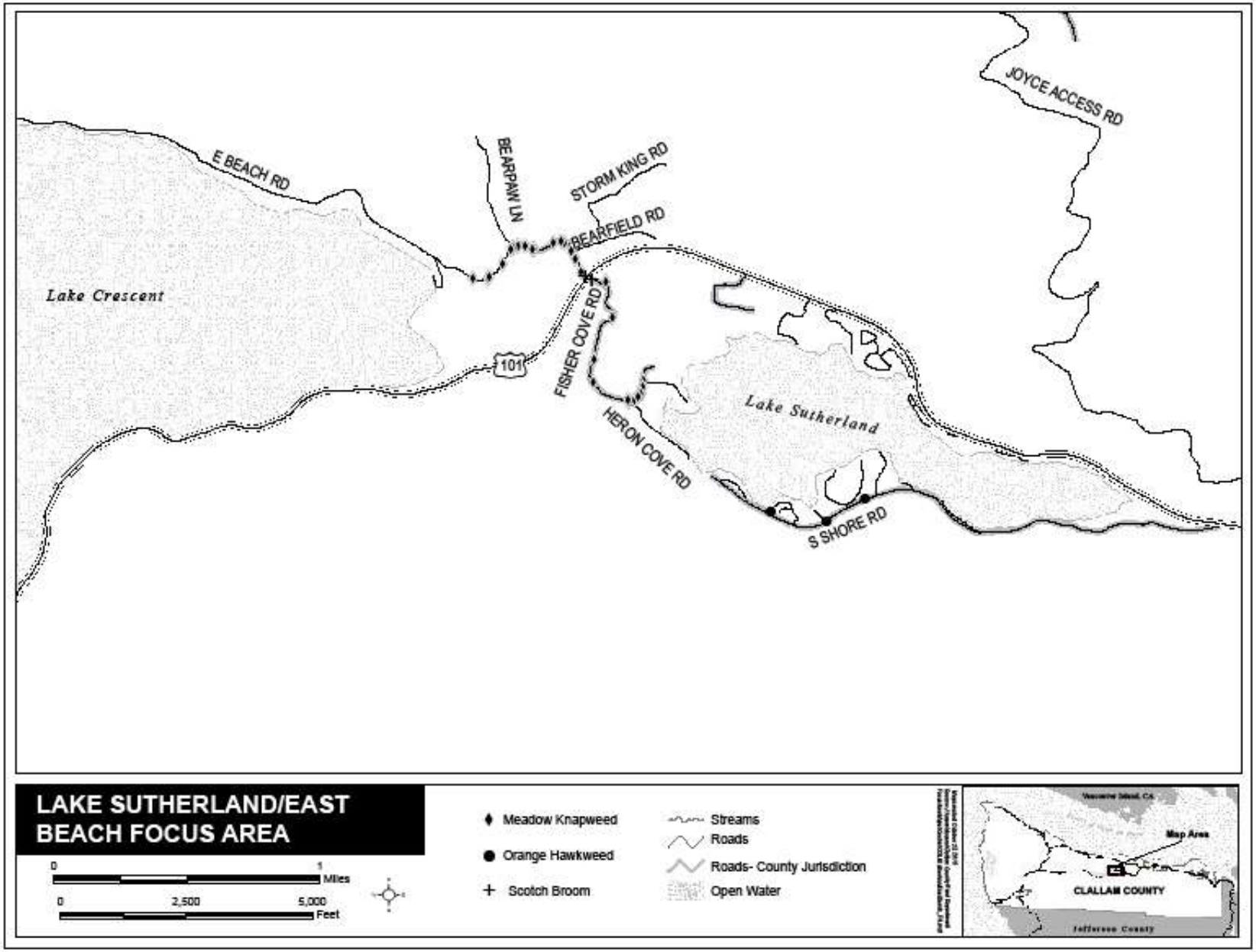


PA Central

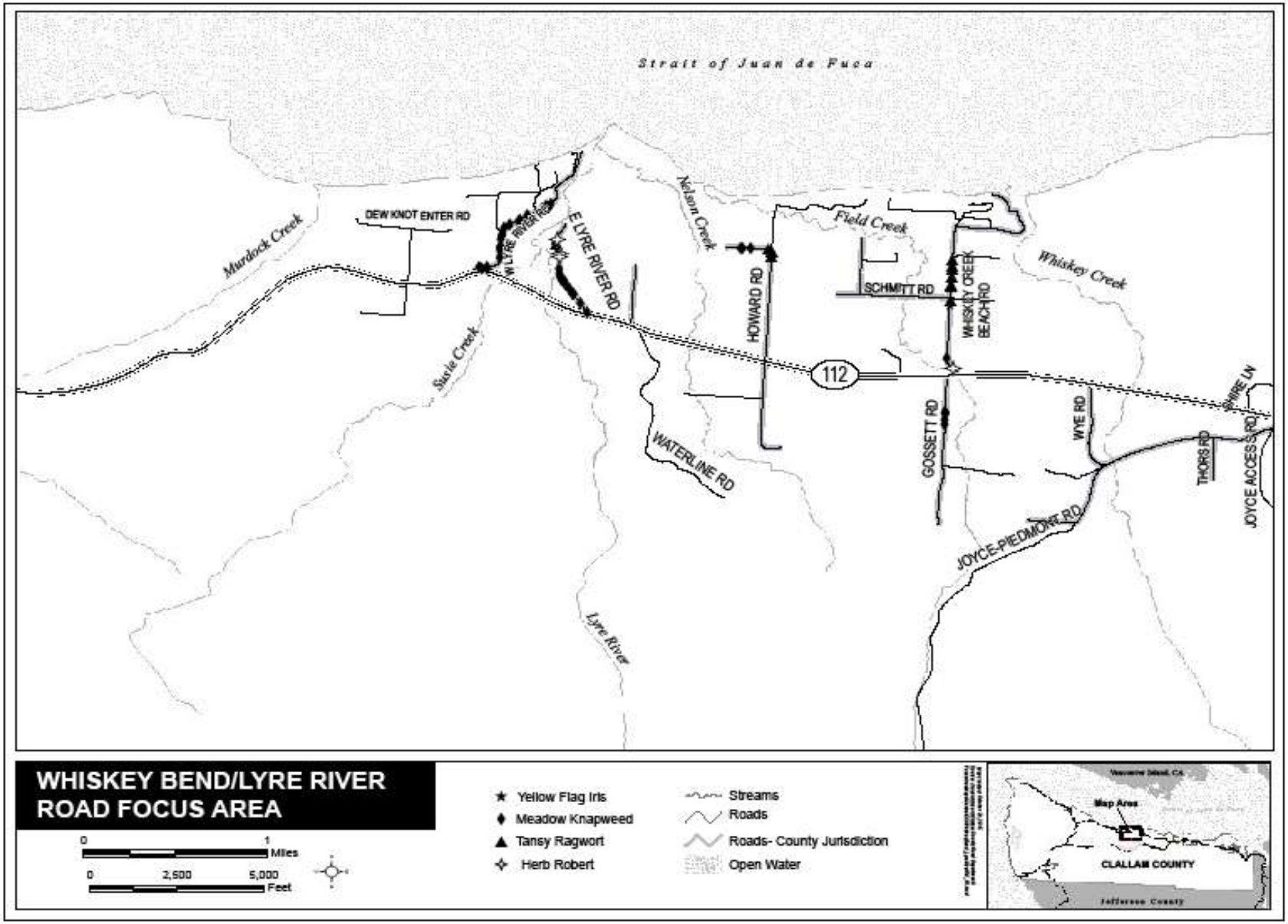
Map 4. Black Diamond/Lauridsen Blvd. Focus Area



Map 5. Lake Sutherland East Beach Focus Area

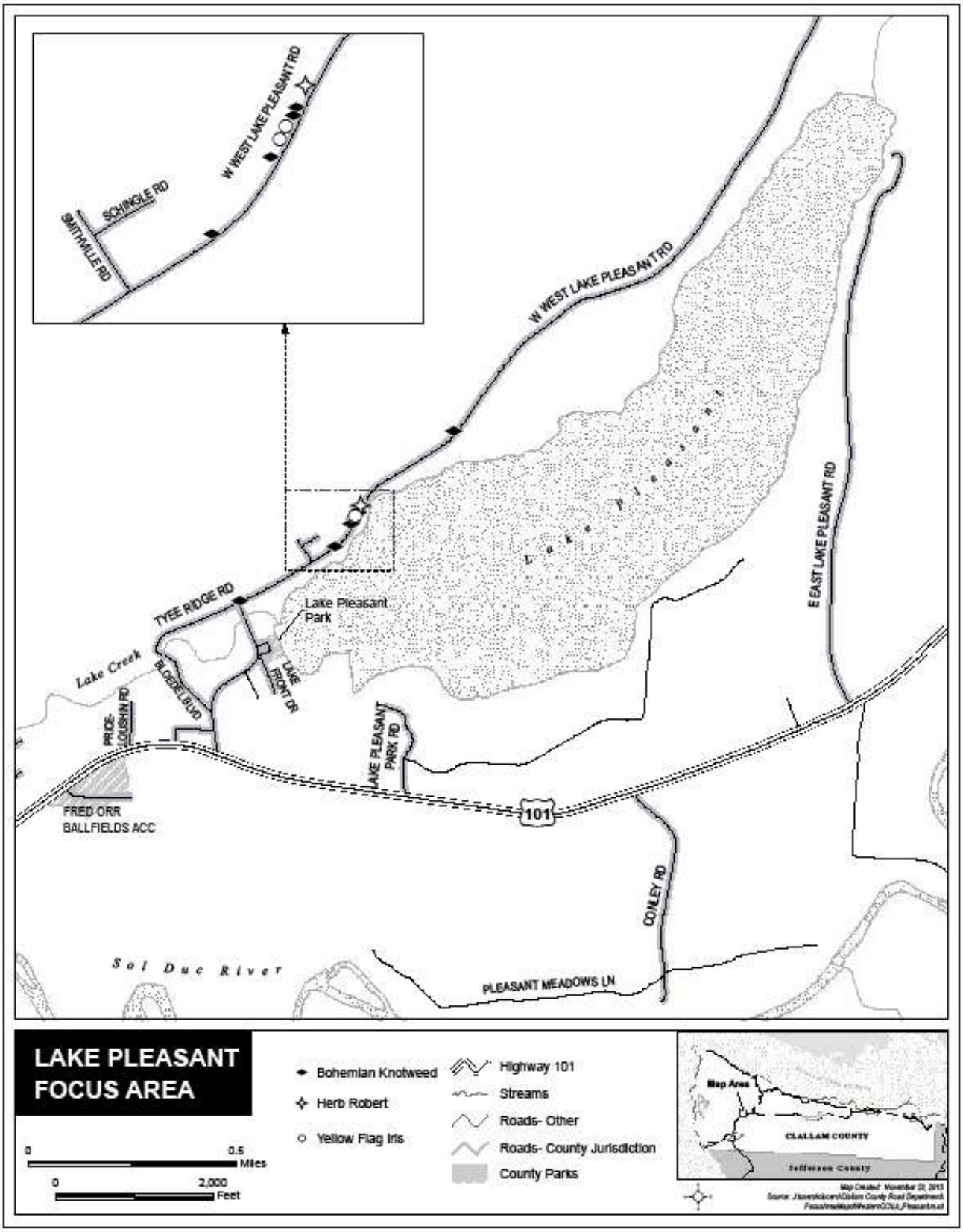


Map 6. Whiskey Bend/Lyre River Focus Area



West Clallam

Map 7. Lake Pleasant Focus Area



Appendix I Known roadside weed locations

The following table contains known roadside weed locations based on 2015 surveys of approximately 250 of 528 miles of the county road system. It does not include most Category 2 weeds unless they were part of the Thistle-Scotch Broom Demonstration Focus Area or found to be locally limited during the survey (Table 11).

Min Address - the first location a weed was recorded on the associated road, based on information from the county's GIS system.
Max Address - the farthest address at which a weed infestation was noted.
Miles - the length of road where weed infestations were documented, not the total length surveyed.
 # Patches - the number of times an infestation was noted in the associated road segment.

The infestation area is noted in both square feet and the equivalent acres. These cells are blank where no information was recorded. Summaries for each road are **bolded**.

Table 11. All roadside weed locations in approximately 250 miles of roads surveyed in 2015.

Road	Weed	Min Address	Max Address	Miles	Area (ft^2)	Area (acres)	# Patches
Atterberry Road	Field bindweed	1080	2099	1.0	180	0.00413	1
	Meadow knapweed	2100	2159	0.2	2	0.00005	3
	Spotted knapweed	2340	2779	0.4			1
Summary		**1080**	**2779**	**2.0**	**182**	**0.00418**	**5**
Barker Road	Poison hemlock	**60**	**159**	**0.04**			**1**
Black Diamond Road	Herb Robert	2440	4419	2.0	500	0.01148	2
	Meadow knapweed	1	519	1.9	642	0.01474	13
Summary		**1**	**4419**	**3.9**	**1142**	**0.02622**	**15**
Blue Mountain Road	Common tansy	5540	6159	0.6			1
	Herb Robert	4000	4509	0.5	500	0.01148	2
	Meadow knapweed	590	1469	0.6	167	0.00383	13
	Spotted knapweed	590	1469	0.9	50	0.00115	1
	Tansy ragwort	310	479	0.8	16	0.00037	5
Summary		**310**	**4509**	**1.9**	**683**	**0.01568**	**22**
Business Park Loop	Poison hemlock	170	409	0.2	12	0.00028	1
	Spotted knapweed	1	169	0.2	521	0.01196	10
Summary		**1**	**409**	**0.4**	**533**	**0.01224**	**11**
Cameron Road	Tansy ragwort	1	119	0.1	45	0.00103	1
	Canada thistle	140	759	0.6			2
Summary		**1**	**759**	**0.7**	**45**	**0.00103**	**2**
Carlsborg Road	Canada thistle	1410	1519	0.2			3
	Scotch broom	1	109	0.2	45	0.00103	3
	Spotted knapweed	110	179	0.1	59	0.00135	11
Summary		**1**	**1519**	**0.5**	**104**	**0.00239**	**17**
Cat Lake Road	Tansy ragwort	**1**	**1259**	**1.2**	**8**	**0.00018**	**2**

Road	Weed	Min Address	Max Address	Miles	Area (ft^2)	Area (acres)	# Patches
Cays Road	Bohemian knotweed	2400	2519	0.1	90	0.00207	2
	Canada thistle	1	519	0.5			3
	Scotch broom	1	519	0.5			1
	Scotch broom	1400	1709	0.3			1
Summary		**1**	**2519**	**0.9**	**90**	**0.00207**	
Charley Creek Road	Bohemian knotweed	**1**	**769**	**0.8**	**100**	**0.00230**	**3**
Chicken Coop Road	Bohemian knotweed	1	369	0.4	0	0	1
	Tansy ragwort	370	1519	0.6	264	0.00606	5
Summary		**1**	**1519**	**1.0**	**264**	**0.00606**	**6**
Cook Road	Canada thistle	**1**	**259**	**0.3**			1
Corriea Road	Poison hemlock	**250**	**849**	**0.6**	**800**	**0.01837**	1
Dan Kelly Road	Bohemian knotweed	1250	3179	1.9	200	0.00459	1
	Tansy ragwort	1	669	0.7	6	0.00014	1
Summary		**1**	**3179**	**2.6**	**206**	**0.00473**	**2**
Deer Park Road	Herb Robert	4820	8739	3.9	1600	0.03673	1
	Scotch broom	4820	8739	3.9	1600	0.03673	2
	Tansy ragwort	250	369	2.3	481	0.01104	12
Summary		**250**	**8739**	**6.2**	**3681**	**0.08450**	**15**
Diamond Point Road	Tansy ragwort	**1**	**519**	**0.9**	**220**	**0.00505**	**8**
Discovery View Drive	Tansy ragwort	**240**	**449**	**0.1**			**2**
E East Beach Road	Meadow knapweed	1	119	0.2	13201	0.30305	17
	Scotch broom	1	119	0.1			1
Summary		**1**	**119**	**0.2**	**13201**	**0.30305**	**18**
E East Lyre River Road	Herb Robert	1	619	0.6	309	0.00709	3
	Meadow knapweed	1	619	0.6	1746	0.04008	14
	Tansy ragwort	1	619	0.6	30	0.00069	1
Summary		**1**	**619**	**0.6**	**2085**	**0.04787**	**18**
E East Sequim Bay Road	Tansy ragwort	**1**	**779**	**0.8**			3
Easterly Road	Meadow knapweed	**1**	**449**	**0.4**	**0**	**0**	**1**
E Runnion Road	Scotch broom	1	259	0.3	9	0.00021	1
	Spotted knapweed	1	259	0.2	1500	0.03444	2
Summary		**1**	**259**	**0.2**	**1509**	**0.03464**	**3**
Eden Valley Road	Fuller's teasel	1	289	0.8	202	0.00464	3
	Herb Robert	290	1389	0.9	120	0.00275	1
	Tansy ragwort	1	289	0.4	30	0.00069	1
Summary		**1**	**1389**	**1.7**	**352**	**0.00808**	**5**
Elwha River Road	Meadow knapweed	**100**	**749**	**0.4**	**13**	**0.00030**	**3**
Farrington Road	Meadow knapweed	670	899	0.3	250	0.00574	3
	Tansy ragwort	1	669	0.5	1604	0.03682	4

Road	Weed	Min Address	Max Address	Miles	Area (ft^2)	Area (acres)	# Patches
Summary		**1**	**669**	**0.8**	**1854**	**0.04256**	**7**
Fisher Cove Road	Meadow knapweed	1	659	0.3	1675	0.03845	12
	Scotch broom	1	659	0.6			1
Summary		**1**	**659**	**0.6**	**1675**	**0.03845**	**13**
Finn Hall Road	Bull thistle	300	1259	0.8			8
	Canada thistle	1	259	0.6			11
Summary		**1**	**1259**	**1.4**			**19**
Fleming Drive	Tansy ragwort	**90**	**319**	**0.2**	**34**	**0.00078**	**4**
Gasman Road	Tansy ragwort	**430**	**549**	**0.1**	**2**	**0.00005**	**2**
Gehrke Road	Canada thistle	1	349	0.3			2
	Scotch broom	1	349	0.3			1
Summary		**1**	**349**	**0.3**			**3**
Glass Road	Bohemian knotweed	**1190**	**2209**	**1.0**			**1**
Gossett Road	Meadow knapweed	**1**	**529**	**0.5**	**172**	**0.00395**	**5**
Gunn Road	Scotch broom	**1**	**119**	**0.1**			**1**
Happy Valley Road	Fuller's teasel	3100	3349	0.2	1400	0.03214	3
	Meadow knapweed	400	819	0.4	42341	0.97202	22
	Scotch broom	4730	5199	0.5	3000	0.06887	1
	Spotted knapweed	2270	2669	0.2	1374	0.03154	13
	Tansy ragwort	2970	3099	0.1	2	0.00005	1
Summary		**400**	**5199**	**1.3**	**48117**	**1.10461**	**40**
Heckle Road	Herb Robert	1	219	0.2	30	0.00069	1
	Scotch broom	1	219	0.2	16	0.00037	4
Summary		**1**	**219**	**0.2**	**46**	**0.00106**	**5**
Henry Boyd Road	Bohemian knotweed	**330**	**439**	**0.1**	**750**	**0.01722**	**1**
Heuhslein Road	Bull thistle	260	639	0.5			5
	Canada thistle	1	259	0.4			9
Summary		**1**	**259**	0.4			**14**
Hoko-Ozette Road	Bohemian knotweed	**1**	**9199**	**9.2**	**300**	**0.00689**	**1**
Hooker Road	Poison hemlock	**140**	**249**	**0.1**	**0**	**0**	**1**
Jamestown Road	Poison hemlock	**1**	**239**	**0.2**	**0**	**0**	**1**
Jimmy Come Lately Road	Meadow knapweed	**1**	**459**	**0.5**	**20**	**0.00046**	**2**
John Jacobs Road	Spotted knapweed	**1**	**679**	**0.7**	**0**	**0**	**1**
Johnson Creek Road	Meadow knapweed	1	269	0.3	4801	0.11022	5
	Yellow archangel	270	1639	0.8			1
Summary		**1**	**1639**	**1.1**	**4801**	**0.11022**	**6**
Kirner Road	Spotted knapweed	**250**	**379**	**0.1**	**4**	**0.00009**	**1**
Kitchen-Dick Road	Bull thistle	1270	1479	0.5			2
	Canada thistle	840	1269	0.6			6

Road	Weed	Min Address	Max Address	Miles	Area (ft^2)	Area (acres)	# Patches
	Fuller's teasel	480	749	0.4	298	0.00684	7
	Meadow knapweed	350	479	0.1	1	0.00002	1
	Scotch broom	1480	2229	0.8			1
	Spotted knapweed	480	749	0.3	153	0.00351	3
Summary		**350**	**1479**	**2.4**	**452**	**0.01038**	**20**
Laird Road	Meadow knapweed	**170**	**659**	**0.3**	**109**	**0.00250**	**5**
Lake Aldwell Road	Meadow knapweed	**1**	**639**	**0.6**	**400**	**0.00918**	**1**
Lake Dawn Road	Orange hawkweed	**1**	**309**	**0.3**	**200**	**0.00459**	**1**
Lewis Road	Bull thistle	500	589	0.2			4
	Canada thistle	350	499	0.2			4
	Scotch broom	890	1059	0.2			1
Summary		**350**	**1029**	**0.6**			**9**
Little River Road	Meadow knapweed	**1**	**3319**	**3.1**	**13575**	**0.31164**	**48**
Lost Mountain Road	Fuller's teasel	3290	4289	1.0	1000	0.02296	1
	Meadow knapweed	1690	2459	0.8	1000	0.02296	2
Summary		**1690**	**4289**	**1.8**	**2000**	**0.04591**	**3**
Lotzgesell Road	Spotted knapweed	**1**	**189**	**0.2**			**1**
Louella Road	Tansy ragwort	**290**	**609**	**0.3**	**20**	**0.00046**	**3**
Lower Elwha Road	Meadow knapweed	1	419	0.3	72	0.00165	6
	Tansy ragwort	1500	1639	0.2	5	0.00011	2
Summary		**1**	**1639**	**0.5**	**77**	**0.00177**	**8**
Lupine Drive	Tansy ragwort	**1**	**439**	**0.4**	**20**	**0.00046**	**2**
Macleay Road	Bull thistle	1	259	0.3			1
	Canada thistle	1	259	0.3			2
Summary		**1**	**259**	**0.3**			**3**
Madrona Way	Tansy ragwort	**1**	**169**	**0.2**	**38**	**0.00087**	**3**
Manzanita Drive	Tansy ragwort	**390**	**569**	**0.2**			**1**
Matson Road	Bull thistle	1	249	0.2			1
	Canada thistle	1	249	0.2			6
	Scotch broom	250	499	0.3			1
Summary		**1**	**499**	**0.5**			**8**
Medsker Road	Yellow archangel	**1**	**509**	**0.5**			**1**
Mount Baker Drive	Meadow knapweed	1	379	0.3			1
	Poison hemlock	1	379	0.3			1
Summary		**1**	**379**	**0.3**			**2**
N Barr Road	Canada thistle	**950**	**1079**	**0.2**			**3**
O'Brien Road	Meadow knapweed	1280	1409	0.1	400	0.00918	1
	Sulfur cinquefoil	1280	1409	0.1	200	0.00459	1
	Tansy ragwort	160	409	0.3	25	0.00057	1

Road	Weed	Min Address	Max Address	Miles	Area (ft^2)	Area (acres)	# Patches
Summary		**160**	**1409**	**0.4**	**625**	**0.01435**	**3**
Old Black Diamond Road	Tansy ragwort	**1**	**269**	**0.2**			**1**
Old Blyn Highway	Tansy ragwort	**2240**	**2539**	**0.3**			**1**
Old Olympic Highway	Bull thistle	2760	2939	0.4			7
	Canada thistle	920	1499	0.5			13
	Field bindweed	4510	5009	0.5	250	0.00574	1
	Meadow knapweed	4510	5009	0.5	13	0.00030	2
	Scotch broom	5770	6269	0.4			3
	Spotted knapweed	5010	5519	0.3	5	0.00011	2
Summary		**920**	**6269**	**2.6**	**268**	**0.00615**	**28**
Olympic Hot Springs Road	Herb Robert	1	239	0.2	200	0.00459	1
	Meadow knapweed	1	239	2.6	23621	0.54226	24
Summary		**1**	**239**	**2.6**	**23821**	**0.54685**	**25**
Palo Alto Road	Fuller's teasel	1590	2159	0.6	1	0.00002	1
	Herb Robert	4490	6479	2.0	90	0.00207	1
	Meadow knapweed	1590	2159	1.5	1573	0.03611	35
	Tansy ragwort	1590	2159	1.1	1883	0.04323	41
Summary		**1590**	**6479**	**3.5**	**3547**	**0.08143**	**78**
Panorama Boulevard	Tansy ragwort	**1**	**169**	**0.2**	**24**	**0.00055**	**2**
Port Williams Road	Tansy ragwort	**278**	**509**	**0.5**	**1**	**0.00002**	**2**
Rhododendron Drive	Tansy ragwort	**600**	**799**	**0.2**	**0**	**0**	**1**
River Road	Meadow knapweed	360	429	0.3	24971	0.57326	7
	Spotted knapweed	360	429	0.3	1685	0.03868	9
Summary		**360**	**429**	**0.3**	**26656**	**0.61194**	**16**
Salal Way	Tansy ragwort	**40**	**329**	**0.3**	**0**	**0**	**1**
Sequim-Dungeness Way	Common fennel	4610	4659	0.1	9	0.00021	1
	Fuller's teasel	4090	4139	0.1	301	0.00691	2
	Meadow knapweed	2260	2509	0.3	0	0	1
	Spotted knapweed	1510	1709	0.2	590	0.01354	3
	Tansy ragwort	3890	4089	0.2	300	0.00689	1
Summary		**1510**	**4659**	**0.6**	**1200**	**0.02755**	**8**
Sherwood Road	Tansy ragwort	**1**	**289**	**0.3**	**266**	**0.00611**	**5**
Shore Road	Bull thistle	670	919	0.2	0	0	1
	Canada thistle	540	609	0.1			3
Summary		**540**	**919**	**0.4**			**4**
Slab Camp Road	Meadow knapweed	1	679	0.7	25	0.00057	1
	Scotch broom	1	679	0.7	500	0.01148	1
	Tansy ragwort	1	679	0.7	4	0.00009	1
Summary		**1**	**679**	**0.7**	**529**	**0.01214**	**3**

Road	Weed	Min Address	Max Address	Miles	Area (ft^2)	Area (acres)	# Patches
S Airport Road	Tansy ragwort	**4000**	**4399**	**0.2**			**3**
S Bean Road	Meadow knapweed	**3750**	**3799**	**0.1**	**176**	**0.00404**	**3**
S Doss Road	Tansy ragwort	**4300**	**5030**	**0.5**	**415**	**0.00953**	**6**
S Mount Angeles Road	Meadow knapweed	4800	5619	0.6	1	0.00002	1
	Tansy ragwort	4300	4730	0.4	16	0.00037	2
Summary		**4300**	**4730**	**1.0**	**17**	**0.00039**	**3**
S South Shore Road	Orange Hawkweed	**1370**	**1519**	**0.2**	**0**	**0**	**3**
Spring Road	Bull thistle	1	29	0.3			2
	Canada thistle	30	559	0.5			2
Summary		**1**	**559**	**0.8**			**4**
Sunshine Avenue	Tansy ragwort	**350**	**429**	**0.1**	**20**	**0.00046**	**1**
Sunshine Plaza	Tansy ragwort	**1**	**129**	**0.1**	**50**	**0.00115**	**1**
Taylor Cut-Off Road	Butterfly Bush	810	1319	0.5	310	0.00712	4
	Poison hemlock	810	1319	0.3	0	0	2
	Tansy ragwort	1740	1919	0.2	4	0.00009	1
Summary		**810**	**1919**	**0.7**	**314**	**0.00721**	**7**
Taylor Ranch Road	Tansy ragwort	**1**	**529**	**0.5**	**90**	**0.00207**	**5**
Thompson Road	Tansy ragwort	**190**	**1299**	**1.1**	**0**	**0**	**2**
Township Line Road	Meadow knapweed	**640**	**729**	**0.1**	**200**	**0.00459**	**1**
TRIPP Road	Orange Hawkweed	**1**	**259**	**0.2**	**500**	**0.01148**	**1**
Turnstone Lane	Spotted knapweed	**180**	**689**	**0.5**			**2**
Vautier Road	Canada thistle	1	279	0.3			2
	Scotch broom	1	279	0.3			1
	Spotted knapweed	510	639	0.1			1
Summary		**1**	**639**	**0.4**			**4**
Vista View Drive	Poison hemlock	**1**	**229**	**0.2**	**150**	**0.00344**	**1**
Ward Road	Yellow Archangel	**420**	**589**	**0.2**			**1**
W Anderson Road	Field bindweed	**1**	**249**	**0.2**	**400**	**0.00918**	**1**
W Edgewood Drive	Meadow knapweed	2100	2299	0.4	3950	0.09068	24
	Tansy ragwort	2100	2299	0.3			1
Summary		**2100**	**2299**	**0.4**	**3950**	**0.09068**	**25**
W Lauridsen Boulevard	Meadow knapweed	**1240**	**1361**	**0.4**	**3511**	**0.08060**	**7**
West Street	Tansy ragwort	**140**	**159**	**0.0**	**75**	**0.00172**	**1**
W Washington Street	Spotted knapweed	**1500**	**1699**	**0.3**			**4**
W West Lake Pleasant Road	Bohemian knotweed	440	629	3.6	4870	0.11180	9
	Herb Robert	630	4729	4.0			1
	Yellow Flag Iris	630	4729	4.0	80	0.00184	2
Summary		**440**	**4729**	**7.7**	**4950**	**0.11364**	**12**

Road	Weed	Min Address	Max Address	Miles	Area (ft^2)	Area (acres)	# Patches
W West Lyre River Road	Meadow knapweed	**1**	**319**	**0.3**	**8102**	**0.18600**	**20**
W West Sequim Bay Road	Spotted knapweed	1410	1989	0.3	3	0.00007	3
	Tansy ragwort	1410	1989	0.3	1	0.00002	1
Summary		**1410**	**1989**	**0.3**	**4**	**0.00009**	**4**
Whiskey Creek Beach Road	Herb Robert	1	459	0.5	120	0.00275	1
	Meadow knapweed	1	459	0.5	180	0.00413	1
	Tansy ragwort	1	459	0.3	815	0.01871	7
	Yellow flag iris	1	459	0.5	80	0.00184	1
Summary		**1**	**459**	**0.5**	**1195**	**0.02743**	**10**
Wild Currant Way	Scotch broom	**1**	**99**	**0.1**			**1**
Woodcock Road	Bull thistle	1	339	0.2			5
	Canada thistle	340	759	0.3			14
	Meadow knapweed	1950	2269	0.3	1	0.00002	2
	Poison hemlock	1250	1639	0.3	1480	0.03398	5
	Scotch broom	340	759	0.3			4
Summary		**1**	**2269**	**1.1**	**1481**	**0.03400**	**30**
Woods Road	Chicory	1	2839	2.9	400	0.00918	1
	Herb Robert	1	2839	2.9	1420	0.03260	3
	Meadow knapweed	1	2839	2.9	20	0.00046	1
	Tansy ragwort	1	2839	2.9	2928	0.06722	25
Summary		**1**	**2839**	**2.9**	**4768**	**0.10946**	**30**
Grand Summary				**94.7**	**186,619**	**4.28418**	**793**

Appendix J References

Noxious weed list

2015 Washington State Noxious Weed List. http://www.nwcb.wa.gov/pdf/-11%20x%2017%20weed%20list%202015_by_common_name.pdf

2015 Washington State Noxious Weed List. http://www.nwcb.wa.gov/pdf/-noxious%20weed%20list%202015_by_scientific_name.pdf

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Pictures of Class B Noxious Weeds. Washington State Noxious Weed Control Board http://www.nwcb.wa.gov/searchResults.asp?class=B

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