CHIMACUM CREEK RESTORATION AND PROTECTION STRATEGY

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement no. SEANEP-2015-NOISC-00008 to North Olympic Salmon Coalition. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA or ECOLOGY endorse trade names or recommend the use of commercial products mentioned in this document.

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Acknowledgments

A very special thank you to all of the agricultural producers along Chimacum Creek without whom this project would never have been conceived or implemented.

This report was developed by the North Olympic Salmon Coalition (NOSC) with Jefferson County Conservation District (JCCD), Washington State University (WSU), Jefferson County Noxious Weed Control Board (JCNWCB), Jefferson Land Trust (JLT) and Natural Systems Designs, Inc (NSD, Inc.). A Technical Advisory Group, The Chumsortium, helped to identify recommended watershed protection strategies and provided needed input for the landowner outreach strategy. The advisors included representatives from the following organizations and agencies: Hood Canal Coordinating Council, Jefferson County Department of Environmental Health, Jefferson County, Jefferson Land Trust, Washington State University, Jamestown S'Klallam Tribe, Washington Department of Fish and Wildlife and the Jefferson County Conservation District.

The report was edited and partially written by Sarah Doyle. Other contributing authors included Emily Bishop (NOSC), Jill Zarzeczny (JCCD), Glenn Gately (JCCD), Craig Schrader(JCCD) , Jerry Clark (JCCD), Susan Dickerson-Lange, (NSD, Inc.), John Soden (NSD, Inc.), Tim Abbe (NSD, Inc.), Darcy McNamara (WSU), Bob Simmons (WSU), and Joost Besijn (JCNWCB). Other contributors included Al Latham (JCCD), Sarah Spaeth (JLT), Owen Fairbank (JLT), Erik Kingfisher (JLT), Malloree Weinheimer (JCNWCB), Owen French (WCC), and Laura Lewis (WSU). Also, many thanks to Katherine Baril, Kate Dean, Kellie Henwood and Judith Rubin.

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INTRODUCTION

This document is part of a collaborative project by local organizations in Jefferson County, Washington, to develop and implement a protection and restoration strategy and engage agricultural landowners for improving and protecting riparian habitat on Chimacum Creek. Partners have been working in the watershed for over 30 years to improve the health of the creek. This document will be the guiding force for future restoration and protection work within the watershed to ensure that all goals are met for both landowners and the organizations. The document provides landowners and restoration practitioners with a look ahead at the major obstacles that should be addressed when moving forward with restoration work.

The North Olympic Salmon Coalition (NOSC) is the lead sponsor of this project. Partners include: Jefferson Land Trust (JLT), Washington State University Jefferson County Extension (WSU), Jefferson County Conservation District (JCCD), and the Jefferson County Noxious Weed Control Board (JCNWCB). Funding is provided by the National Estuary Program (NEP), through a grant administered by the Washington Department of Ecology (WA DOE).

This document will provide outreach and restoration and management recommendations for the Chimacum Watershed to improve water quality and riparian health within the watershed while maintaining the vibrant agricultural community that resides within the floodplain.

Ultimately, protection of the watershed relies on the support of watershed residents. This plan is intended to be used by the entire watershed community to improve the health and habitat of the creek, and expand the local economy and well-being of the community. Through involvement of the entire watershed community, our legacy can be one of collaborative, inclusive management for a healthy Chimacum Creek that supports our agricultural community.

Background

Geographic Description

The Chimacum Creek Watershed is located in the far north eastern side of the Olympic Peninsula in East Jefferson County, Washington. The watershed slopes in the shape of a 'Y' with the main stem draining north to Admiralty Inlet, Puget Sound (Figure 2). Combined stream length of the East and West Forks is approximately 29.5 miles. The low-gradient creeks drain approximately 37 square miles of land, forming the largest drainage basin on the Quimper Peninsula. In the rain shadow of the Olympic Mountains, the Chimacum Watershed receives approximately 29 inches of rain per year.

Chimacum Creek originates in a number of spring fed tributaries and lakes in the forested hills of the Quimper Peninsula. The main stem originates from Delanty Lake at River Mile (RM) 13.1. From Delanty Lake to RM 11.8 at Old Eaglemount Road, the stream passes through agricultural land with peat soil and very low gradient. This section of stream is dry from about June to October. From RM 11.8 to RM 9.3 Chimacum Creek passes through predominantly commercial forestland. The stream in this forested

reach has good gradient and stream complexity, although large woody debris (LWD) is still lacking in this reach. There is extensive coho and trout spawning in this reach. From RM 9.3 to 3.4 at Highway 19, the creek passes through agricultural land with peat soil. Below RM 3.4, the creek passes through predominantly residential and mixed use lands before entering a forested ravine in the last mile. East Chimacum Creek originates in forested wetlands south of Egg and I Road. It leaves the forest at RM 5.4 and travels through mostly agricultural land until the confluence with the main stem at RM 2.7. These low gradient agricultural lands are the focus of our protection and restoration strategy. Below RM 3.4, the creek passes through predominantly residential and mixed use lands before entering a forested ravine in the last mile.

Chimacum Creek is approximately 20 feet wide for most of its length within the project area, and is situated within a broad lowland valley. The width of the valley ranges from over 3,000 feet wide to less than 100 feet; more constrained reaches are located where the creek cuts through glacial moraines, or where the creek descends from the upland glacial plateau to the lowland valley. Valley width is over 1000 feet on relatively flat portions of the upland glacial plateau, at elevations ranging from about 300-600 feet.

Current Creek Health

Riparian zones in the headwater areas are predominantly forested with a mixture of mature coniferous and deciduous trees, while riparian areas within the project area are dominated by reed canarygrass, willow, bulrush, and occasionally alder trees. In the 1950's, reed canary grass was introduced to pasture areas as wet-tolerant forage species for cattle. Reed canarygrass proved to be extremely invasive. It now covers banks and floodplains and clogs and fills stream channels, preventing adequate flow, depleting dissolved oxygen and precluding the establishment of native riparian plant species. The flooded pastures, lack of riparian cover, and decomposing reed canarygrass in the fall have resulted in increased water temperatures and decreased dissolved oxygen values (JCCD 2015).

Chimacum Creek is listed in the *Hood Canal Pollution Identification and Correction Plan* (2014) having been established as a source of pollutants, particularly fecal coliform, by the Jefferson County Department of Health. Chimacum Creek is listed as a Category 5, 303(d) water body in the *Water Quality Standards for Surface Waters of the State of Washington*. Chimacum Creek and tributaries are categorized as 'core summer salmonid habitat', which calls for a 7-day average daily maximum temperature (7-DADMax) of 16 degrees Celsius. Chimacum Creek and East Chimacum Creek are both on Ecology's 303(d) list for having failed the temperature standard. Of the 29 stations monitored with temperature data loggers in 2013, 16 stations (55%) failed to meet the 7-DADMax-16^{o}C standard. The main stem of Chimacum Creek is listed for failure to meet water quality standards for fecal coliform bacteria and temperature. East Chimacum Creek is listed for temperature exceedances only, although fecal coliform exceedances had also been found there by the Jefferson County Conservation District (Jefferson County, 2011).

Salmonid Limiting Factors in Chimacum Watershed

Anadromous fish runs historically include native coho, summer chum (in the lower 2 miles) and steelhead. Resident fish runs include abundant cutthroat and rainbow trout. Native coho and chum runs in the Chimacum Watershed are greatly diminished from historic levels (Lichatowich, 1993). According to the Salmon and Steelhead Stock Assessment (SASSI), Chimacum coho are a unique stock due to their geographic isolation and late run timing. The 2002 Salmon and Steelhead Stock Assessment lists the Chimacum coho as 'healthy'; however, the SASSI report states that this rating is provisional, as there are concerns that the index data may represent only better-quality coho spawning habitat and may not be representative of the total basin (WDFW,2002). A habitat assessment for the watershed documented a greater than 90% loss of juvenile coho rearing habitat over the last 150 years (Bahls and Rubin 1996). Since European settlement in the 1850s, an estimated 6% of summer rearing habitat, 3% of winter rearing habitat, and 88% of spawning habitat remains (Correa 2002). Major problems include low dissolved oxygen and elevated temperatures associated with the lack of forested riparian cover, heavy siltation of spawning and rearing gravels in the main stem and tributaries, and loss of channel complexity and structure, particularly the loss of LWD that forms pool habitat (Bahls and Rubin 1996).

Figure 1. Coho Salmon returning to Putansuu Creek, a tributary of Chimacum Creek

Riparian degradation has been identified as a significant limiting factor for Summer Chum in the Summer Chum Salmon Recovery Plan (HCCC 2015) Table 6.1, in the Chinook salmon and Bull Trout Recovery Plans, in the WRIA 17 Management Plans, and in the Summer Chum Conservation Initiative. Virtually all watershed assessments and species recovery plans, from landscape to reach scales, call for improving and restoring riparian habitat quality and quantity. There are also numerous limiting factors cited in multiple Salmon Recovery Plans, such as water temperature, LWD production, and channel complexity among others that are addressed by restoring and improving riparian habitat. Moving riparian habitats to a later successional state, and expanding the quality and quantity of riparian areas is a self-sustaining restoration technique. Once the riparian areas are firmly established, they will help address multiple limiting factors for Hood Canal Summer Chum and other salmonids. Further explanation of current riparian conditions can be found in the ‘Chimacum Creek Riparian Management Plan’ that is appended onto this document.

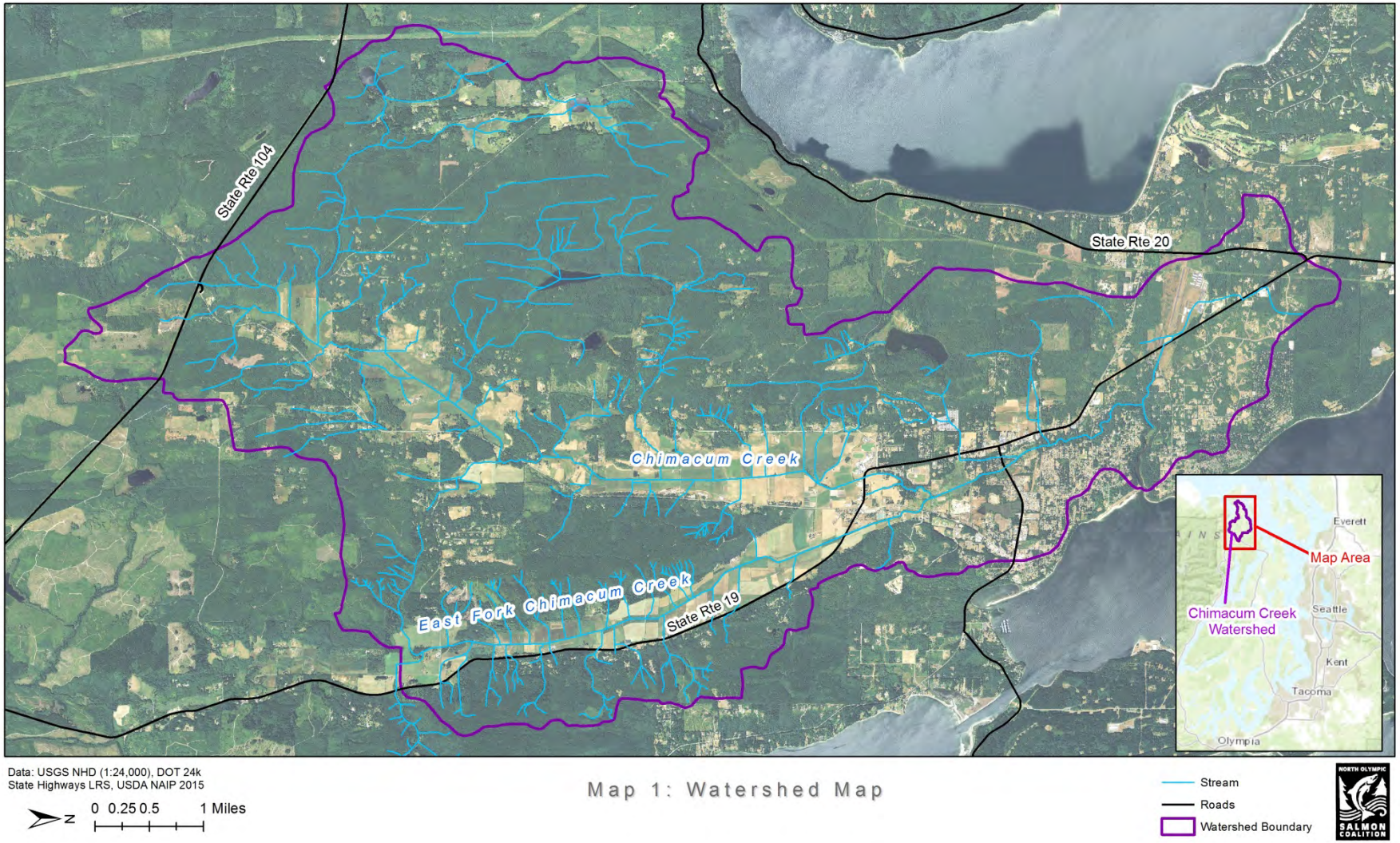


Figure 2. Chimacum Creek Watershed

Land Use History

All land within the management area is owned by 61 landowners and is comprised of 60% agricultural/open space land use with the remainder 40% of the properties being small hobby farms or households on acreage. General Land Office surveys, conducted between 1858 and 1873, reported both branches of Chimacum Creek to be dominated by beaver marshes, cedar and spruce swamps, and shallow lakes (Bahls and Rubin 1996). To facilitate farming, much of Chimacum Creek and its tributaries were channelized, tile drains were installed, and ditches were excavated to improve drainage. Historically, numerous dairy farms were operated in the watershed. Today, the most common agricultural activities are pasturing beef cattle, horses and sheep, and growing hay and vegetable crops. Table 1 compares the historic conditions of Chimacum Creek to the current conditions and the percentage of habitat that has bene lost as a result of these changes.

Figure 3. Cattle in Chimacum Creek (date unknown)

Until the 1980s, when cattle exclusion fencing along creeks began more earnestly, livestock had access to much of Chimacum Creek. Monitoring downstream of agricultural areas in the 1980s and 1990s revealed high fecal coliform concentrations which were generally attributed to manure from livestock. Since the 1980s, many miles of fencing have been installed along the banks of Chimacum Creek and its tributaries. Through fencing and other Best Management Practices (BMPs), progress has been made in reducing fecal coliform levels in Chimacum Creek. Although the creek is now fenced, lack of riparian cover and the presence of invasive reed canarygrass has resulted in poor water quality and degraded salmonid habitat within the planning area.

River Component	Historic	Current	Percent reduction	Information Source
Wetlands	2240 acres (1650 inundated in the winter only and 590 inundated year-round)	904 acres of wetland (classified by the NLCD) within the historic footprint, much of which is located on agricultural properties	>60%	Spatial analysis of (Bahls & Rubin, 1996) and (Homer et al., 2015)
River channel length	27.2 miles	21.7 miles	>20%	Based on winter rearing habitat length reported in Table 4 of (Bahls & Rubin, 1996)
Riparian Forest	Unknown, but very high before agricultural conversion	36 % of main channels has some riparian vegetation in various stages of maturity after re-planting	>60%	Spatial analysis of (USDA, 2015)
Agricultural ditches within valley bottom	Unknown tributary lengths; no agricultural ditches	Approximately 16 miles of tributary/distributary ditches within valley bottom, 26% has some riparian vegetation	Unknown	Spatial analysis of (USDA, 2015)

Table 1: Current vs. historic creek conditions

Past Protection and Restoration Efforts

Chimacum Creek has a long history of protection and restoration (Figure 5). Landowners and conservation groups have been collaborating to develop ways to balance the needs of the agricultural community with the environmental health of the Chimacum Watershed.

Since 1991, concurrent with the reestablishment of ESA-listed Hood Canal Summer Chum in Chimacum Creek, the Jefferson Land Trust has protected6.7 miles of Chimacum Creek riparian buffers with 14 conservation easements that also protect over 550 acres of farmland. A further 160 acres, extending along 2 miles of the lower main stem have been acquired by Jefferson Land Trust, the Washington Department of Fish and Wildlife, and Jefferson County for permanent habitat protection.

Conservation Reserve Enhancement Program (CREP) plantings and other non-CREP funded riparian restoration projects have resulted in tens of thousands of trees and shrubs being planted in riparian buffers in the Chimacum watershed. Planted riparian buffers in the watershed encompass 82.2 acres and 9.3 miles of stream length. The thousands of trees that have been planted in riparian buffers over the years are making a measurable difference in the water quality of Chimacum Creek. Regression analysis of the average of the maximum daily highs for July and August from 1998 to 2013 shows downward temperature trends at three key stations downstream of riparian planting projects (JCCD 2015).

Within the planning area, four stream channel restoration projects were conducted by NOSC and JCCD which restored over 1.5 miles of spawning and rearing habitat. These projects involved construction of re-meanders, placement of woody debris, the creation of gravel spawning pads, and installation of tree plantings. The efforts have proven to be successful. Sites that were once reed canarygrass ditches with silted bottoms, now have decreased water temperatures and salmon actively spawning and rearing within the reaches.

Figure 4. Restoration project on mainstem Chimacum Creek (2000)

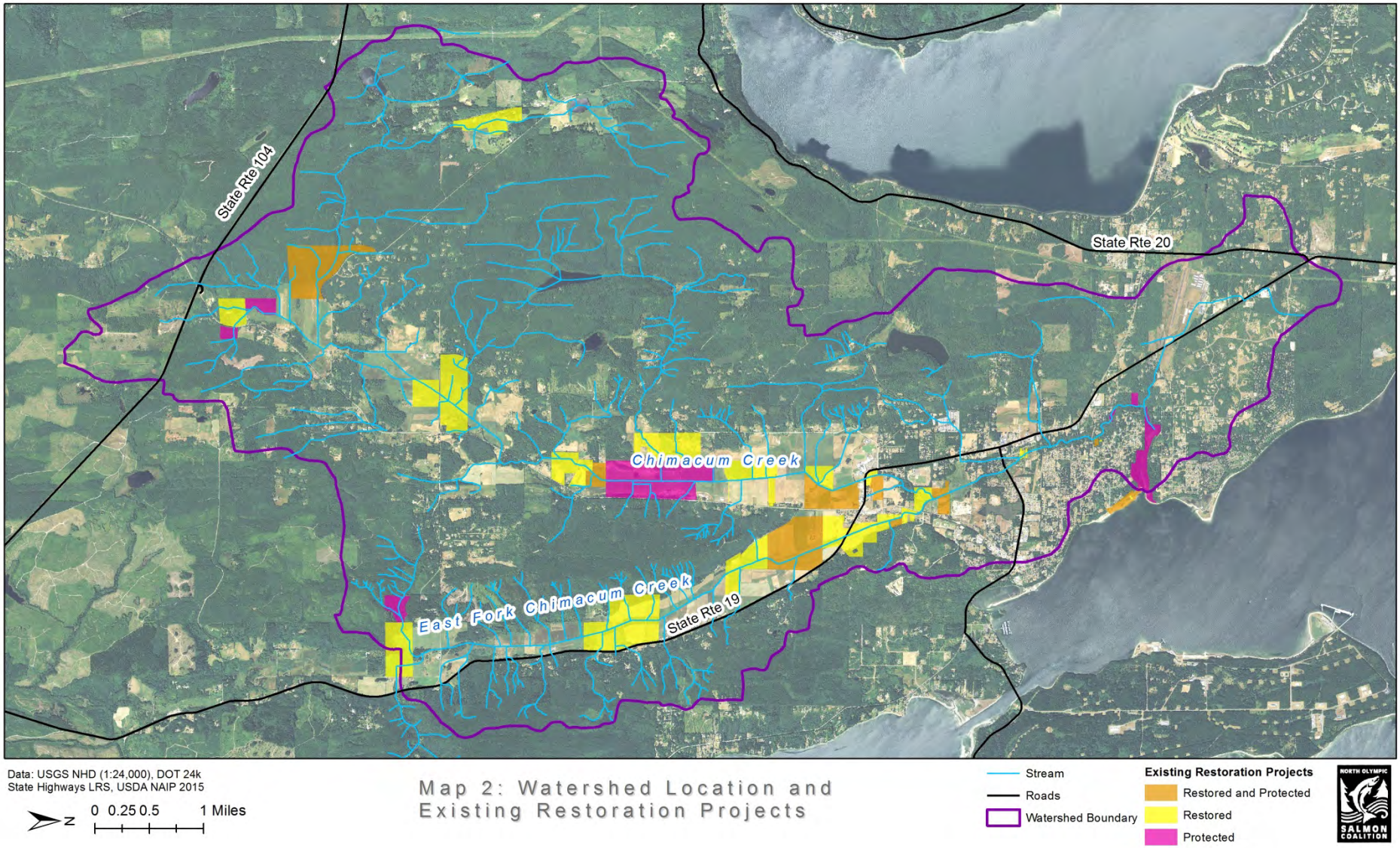


Figure 5. Past restoration and protection projects on Chimacum Creek

MANAGEMENT PLAN SUMMARIES

The documents developed as a result of this planning project are designed to address the ongoing issues within the Chimacum Creek watershed that have been impeding landowner participation to fish habitat and water quality improvements. Since landowners have struggled with drainage, beaver and reed canarygrass infestations over the last two decades, project partners felt that there needs to be a concerted effort to address community concerns in order to identify and seek to overcome the barriers to restoration. The following section provides a brief summary of the documents developed during this planning process. The full detailed reports can be found in the appendices of this document.

Geomorphic Assessment

Background and Purpose

This document (Appendix B) describes assessment of the spatial relationships between water quality issues and geomorphic features in Chimacum Creek, in order to prioritize future analyses and conservation and restoration efforts. The authors drew on previously collected point data and publicly available spatial data to identify opportunities for restoration and key data gaps.

Geomorphology

Natural Systems Design, Inc. (NSD, Inc.) characterized the geomorphic features of the Chimacum Creek floodplain by mapping elevation of the valley relative to the elevation of the nearby water surface. The Relative Elevation Map (REM) map and elevation profiles across the channel and floodplain were used to identify remnant floodplain features such as meander bends, and current impairments to floodplain connectivity such as channel down-cutting (i.e., incision).

The geomorphic features of the Chimacum Creek valley are consistent with its historic form as an alluvial valley with abundant wetlands (Figure 3). In particular, there are many continuous lowland areas surrounding what is now the channel. Most of these low areas identified in the REM maps also coincide with General Land Office (GLO) survey wetland data presented in Bahls & Rubin (1996). NSD identified several locations where the channel is incised relative to its floodplain and where the current channel is higher than nearby remnant meanders in many cases, as the result of past and current land uses. Note that the topographic and REM analyses are limited by the spatial resolution and accuracy of the Light Detection and Ranging (LIDAR) data, and additional ground surveys are recommended (see Recommendations section).

Geomorphic assessment in the 1990s found a general lack of LWD, channel complexity, and side channels (data from Bahls & Rubin 1996), and these features were reiterated in a 2002 assessment of habitat. The present assessment of channel and floodplain features based on the REM also found channel complexity is low except where previous restoration actions such as channel re-meandering have been implemented.

Water Quality

The most frequent water quality exceedances for high temperature and low dissolved oxygen occurred in the main stem of Chimacum Creek. The spatial pattern of water quality exceedances overlaid with riparian vegetation suggests that locations downstream of un-vegetated ditched sections are more likely to have impaired water quality, but there is not a robust statistical correlation (Gately et al., 2015). Water temperature is mainly controlled by net solar radiation and advection of different temperature water from tributary inflow, or groundwater (Moore, Spittlehouse, & Story, 2006). Thus, in-situ heating in un-vegetated reaches as well as warm inflow from un-vegetated channel and tributary ditches are likely the main contributors. Spatial analysis of the aerial imagery indicates that approximately 64% of the main channel is un-vegetated within the valley bottom (Table 1). Additionally, there are approximately 16 miles of ditches, of which only 26% is vegetated. It is unknown what percentage of the ditches are tributaries versus distributaries relative to the main channel.

Temperature exceedances are also associated with the flow regime in Chimacum Creek. Observational data collected by Jefferson County Conservation District suggest that water temperature is generally higher at lower stream flows. The typical timing of low flows during the summer coincides with warmer air temperatures, and, during low flows there is less cold water advected into the system and less total mass to heat.

Fish Passage Barriers

Barriers to fish passage at road crossings in the Chimacum Creek watershed were previously identified and prioritized for removal or modification (e.g., Bahls & Rubin, 1996; Correa, 2002; Smayda Environmental Associates, 2001). While fish passage assessment is outside the scope of this analysis, NSD, Inc. emphasizes reconnection of viable habitat is a high-priority restoration action to consider. As of 2001, the prioritized list of Jefferson County owned fish passage barriers on Chimacum Creek included the following (note that the number in parenthesis is priority level assigned in Table 2 of Till, Soncarty, & Barber (2000):

- Chimacum Creek at Eaglemount Road (#5 for Jefferson County)
- Naylors Creek at West Valley Road (#9 for Jefferson County)
- Naylors Creek at Gibbs Lake Road (#11 for Jefferson County)
- Chimacum Creek at Center Road (#12 for Jefferson County)
- Chimacum Creek at Eaglemount Road (#26 for Jefferson County)
- E Chimacum Creek at Egg & I Road (#30 for Jefferson County)
- Unnamed Tributary to Chimacum Creek at Eaglemount Road (#40 for Jefferson County)
- Unnamed Tributary to Chimacum Creek at Center Road (#52 for Jefferson County)
- Unnamed Tributary to Chimacum Creek at Center Road (#82 for Jefferson County)

Washington Department of Fish and Wildlife completed fish passage barrier assessments on Chimacum Creek in 2016 (http://apps.wdfw.wa.gov/fishpassage/). These assessments indicated locations and passability of culverts on private agricultural lands that were not included in the Jefferson County culvert survey listed above. A Priority Index (PI) applied to several culverts within the watershed will help practitioners in determining future fish passage barrier removal projects.

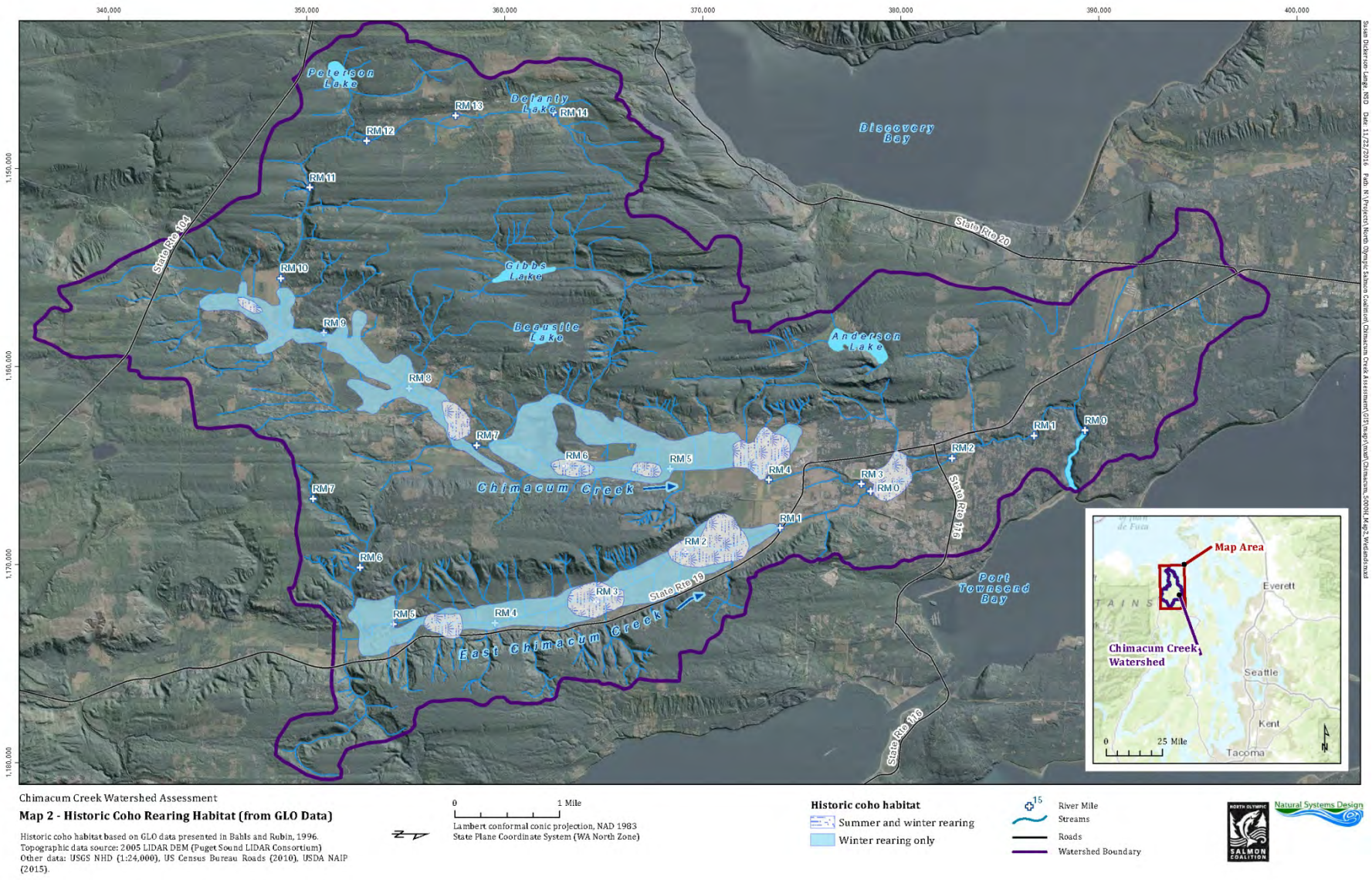


Figure 6. Historic wetlands in Chimacum watershed.

Riparian Management Plan

Background and Purpose

The Riparian Management Plan (Appendix C) will act as a tool to assist landowners and local conservation planners in making management decisions for the riparian areas on their property. It will describe the suite of best management practices that can be implemented to meet sustainable land use goals.

Valley reaches with riparian vegetation were delineated based on 2015 aerial imagery (USDA, 2015). Approximately 36% of the main channel and 26% of the tributary/distributary ditches are vegetated. The riparian vegetation communities range in maturity and in areal extent, and are generally the result of restoration, for example, planting of Conservation Reserve Enhancement Program (CREP) buffers (personal communication with Sarah Doyle, 2016). Over 9 river miles of riparian vegetation, covering over 80 acres, were restored as of 2015 (Gately et al., 2015). Since the main land use of the valley area is agriculture or pasture, restored riparian vegetation is generally limited to an approximately 10-400-foot corridor spanning the channel.

Key Challenges and Concerns

Ecological and socio-political characteristics present in the Chimacum Creek watershed intersect to create key challenges and concerns among the landowners and conservation planners in this area. To address the challenges and concerns on a watershed scale, this plan seeks to identify each challenge independently in order to understand how they influence the one another. This plan will examine the following key challenges and concerns of the Chimacum Creek watershed stakeholders:

- Drainage management
- Buffer widths
- Noxious weeds in riparian buffers
- Beaver activity in the Creek

Drainage Management

"Prime" agricultural soils—identified by US Department of Agriculture Natural Resource Conservation Service (NRCS)— are those in the lowland floodplains of the Chimacum Valley; and most of these soils are wetland soils, making drainage management a challenge and a priority for local agricultural producers for more than a century (McNamara and Simmons 2016). Around the turn of the 20th century, coniferous forests were converted to pasture and much of Chimacum Creek and its tributaries were channelized and drainage improving tiles were installed. Agricultural producers along the creek formed a Drainage District in 1921 to manage and maintain the waterways (Bahls and Rubin 1996). Drainage District members worked together to clean out accumulated fine sediment and invasive vegetation from low-gradient reaches in order to maintain function and flow of the creek for agricultural purposes. In early 1970's the drainage district board resigned and has remained inactive.

Fields and pasture along Chimacum Creek have regularly flooded in the winter, which provide habitat for trumpeter swans and other waterfowl during that season (Latham 2004). However, when invasive

vegetation and sediment are left unmanaged, long-term flooding in low-gradient reaches of the watershed not only reduces acreage of farmable land, but also can impact fish passage and results in low levels of dissolved oxygen in the water. Landowners cite difficulty in acquiring permits to work in the creek due to stricter regulations and cost of maintenance activities as road blocks to maintaining the drainage as they had in the past.

Buffer Widths

The term "riparian buffer" describes a vegetated strip buffering the stream against the activities that lie beyond it. Riparian buffers provide a number of valuable functions to their adjacent waterways and associated wildlife:

- Improve fish habitat by providing large woody debris, cooling the water, and maintaining high levels of dissolved oxygen by reducing excessive vegetation from decaying in waterways;
- Stabilize stream banks and prevent soil erosion into waterways;
- Prevent excess nutrients and pollutants from surrounding lands from entering waterways.

While it is agreed upon that buffers are vital to water quality and habitat, there is not consensus on the best buffer width. This is a result of a number of factors. First, the desired buffer function must be defined for the site or watershed (e.g., shade for cooler water temperatures, native vegetation to prevent erosion and compete with invasive weeds, prevention of nutrients and pollutants from entering the stream, etc.). Secondly, variable site condition, including soil type, slope of the land, and surrounding land use that can impact the effectiveness of buffers at varying widths, must be taken into consideration.

The Jefferson County Department of Community Development is in the process of updating its Critical Areas Ordinance (CAO) in accordance with the requirements of the 1990 Washington State Growth Management Act (GMA). Existing and ongoing agriculture has historically been exempt from critical areas regulations established under the GMA. However, in 2005, case law established that existing agriculture can generally no longer be exempted from critical area ordinances (Clallam County v. Western Washington Growth Management Hearings Board, 2005).

Following the legal change, a temporary allowance for agricultural exemptions was put in place (RCW 70A.560) while the conflict between protecting agricultural lands and protecting critical areas under GMA was examined. The temporary allowance ended in 2011, when Washington State adopted the Voluntary Stewardship Program (VSP) (RCW 36.70A.705 – 904). The purpose of VSP is to protect natural resources, including critical areas, while maintaining and enhancing the state's agricultural lands. It encourages voluntary local stewardship efforts as an alternative to critical areas regulation and enforcement under the GMA. In 2011 and 2012, Jefferson County considered the VSP program and ultimately decided not to participate (Jefferson County BOCC, 2012). The Board of County Commissioners recognized that site-specific farm plans and associated BMPs, coupled with watershed-wide restoration efforts, were already being implemented (and would continue) to protect critical areas and sustain agricultural activities in Jefferson County. An update to the CAO will likely impact agricultural

producers by removing the temporary allowance so discussion of the buffer widths and their benefits is a pertinent discussion for land management efforts in the watershed. Concepts that should be discussed and studied for effectiveness are working buffers and flexible buffers (Page 12- *Riparian Management Plan*).

Noxious Weeds in Riparian Buffers

Landowners in the Chimacum Valley have been struggling to manage reed canarygrass in an effective manner that doesn't hinder fish habitat or cause loss of agricultural lands. Reed canarygrass (*Phalaris arundinacea)*, a fast-growing, rhizomatous perennial grass, is a major concern for riparian restoration and agricultural production in Western Washington. Monoculture precludes establishment of native tree and shrub species and can cause flooding and drainage issues on agricultural lands.

The plan provides recommendations for riparian plantings in reed canarygrass infested areas. The methodology that would be most practical for a site would depend upon the hydrology, degree of infestation and the presence/absence of native plant species. Several studies were reviewed to determine successful suppression techniques for RCG while keeping in mind the applicability of the technique within the Chimacum watershed.

Beaver Activity

Since beaver management was a key issue for landowners within the watershed and is directly tied to forested riparian buffers, partners worked together to develop a separate beaver management plan to address beaver activity on the creek. The Beaver Management Plan (Appendix D) is summarized below.

Beaver Management Plan

Background and Purpose

The purpose of the Beaver Management Plan (Appendix D) is to assist landowners and local conservation planners in making management decisions regarding beaver activity in the Chimacum Creek watershed, balancing habitat needs of beaver and associated wildlife and the need to protect private property and resources – with a focus on agricultural lands. The plan outlines a transparent process for evaluating beaver impacts on both a watershed scale and a site-specific scale. It highlights the spectrum of adaptive best management recommendations. All beaver management actions require ongoing maintenance and monitoring. A flexible adaptive management plan is well-suited to address beaver-related resource concerns. The plan was reviewed and approved by the Washington Department of Fish and Wildlife for concurrence with their current regulations for beaver management.

Beaver were present in the Chimacum Creek watershed since long before the area was settled. However, around the turn of the 20th century, beaver habitat was significantly reduced as a result of watershed-scale alteration of the forested and meandering stream. The combination of habitat loss and increased trapping resulted in a greatly reduced beaver population.

In the late 1990's, tree and shrub buffers started being established along portions of the creek and beaver began to move back into this system. Most of the buffer sites that have been planted have seen beaver activity and a loss of trees. In addition to local beaver populations existing in close proximity to agricultural resources and infrastructure, poorly draining soils and clogging of the creek from RCG and other aquatic noxious weeds makes this area particularly at risk for flooding.

Beaver dams are established in 17 known locations within the valley bottom in both forks of the Chimacum Creek (personal communication with S. Doyle, 2016). Beavers serve an important function in the Chimacum Creek watershed because they create floodplain waterbodies and areas of backwater that create habitat complexity and are critical rearing areas for Coho (Pollock et al., 2004).

Beavers require robust riparian vegetation, and preferred browsing species are cottonwood, willow, and aspen (Boyle & Owens, 2007). Due to concerns with beaver impact on maintaining immature riparian buffers when beavers are present, guidance from the Washington Department of Fish and Wildlife (2004) recommends interspersing less desirable riparian plant species Sitka spruce, elderberry, cascara, Indian plum, pacific ninebark, and twinberry with preferred browsing species. Beavers also require perennial streamflow and relatively low stream power, which is controlled by channel gradient and streamflow. Previous investigations in the Pacific Northwest suggest a maximum gradient of 0.06 in the lower part of the watershed (where contributing area is higher), up to a maximum gradient of 0.1 in headwaters where contributing area is lower (see Figure 2 in (Pollock et al., 2004)).

Classification of Suitable Beaver Habitat

NSD's *Geomorphic Assessment of Chimacum Cree*k includes a hydrologic assessment that identifies suitable beaver habitat along the Creek based on preferred gradient requirements for beaver establishment (Figure 7**)**. In the project area, where agricultural land dominates the landscape along

Chimacum Creek, *suitable* is defined as reaches that have habitat characteristics that can support beaver populations and where potential damage to resources and infrastructure is minimal or can be mitigated. These watershed-scale classification categories are the first level of evaluation in determining management responses. The three categories of reach classification for beaver habitat in the Chimacum Watershed are:

- *Beaver Conservation Zone*—reaches capable of supporting beaver populations and dam building without negative effects on infrastructure or resources.
- *Living with Beaver Zone*— reaches where beaver activity has potential to cause damage, but impacts are minimal and/or mitigated with adaptive management strategies.
- *Nuisance Beaver Zone*— can support beaver populations at low densities, but due to presence of sensitive infrastructure or resources, these are areas where beaver are discouraged.

Beaver and Restoration Design

It is important for conservation planners to take into account beaver activity when designing a restoration project, especially if it includes riparian restoration. The plan highlights restoration design strategies that can be implemented to prevent beavers from damaging a restoration site or impacting landowners adjacent to restoration projects.

Beaver Assessment and Management

The adaptive beaver management plan outlines a recommended process for landowners to use to evaluate beaver management options on their property. The recommended beaver management techniques are highlighted in the *Recommendations* section of this report.

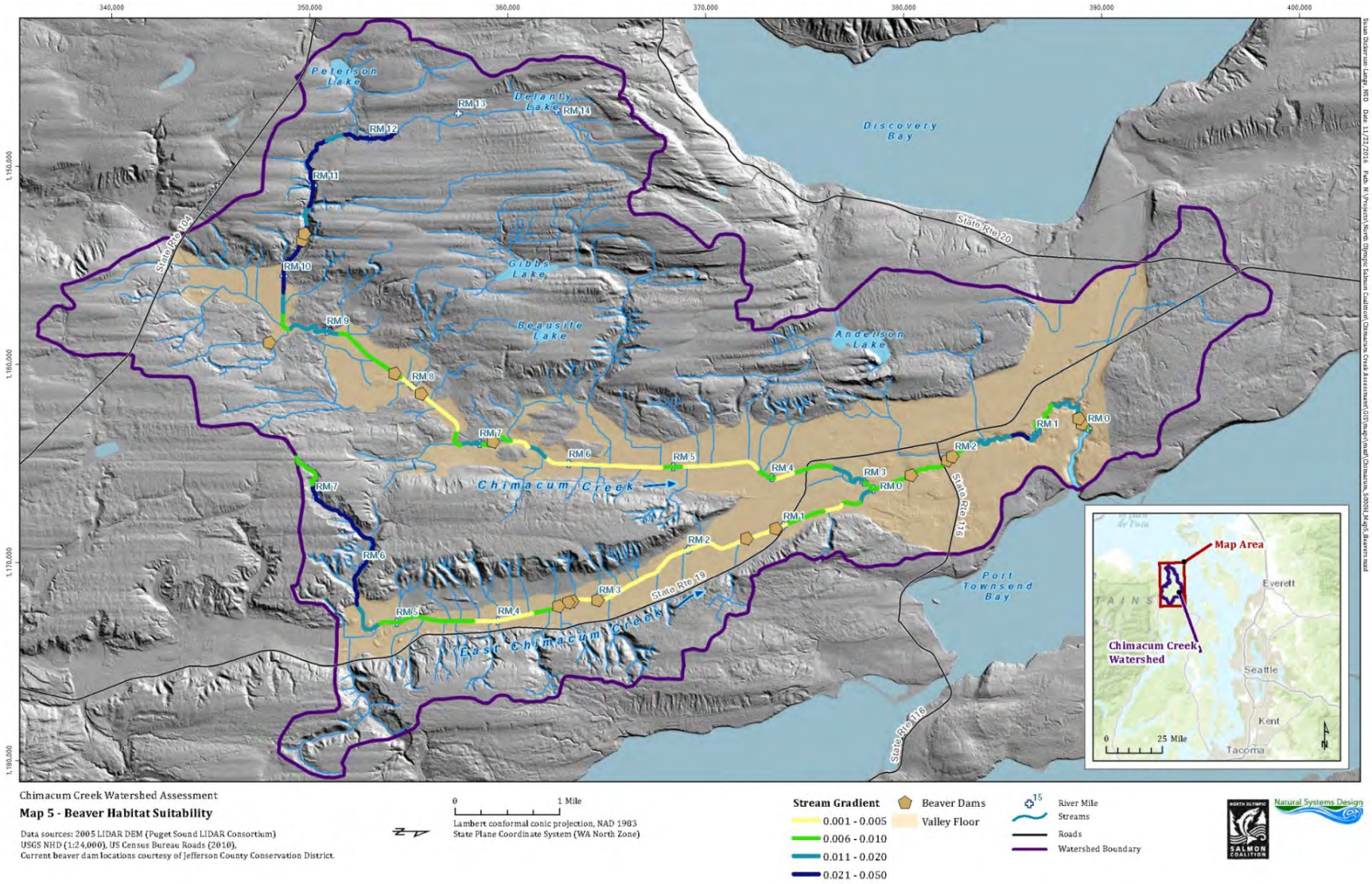


Figure 7: Map of beaver habitat suitability in the Chimacum watershed

Landowner Outreach Strategy

Background and Purpose

Washington State University: Jefferson County Extension completed audience research, developed an outreach plan, and implemented Phase I of the Landowner Outreach Strategy (Appendix A). This strategy focuses on views held by agricultural landowners. These perspectives will help the organizations better understand landowner barriers and motivators in fostering increased local support and participation for watershed protection and restoration activities.

Reports from this landowner outreach study includes the *Chimacum Creek Audience Research and Outreach Strategy*, published in August 2016, an *Evaluation Plan* prepared prior to the initial outreach activities, and an *Evaluation and Final Report*, published in November 2016.

Methodology

WSU completed the audience research and developed an implementation plan to engage landowners to participate in the protection and restoration of Chimacum Creek. WSU used a social marketing methodology developed by Dr. Nancy Lee, adapted for this small, rural audience.

The initial objective was to identify which behavior changes are acceptable to landowners and under what conditions they will gain acceptance. Analysis included a literature search on comparable projects, followed by audience research to determine the best methods to approach landowners.

Four main methods were used to conduct audience research:

1. Focus Group and Follow-up Meetings
2. Landowner Interviews
3. Field Survey
4. Literature Search and Website Review

Analysis

The agricultural producers interviewed for this project had a deep understanding of their land and expressed thoughtful perspectives on how to manage it sustainably. Everyone was aware of and pragmatic about the issues. They seem to accept the need for riparian and other environmental protections even if they don't agree with some of the methods or the amount. Many had experienced some success with restoration and protection projects or programs and each offered stories of things gone wrong. Landowners thought things went well when the work was done efficiently, clean up was completed, trees grew, and maintenance was performed. Landowners thought things went poorly when projects weren't completed properly, trees died, maintenance wasn't done, or costs to the landowner were higher than expected. The landowner interviews also provided valuable suggestions to improve restoration project success.

Despite commonalities of agricultural production, each landowner has unique goals and plans for their land. They may be willing, in theory, to try different approaches, but will need to be interacted with individually. Respondents were open-minded to new ideas that could benefit their land, but didn't

appreciate being talked down to or not being fully informed of the validity (including pros and cons) of a recommended approach. Many of the landowners are aging and plans for succession vary. Many want to "do the right thing" in terms of environmental restoration and protection and have made efforts to do so. Those who have experienced flooding, property damage, and loss of productive land are frustrated and hope for solutions. The report provides a situational analysis identifying the factors that may impact the success of this project.

Landowner Barriers and Motivators

Audience barriers are reasons landowners in the project area may be resistant to adopt the behavior of participating in restoring or protecting Chimacum Creek. Motivators are reasons the audience might be willing to participate. Barriers and related motivators (Table 2) were identified based on landowner interviews, past interactions between landowners and restoration or protection organizations and the literature search.

Table 2: Barriers and related motivators

Barrier to participation	Motivator for participation
Lack of a viable, sustainable, practical solution to the issues of beaver causing flooding and RCG infestation	A reliable, believable solution that would be allowed (able to get permit) by agencies and that landowners believe will work
Fish-centric programs and language	Putting agriculture first – in meetings, language, funding, etc.
Talking down or using jargon	Straight talk and respect
Unknown or unclear information	Full disclosure about any potential impacts of restoration –pros and cons
Strings attached	Fully explain details of any anticipated costs to landowner
Perceived unfairness in the distribution of services, funding to different landowners	Equitable distribution of services and programs - Transparency and good communication about projects to whole community
Loss of productive agricultural land to buffers or flooding	Keep as much land in agriculture as possible; participate in a program that will provide some income if the land will be taken out of production
Changing science – recommending restoration one way, then another	Acknowledging the past, being up front with new recommendations and the science behind them
Overlapping or competing regulations, programs, and agencies	Clear explanations regarding programs, regulations and regulatory agencies
Being told what to do	Treating landowners as a full partner

Changing and new regulations	Taking the concerns of agricultural producers into account during decision making and providing clear and timely information about changes
Ongoing struggles to overcome issues perceived to arise from restoration	Timely assistance and real solutions to beaver, RCG, and other issues
Long term flooding that reduces productive farm land	Enrollment in CREP or a conservation easement or permanent acquisition
Cost of everything required – fencing, piping, watering, buffering, etc.	Assistance with costs
Invasive noxious weeds blocking stream	Permanent, long term solution

Landowner Outreach Implementation

Four outreach strategies are recommended in the *Chimacum Creek Audience Research and Outreach Strategy* report. They include:

- Enhance and expand collaboration among partner organizations.
- Raise landowner awareness of partner organization services.
- Increase understanding of Chimacum Creek issues and potential solutions.
- Build relationships with individual landowners.

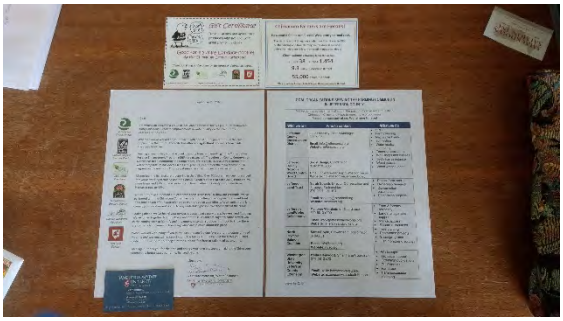


Figure 8. Outreach materials provided to Chimacum Landowners.

Activities were identified for each of the outreach strategies. An initial outreach effort during Phase 1 touched on all of the strategies in the outreach plan. A letter was sent to all agricultural producers (62 total) along Chimacum Creek from partner organizations. The letter introduced the partner organizations and thanked landowners for helping improve water quality in Chimacum Creek over the years. An incentive (a coupon for a cookie from our local farm stand) was included as a thank you. The letter identified success regarding water quality and the private agricultural landowner's role in making this success happen. It also increased an understanding of Chimacum Creek issues and recognized and acknowledged unintended consequences of some past efforts and set the stage for future outreach.

There was a 10% return on the incentive coupon which was considerably lower than anticipated. Possible reasons for the low number returned include the low value of the incentive, the short time it was available (one month) didn't allow landowners time to redeem them; some landowners don't eat sugar and didn't realize the coupon was transferable, or a cookie wasn't an incentive for them. Cash or another incentive may have proved more enticing, although the incentive was meant to be a small token of appreciation. The incentive was meant to help us gage how many landowners read the letter, since we could count how many cookie coupons were turned in, however in retrospect it did not work out to be an effective proxy.

Landowners contacted after the letter was sent reported feeling appreciated, even if they did not take advantage of the incentive and it appears the mailing was accepted by most in the spirit in which it was intended. Many were curious about the intent of the letter, providing an opportunity for future conversations.

In addition to the letter, partner organizations had success implementing the outreach strategy "increasing understanding of Chimacum Creek issues and potential solutions' by hosting a workshop on beaver management. We heard from landowners during our outreach that they would like to learn more about techniques for management issues on the creek. In response to their concerns, NOSC and JCCD partnered to conduct a Beaver Management Workshop that attracted over 40 local landowners and included a wildlife conflict management specialist from Washington Department of Fish and Wildlife. Landowner participation seems to be increased at events like this, including the Conservation District's annual open house this year.

Many landowners are willing to meet one on one as indicated by the response to the audience research interviews. One example of this working is with an individual landowner who accepted a group field trip with several partner organizations to discuss beaver and flooding issues. Furthermore, individual landowner outreach will be accomplished by partners identifying compatibility between themselves and landowners and the organization whose expertise is most needed.

A list of recommended next steps to improve landowner engagement is found in the Evaluation and Final report in appendix E of this document. As priorities are identified by other partners for protection or restoration, the audience research will provide valuable information for ways to approach landowners that respect their goals and lifestyles.

RECOMMENDED ACTIONS

This section of the strategy provides the results of collaborative research and project development. Because much of the restoration and protection strategies outlined in this section rely on voluntary implementation by landowners and residents of the watershed, it is imperative to create positive relationships with those who will be needed to voluntarily implement BMPs. Thus, effective ongoing landowner engagement is fully a part of the overall plan for moving forward and should be a top priority for organizations working within the watershed. Many of the following management recommendations were developed with landowner input with respect to the needs of landowners managing land along the creek.

The successful implementation of restoration and protection strategies provided in this report will require a combined effort between the NOSC and local partners within the watershed. All entities will need to be involved in the decision making process, as it will increase transparency and likelihood of implementation success. Continued collaboration will also ensure that identified priorities and strategies are incorporated into local planning and grant applications.

The restoration and protection strategies presented in this report should not be considered all-inclusive or complete. Many strategies are predicated on needed funding being secured. For instance,, the proposed actions outlined are subject to adaptive management—a consistent approach of implementation, evaluation and improvement.

Conservation and Restoration Actions

Prior to determining the recommended restoration and restoration actions for the Chimacum Watershed, it is important to highlight the overall goals of the restoration and protection strategy:

1. Address perennial inundation of agricultural lands for farmers and fish
2. Increase availability of wetland habitat for coho rearing where available
3. Decrease water temperature
4. Improve the quality of coho rearing habitat in the main channel
5. Exclude invasive reed canarygrass

Guidance for restoration strategies in the Pacific Northwest suggests a hierarchy of actions: (1) protecting high quality habitat, (2) reconnecting isolated habitat, (3) restoring natural hydrologic, riparian, and geologic processes and (4) improving instream habitat (T. J. Beechie et al., 2010; Roni et al., 2002). As such, NSD recommends applying a similar priority structure to the Chimacum Creek watershed (Figure 9).

The degradation of aquatic habitat in Chimacum Creek and frequent agricultural flooding are both primarily rooted in the conversion of a low-lying, wet alluvial valley to an agricultural valley. Based on review of previous reports and analysis of relict geomorphic features, Chimacum Creek historically consisted of complex channel forms with multiple meandering threads, as well as areas of connected

wetlands that lacked channel form. These wetlands were particularly important for supporting Coho (Pollock et al., 2004)

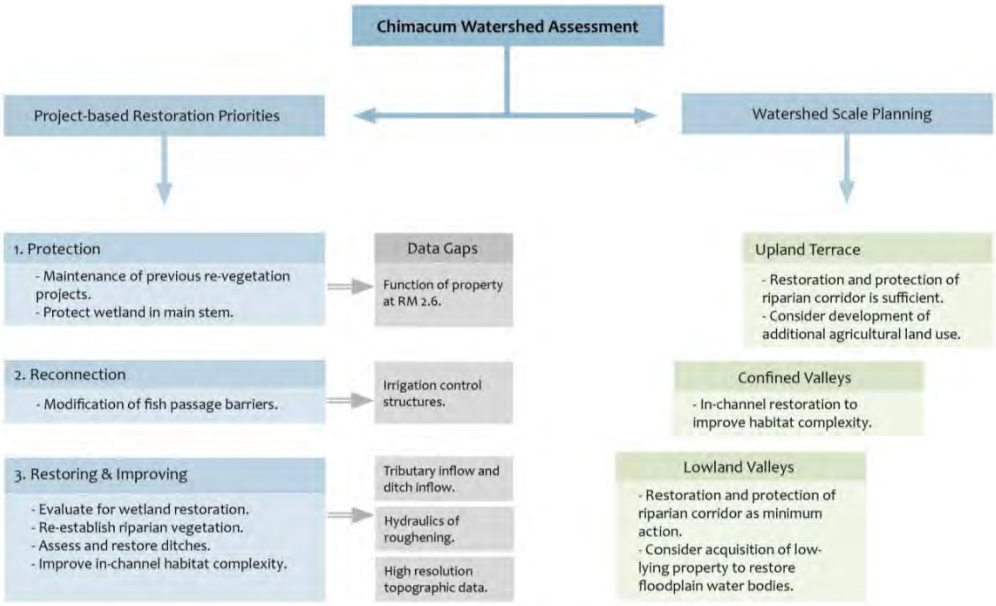


Figure 9: Priority structure for restoration and protection actions on Chimacum Creek

A return to the historic state is undesirable because of the cultural and economic importance of agriculture to the valley and to the surrounding communities. However, restoration actions to protect and re-establish floodplain waterbodies, increase habitat connectivity, create channel complexity, and establish robust riparian vegetation are likely to have the most benefit for both fish habitat and water quality in the watershed. In this approach, we recommend the following prioritized actions:

1. Protect restoration investments by maintaining previous re-vegetation efforts, and protect functioning wetlands from land-use change
2. Continue actions to remove and/or replace barriers to fish passage
3. A suite of project-based actions to restore hydrologic, geomorphic, and riparian processes and improve habitat, including:
    a. Evaluating some properties for floodplain reconnection and wetland restoration over large areas;
    b. Re-establishing riparian vegetation over as much of the length of the main channel as possible;
    c. Assessing the quantity and quality of inflow from tributaries and tributary ditches, and reestablishing riparian vegetation or consolidating ditches where possible; and
    d. Creating in-channel habitat complexity by placing large woody debris.
4. Addressing key data gaps

Wetland Protection and Restoration

Protection of high-functioning habitat and previously restored areas is high priority for long-term health of the watershed. In particular, NSD Inc. recommends protecting established riparian vegetation communities, and maintaining revegetated locations where the riparian vegetation community is not yet fully established. Similarly, where restoration actions included the placement of large wood in the channel (e.g., near RM 10.3), NSD, inc. recommends re-planting the riparian forest in order to support continuing wood recruitment. They additionally identified one location (RM 2.6) downstream of the confluence that appears from aerial imagery to be undeveloped wetland (Figure 10). However, zoning records indicate a mix of zoning for residential houses, agricultural open space and vacant land. It is recommended that an appropriate organization investigate the zoning and ownership status of this land and possible protection as designated wetland.

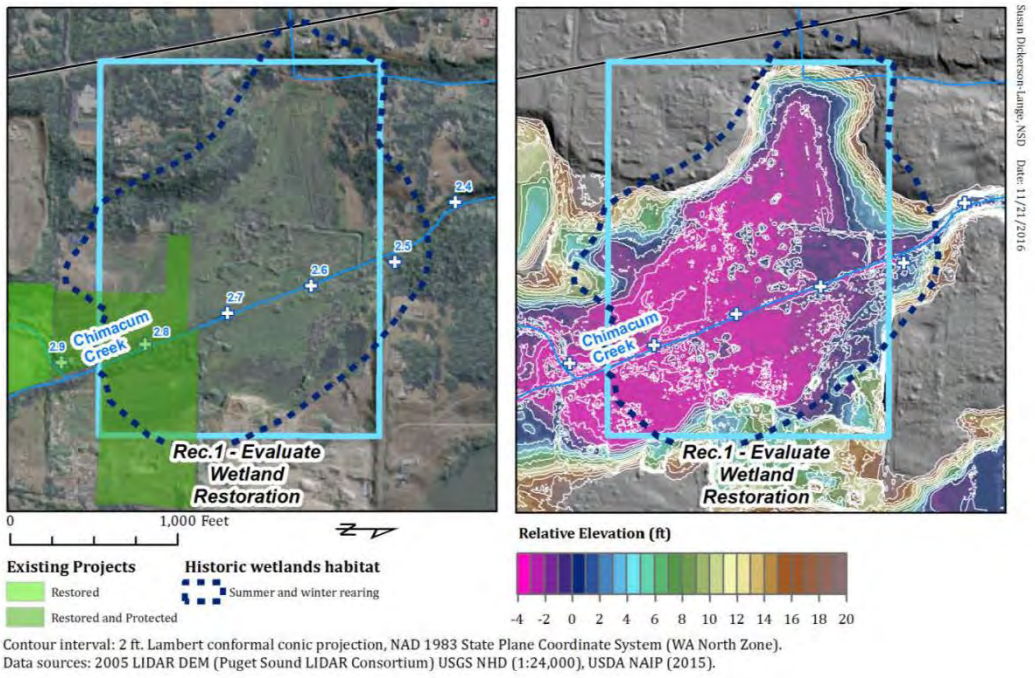


Figure 10. Proposed conservation and restoration site of high quality wetland habitat.

By restoring historic wetlands to some locations, rearing habitat for Coho is vastly improved and water temperature is lowered through shading from wetland plant communities and ground water-surface water exchange. Off-channel water storage is increased, which may reduce inundation in downstream locations (Watson, Ricketts, Galford, Polasky, & O'Niel-Dunne, 2016). The locations which are identified in Appendix 1 of the *Geomorphic Assessment of Chimacum Creek* for wetland restoration coincide with historic wetlands and topographically low areas in the floodplain. These locations are ideal to support and encourage beaver activity through establishing appropriate vegetation. This restoration strategy is only feasible where property can be acquired for restoration over most or all of it. Wetland restoration projects will likely include some amount of excavation to reconnect the channelized creek with topographically low areas. Establishment of the wetland vegetation community would require planting

of native trees and shrubs in combination with repeat treatment to suppress reed canary grass during the first few years while the native plants establish. Two-dimensional hydraulic modeling and some hydrology modeling are recommended to assess potential for re-engagement and to direct restoration design.

Drainage Ditch Management

NSD Inc. identified approximately 12 miles of un-vegetated ditches in the Chimacum Creek stream network from analysis of aerial imagery (USDA, 2015). The flow direction (tributary versus distributary) and approximate magnitudes of these ditches represent a major data gap. Where un-vegetated ditches are acting as tributaries, they may be contributing to impaired water quality by conveying high temperature water heated by direct sunlight. Conversely, distributary channels may be lowering flow in the main channel and contributing to high water temperatures. It is recommended that the network of ditches be mapped and assessed for function, water quality, flow direction, and flow magnitude. Through analysis and discussion with farmers, some ditches may be decommissioned. At a minimum, riparian buffers should be established along these tributaries, and possibilities for tributary ditch consolidation should be assessed.

Due to the extent of drainage ditches in the watershed and the difficulties of managing reed canarygrass infestations and beavers in those ditches, another recommendation is to consider re-establishing a Chimacum Drainage District to allow for watershed-scale planning for maintenance of drainage ditches in the planning area.

List of Restoration Actions

The recommended restoration actions presented in Table 3 include a qualitative assessment of restoration priority, based on analysis of the watershed. In particular, NSD, Inc. findings suggest that the best opportunities to improve Coho habitat in the watershed are (1) addressing high water temperatures through establishing riparian vegetation along the channel and ditches, and (2) re-establishing water bodies or complex channel forms in topographic low areas that were historically wetlands. NSD, Inc. additionally suggest that locations in main stem Chimacum Creek are higher priority for restoration than east fork Chimacum Creek because water quality is relatively good in the east fork. However, the east fork has two long reaches with little habitat complexity (RM 2-3 and RM 3.5-5.0). One or two strategically located restoration projects to improve habitat complexity in these reaches could have large benefits for habitat connectivity in the east fork. Since the natural function of Chimacum Creek relies upon large floodplain waterbodies, beaver activity, and riparian forests, there is high potential for land-use conflict when considering process-based restoration in concert with agricultural and residential land uses. NSD, Inc. recommends considering watershed-scale planning in order to accommodate room for Chimacum Creek to function naturally where feasible and simultaneously designate locations for optimal agricultural land-use.

Watershed-scale planning

From the perspective of watershed-scale planning, the priority becomes balancing the economic and agricultural viability of the valley with providing as much room as possible for river processes to function naturally. Widespread restoration and land protection can be perceived as encroaching upon

agriculture; however, based on the topography and hydrology of the floodplain, many locations identified for possible restoration are likely to already experience high groundwater levels or shallow inundation that hinders the productivity of land for standard agricultural practices.

NSD, Inc. recommends considering watershed-planning based on the following geomorphic units:

Lowland alluvial valley. Low areas of the valley that were perennially inundated historically are high priority for restoration and are likely present major drainage challenges for agriculture. Where possible, agriculture should be concentrated in higher portions of the valley. During a field visit, NSD, Inc. observed houses and barns located at the top of hummocks, indicating that adapting land use to higher relative elevations is not inconsistent with current practices.

Confined valley. Locations where the creek flows through glacial moraines, which consist of sediments deposited during the last glaciation, are 'pinch points' in the valley and the gradient of the creek is steeper. Similarly, gradient is higher where the creek descends from the upland glacial terrace to the lowland valley. These locations are generally compatible for restoration along with agricultural or residential land use because river processes are more contained in the valley. However, the creek is also likely to be incised (i.e., down-cut) in these locations and restoration may increase overbank flooding.

Upland terraces. The relatively flat upland glacial terraces in the Chimacum Creek watershed results in alluvial valleys high in the system (e.g., near Delanty Lake). Restoration to protect and improve water quality (i.e., riparian vegetation) is important in these locations, but there may also be opportunities to expand agricultural land use. In particular, both the USDA prime farmland soil classification data and surface slope suggest that upland agriculture may be feasible, given water sources and additional soils assessment. Substantial portions of the upland glacial terraces are relatively flat, with slopes of 0-5%, and soils have been mapped as potential farmland. A pilot project to explore land-use development in the upland alluvial valleys could make a competitive proposal for a program like Floodplains by Design (http://www.floodplainsbydesign.org/).

Table 3. Recommended protection and restoration actions

REC #	TYPE	RM	LOCATION	RECOMMENDATION CATEGORY	RECOMMENDATION	PRIORITY	CONSIDERATIONS
1	Protection and Restoration	2.6	Mainstem, downstream of confluence	Protect Current Land Use; Evaluate Potential for Wetland Restoration	Existing wetland currently zoned as mix of rural residential, agricultural open space, and vacant land. 2015 aerial photo shows development only at outer edges. Protect from additional development and evaluate for wetland restoration.	High	Additional opportunities here to improve channel/habitat complexity.
2	Restoration	3.3	Mainstem, upstream of confluence	Roughen	Roughen channel with large wood to create habitat diversity.	Low	Riparian vegetation is mature, and 1996 data indicates presence of Coho and gravel, but no large wood, near RM 3.2. Additionally recommend 2-D hydraulic modeling to assess activation flows and changes in inundation from roughening, particularly since there are houses nearby.
3	Data Gap	3.2	Right bank tributary (ditch) to main stem	Analysis	Evaluate flow direction, discharge, and water quality in the ditch.	High	Two monitoring locations observed temperature exceedances 0.3 miles downstream of this tributary-ditch.
4	Restoration	3.9-4.1	Main stem	Re-meander	Re-meander small bends and roughen channel to aggrade incised channel downstream of control structure. Consider re-connecting to larger right bank meander upstream of control structure.	Medium	Good opportunities to add in-channel habitat complexity here, but restoration at this location depends on future actions regarding irrigation control structure. At a minimum, consider riparian planting on unvegetated left bank. Additionally recommend 2-D hydraulic modeling to assess activation flows and changes in inundation from roughening.
5	Data Gap	4	Main stem	Analysis	Investigate operation of irrigation control structure to determine effects on upstream flooding and downstream incision.	High	

REC #	TYPE	RM	LOCATION	RECOMMENDATION CATEGORY	RECOMMENDATION	PRIORITY	CONSIDERATIONS
6	Restoration	4.1 - 4.2	Main stem	Evaluate Potential for Wetland Restoration	Evaluate potential for wetland restoration in site of historic perennial wetland.	High	Alternatively, maintain and re-establish riparian vegetation. Investigate amount and timing of tributary-ditch inflows and consider planting riparian vegetation along ditches.
7	Restoration	4.3-4.5	Main stem	Riparian Vegetation	Establish riparian vegetation along ditched reach.	High	Water quality exceedances in this reach
8	Restoration	5.1-5.4	Main stem, upstream of glacial moraine	Evaluate Potential for Wetland Restoration	Evaluate potential for wetland restoration in site of historic perennial wetland.	High	Alternatively, establish riparian vegetation (see Recommendation #9).
9	Restoration	5.0-6.1	Main stem	Riparian Vegetation	Establish riparian vegetation along ditched reach.	High	
10	Restoration	5.7-6.1	Main stem	Evaluate Potential for Wetland Restoration	Evaluate potential for wetland restoration in site of historic perennial wetland.	Medium	Appears to be ponds in the 2015 aerial photograph.
11	Data Gap	7.3	Right bank tributary-ditch to main stem	Analysis	Investigate inflow from unvegetated tributary ditch.	High	The 1996 data identifies a small pool in this tributary-ditch, but no Coho or wood.
12	Restoration	7.1-7.3	Main stem, confined reach	Roughen	Roughen channel with large wood to create habitat diversity.	Low	The 1996 data identifies some wood, pools, and Coho in this reach. Could be opportunity to enhance habitat further by placing large wood. Additionally recommend 2-D hydraulic modeling to assess activation flows and changes in inundation from roughening.
13	Restoration	7.4-7.7	Main stem	Evaluate Potential for Wetland Restoration	Evaluate potential for wetland restoration in site of historic perennial wetland.	High	Could also re-meander for smaller footprint, some evidence of relict meander features. At a minimum, establish riparian vegetation (see Recommendation #14).

REC #	TYPE	RM	LOCATION	RECOMMENDATION CATEGORY	RECOMMENDATION	PRIORITY	CONSIDERATIONS
14	Restoration	7.4-7.8	Main stem	Riparian Vegetation	Establish riparian vegetation along ditched reach.	High	
15	Protection	7.9-8.3	Main Stem	Riparian Vegetation	Protect and enhance riparian vegetation planted during previous restoration efforts; 2015 imagery suggests very small plants.	High	Note that there are existing beaver dams, and the low lying portion of the valley adjacent to the right bank could possibly become inundated.
16	Restoration	8.4-8.8	Main Stem	Riparian Vegetation	Establish riparian vegetation along ditched reach.	High	
17	Restoration	8.6-8.9	Main Stem	Re-meander	Re-meander and/or roughen channel in this reach through wood placement; some suggestion of relict channel features from the REM map.	Low	Additionally recommend 2-D hydraulic modeling to assess activation flows and changes in inundation from roughening.
18	Data Gap	8.8	West Valley tributary-ditch and unnamed tributary-ditch at left bank	Analysis	Investigate inflow from unvegetated west valley tributary ditch and from partially vegetated unnamed tributary ditch.	High	Water quality exceedances in both tributary ditches; establish or enhance riparian vegetation along ditches if inflow is substantial.
19	Restoration	9.0-9.4	Main stem, confined reach	Roughen	Improve habitat complexity by adding roughness; opportunity to re-engage flood plain.	Low-Medium	Additionally recommend 2-D hydraulic modeling to assess activation flows and changes in inundation from roughening.
20	Restoration	Trib.	Barnhouse Creek	Riparian Vegetation	Establish riparian vegetation along ditched reach.	High	Water quality exceedances at confluence of Barnhouse Creek and Chimacum Creek.

REC #	TYPE	RM	LOCATION	RECOMMENDATION CATEGORY	RECOMMENDATION	PRIORITY	CONSIDERATIONS
21	Restoration		Barnhouse Creek	Evaluate Potential for Wetland Restoration	Evaluate potential for wetland restoration in site of historic perennial wetland.	Medium	Alternatively, establish riparian vegetation (see Recommendation #20).
22	Data Gap	10.3-11.2	Main Stem - Confined reach on slope of glacial terrace	Analysis	There is a logging road along the river where beavers have established - hydraulic modeling and assessment of threat to road.	Low-Medium	Opportunity to roughen channel and add complexity here, but need field assessment of morphology and infrastructure. Lidar resolution diminishes in forest.
23	Restoration	13.5-13.7	On glacial terrace, just downstream of Delanty Lake	Riparian Vegetation	Establish riparian vegetation along ditched reach.	Medium	
24	Protection	ECH 1.2-1.6	East Fork	Riparian Vegetation	Protect and enhance riparian vegetation from previous restoration; 2015 imagery shows very small/sparse vegetation	High	Consider existing beaver dams in this reach when enhancing riparian vegetation.
25	Restoration	ECH 2.2-2.9	East Fork	Riparian Vegetation	Establish riparian vegetation along ditched reach.	Medium	
26	Restoration	ECH 2.8-3.4	East Fork	Evaluate Potential for Wetland Restoration	Evaluate potential for wetland restoration in site of historic perennial wetland.	Medium-High	Consider enhancing habitat complexity via wetland restoration or placement of large wood or re-meandering in either this location or see Recommendation #28. There are long stretches with low complexity through these portions of the east fork, and improving habitat through one or both of these reaches could improve habitat connectivity in east fork Chimacum.
27	Restoration	ECH 3.3-4.4	East Fork	Riparian Vegetation	Establish riparian vegetation along ditched reach.	Medium	

REC #	TYPE	RM	LOCATION	RECOMMENDATION CATEGORY	RECOMMENDATION	PRIORITY	CONSIDERATIONS
28	Restoration	ECH 4.3-4.7	East Fork	Evaluate Potential for Wetland Restoration	Evaluate potential for wetland restoration in site of historic perennial wetland.	Medium-High	See note in Recommendation #26.
29	Restoration	SWA 0.3-0.0	Swansonville Creek	Riparian Vegetation	Establish riparian vegetation along ditched reach	Medium	
30	Data Gap	SWA 0.3	Swansonville Creek	Analysis	Investigate possible causes of DO exceedance at SWA 0.3 since contributing area is fairly small	Medium	
31	Data Gap	ECH 5.6-6.0	East Fork, confined reach on slope of glacial terrace	Analysis	REM is poor here due to lidar resolution in dense forest. Possible opportunities to place wood and create channel complexity, but needs analysis and better spatial data	Low	

Riparian Management

Project Partners delved into the complex issues surround riparian management in the Chimacum Watershed. Reed canarygrass is an invasive species of concern for agricultural landowners within the watershed. The species is known to amplify flooding and water quality issues and management is often cost-prohibitive or requires landowner to enter an extensive permitting process. The Riparian Management Plan researched existing literature on RCG removal and management to determine a list of recommended control techniques for landowners and resource managers. Farmers and local conservation organizations have spent over 20 years managing reed canarygrass within planting areas and have been able to develop an understanding of effective techniques. This plan provides an overview of techniques currently used by local practitioners and provides other options based on techniques applied by other groups managing this invasive species in the northwest region (Table 4).

Reed Canarygrass Best Management Practices

The best management approach to use will depend on your overall management goals and objectives, the size, distribution and location of your reed canarygrass infestation(s), your capability and willingness to use herbicides (or not), and your available resources (time, money, equipment, etc). Understanding the ways in which RCG spreads and colonizes is key for implementation of management decisions and the method used will often depend upon site specific conditions.

The following recommendations from this plan do not guarantee control and/or eradication of reed canarygrass. The methods listed below have however, been used with some success in the Chimacum Watershed and the greater Pacific Northwest region. Every method will require follow-up monitoring and treatment (including replanting native species) to ensure the long-term success of your treatment. There are a few important points to remember when considering management for this species:

1. *Suppress above and below ground vegetative growth*. RCG is persistent due to its prolific seed dispersal, robust vegetative growth, and dense network of underground rhizomes and seeds. Thus, techniques used to suppress above ground vegetative growth need to be paired with techniques that address the seed bank and underground rhizomes. You won't achieve success if only one component is treated.

2. *Timing is important*. Mowing or applying herbicide after RCG has achieved some growth in the late spring will reduce or eliminate seed development, allow release of native vegetation, and drain rhizome carbohydrates reserve.

3. *Be persistent*. You will likely need to treat the site for a minimum of 3 to 5 years.

4. *Plant native after treatment.* Sites with diverse vegetation at the onset of treatment tend to respond more positively to treatments than monotypic stands. The primary goal is to replace RCG with a diversity of native species. Once established, the native vegetation will compete for sunlight, suppressing the RCG seed bank and re-growth.

5. *Practice adaptive management*. If one method doesn't work, try a different technique. Share your lessons learned with others in the community.

Table 4 is a list of recommended treatment techniques for RCG infested sites. For more information on techniques and a list of resources, see *Chimacum Creek Riparian Management Plan.*

Table 4. Recommended Management Practices for Reed Canarygrass

TREATMENT	EFFECT	SHOULD USE	COULD USE	SHOULD NOT USE	COMMENTS
Native Tree/Shrub Planting	•When woody species overtop RCG, shade slows its growth •May change plant community •Adds structure to habitat	•Where herbaceous vegetation cannot gain a competitive advantage	•Where landscape is receiving RCG seed inputs •Where inflows can't be diverted •To connect existing woody patches	•Where management goal is to maintain grassland habitat	•Apply herbicide/mulch around newly planted trees/shrubs •Conifers may be the most effective at shading RCG •Need to control RCG for 3-5 years to allow trees to establish •Best long-term strategy
Mowing	•Reduces RCG height •Increases light- promotes competition •Depletes rhizome reserves	•To prepare for herbicide application •To stress RCG •5x or more per year if no other treatment	• Prior to RCG seeding to eliminate seed set.	•Where hummocks and microtopography will be damaged •If site is too wet for equipment.	•Mow in late spring before RCG seed heads appear to prevent seed production •May impede establishment of natives, due to remaining mat of vegetation.
Herbicide- broad spectrum (Aquatic use herbicide like Glyphosate (Aquamaster, Aquaneat) or Imazypyr	•Reduces plant height •Increases light- promotes competition •Depletes rhizome reserves	•**Mid-summer to late fall** for maximum translocation to roots •After mowing treatment when stems are at booth height	•For treating within areas of natives •As an initial herbicide treatment on monotypic stands of RCG	•On sites with desirable native vegetation unless spot sprayed. •Immediately after mowing	•Should be part of a continued control strategy, where natives are later introduced •Multiple treatments may be necessary •Will need an NPDES permit for application in wetlands •Rhizome translocation less effective if temperature >70^{o}F •Other treatments may influence herbicide effectiveness •Always follow herbicide label instructions
Tillage	•Exposes rhizomes to light; might activate dormant buds •Fragments rhizomes and may increase RCG density •Can contribute to erosion	•In combination with herbicide treatment •On monotypic, damaged sites to prepare for crop production.	•To prepare a seedbed •To reduce RCG seed bank	•Where microtopography must be maintained. •Where RCG is mixed with desirable natives •On wet sites, where soil could become compacted •If offsite impacts are possible	•For most effective control, combine with another treatment •Depth should be 4-6' to target RCG rhizomes •Till in spring or early summer •Repeated tillage can be effective if conducted every four weeks
Mulching/ solarization with plastic or fabric	•Non-selective treatment; shades out all plants •Kills adult plants •Kills RCG rhizomes	•For small, isolated RCG clones •For1-3 consecutive years	•To facilitate seeding or planting of natives	•Where desirable natives are mixed with RCG •For abatement on large sites	•Resurgence from seedbank may occur when tarping removed •May have adverse effects on soil microorganisms and chemistry •Not always an effective treatment

Table 5. Demonstrates the recommended strategies for planting in reed canary grass based on the level of infestation.

Level of infestation	RCG suppression recommendations	Recommended planting (after initial treatment)
Scattered/patchy RCG	1. Dig out using a shovel 2. Spot-spray or wick with herbicide 3. Spot flame with a propane torch (only works for seedlings or young individuals	High density shrub planting in disturbed area
Larger patches of RCG surrounded by native vegetation	1. Dig out using a shovel (depends on size) 2. Cover with shade cloth (may be preceded by mowing) 3. Mow (to eliminate seeds), then spot-spray or wick with herbicide 4. Spot-spray or wick with herbicide	High desnity shrubs, deciduous trees (cottonwood, alder)
Large patches with scattered native vegetation	1. Mow then cover with shade cloth 2. Mow then herbicide (wick, spot-spray or boom) 3. Herbicide using appropriate application technique 4. Cover with shade cloth (may be preceded by a mow treatment	Dense native sedge, shrubs, deciduous/coniferous trees
Large monoculture of RCG	1. Mow using large mower, herbicide spray using boom sprayer 2. Tillage	Dense native sedge species, shrubs, deciduous/coniferous trees

Riparian Planting

Management activities that create bare ground (e.g. removing trees, constructing scrapes, re-contouring wetlands, using nonselective herbicides) should be reseeded or planted quickly, as RCG can rapidly colonize these sites after the disturbance. When planning for RCG abatement, your goal should be to create a closed canopy of herbaceous species as quickly as possible, before RCG can re-establish. Research and local examples have shown that a closed herbaceous canopy will filter sunlight, increasing the amount of far-red (FR) light reaching the soil surface. As transmission of far-red light increases (relative to blue light), the percentage of RCG seeds that germinate decreases (Wisconsin Reed Canarygrass Management Working Group 2009).

Furthermore, RCG displays very low establishment rates and low seedling aggressiveness under light-limited conditions. The ideal endpoint planting, therefore, is one that exhibits a complex, multi-species herbaceous canopy. The best way to ensure this is to plant a diverse mixture of different native plants to create a layered effect (e.g., trees, shrubs, sedges, rushes, cool- and warm-season grasses, and forbs).

Species Selection

We recommend species that have potential to coexist with RCG in situations where the latter is under stress from management treatment. Proactive re-vegetation with a diversity of native species should be

a component of any RCG control project. Research has demonstrated that competition from established native species augments and accelerates RCG management efforts.

Effective bank revegetation uses a mix of plant species to incorporate structural diversity along the bank. Plants should be selected based on site conditions and the desired function of the planting. Functions may include quick growth, strong roots to resist erosion, ability to produce shade, or the ability to produce a marketable crop (see Working Buffers in *Chimacum Riparian Management Plan*).

Table 6 demonstrates the different native plant species that are recommended for planting and an overview of their habitat requirements. The Jefferson County Conservation District and North Olympic Salmon Coalition have specialists on staff that can provide landowners with a list of recommendations that could suit their site needs.

Table 6. The following species are recommended for planting

Latin Name	Common Name	Hydrology	Notes
GRASSES AND SEDGES			
Scirpus microcarpus	Smallfruit bulrush	OBL	
Glyceria grandis	Reed Mannagrass	OBL	
Carex obnupta	Slough Sedge	OBL	
Schoenoplextus acutus	Hardstem Bulrush	OBL	
SHRUBS			
Lonicera involucrate	Twinberry	FAC	Not preferred by beaver
Rubus spectabilis	Salmonberry	FAC	Beaver resistant
Rosa nutkana	Nootka Rose	FAC	Beaver resistant
Spiraea douglasii	Douglas Spirea	FACW	Beaver resistant
Oemleria cerasiformis	Indian Plum	FACU	Not preferred by beaver
Physocarpus capitatus	Pacific Ninebark	FACW	Not preferred by beaver
Sambucus racemosa	Red Elderberry	FACU	Not preferred by beaver
Cornus sericea	Red Osier Dogwood	FACW	Beaver Resistant
TREES			
Alnus Rubra	Red Alder	FAC	Preferred by beaver
Fraxinus latifolia	Oregon Ash	FACW	Not preferred by beaver
Populus balsamifera	Black Cottonwood	FAC	Preferred by beaver
Alnus rubra	Alder	FAC	
Picea sitchensis	Sitka Spruce	FAC	Not preferred by beaver
Salix sp.	Willow	FACW	Beaver resistant
Frangula purshiana	Cascara	FAC	Not preferred by beaver
Thuja plicata	Western Red Cedar	FAC	
Malus fusca	Pacific Crabapple	FACW	

Obligate Wetlands (OBL). Almost always occurs in wetlands (estimated probability > 99%) under natural conditions

Facultative upland (FACU). Usually occur in non-wetlands (estimated probability 67% – 99%), but occasionally found in wetlands (estimated probability 1% – 33%). Almost always occurs in wetlands (estimated probability > 99%) under natural conditions

Facultative wetland (FACW). Usually occurs in wetlands (estimated probability 67% – 99%), but occasionally found in non-wetlands

Facultative (FAC). Equally likely to occur in uplands or wetlands

Beaver Management

Beaver and Land Management

Discouraging beaver from colonizing an area that has been identified as a *Living with Beaver Zone* is easier than mitigating impacts from beaver activities that are destructive to surrounding resources or infrastructure. To discourage beaver colonization, conservation planners can include the following considerations in the design process:

1. Reduce or eliminate tree and shrub species (native and non-native) that beaver find most desirable;
2. Temporarily or permanently protect newly planted or desirable trees in riparian buffers where beavers are likely to inhabit (Table 7).

The probability of a particular plant being eaten depends on its own palatability and the availability and desirability of alternative plant species (Nolte 2003).

By reducing or eliminating desirable plants, conservation planners can select plant species that are *not preferred* or are *beaver resistant*. *Beaver resistant* species refer to those that beaver may choose to eat or cut, but that respond to browsing with vigorous and bushy regrowth.

Not Preferred (by Beaver) Species	Beaver Resistant Species
Cascara	Willow spp.
Sitka Spruce	salmonberry
Red elderberry	Nootka rose
Oregon ash	Red-osier dogwood
Twinberry	Douglas spirea
Pacific ninebark	
Indian plum	

Table 7. The above species are recommended for planting because they are either *not preferred* or *beaver resistant* (JCCD 2012, City of Portland 2010).

If preferred species are not available, beaver will likely still eat or build with less desirable vegetation, but planners can strategically place desirable species further from the stream bank when buffer widths allow–as beaver do not like to travel far from the safety of water. According to Beaver Solutions, llc., most trees that beavers cut down are within 100 feet of the water.

Conservation planners can also try to out-compete beaver by sheer number and vigor of plants installed. By choosing beaver resistant species that re-sprout with vigor when cut by beaver, regrowth not only creates a bushy plant that shades out surrounding invasive reed canarygrass and other weeds, but also stimulates root growth. Extensive underground root systems enhance riparian health by stabilizing stream banks and preventing erosion (Hawley-Yan 2016).

Plant Protection

Plant protection alters beaver habitat by reducing available food supply. When beaver exhaust their food supply, they will relocate—though it may take years (Beaver Solutions 2016). Plant protection also

prevents mortality to newly established trees both directly from cutting or collaring and indirectly, from flooding due to dam construction. In reaches of Chimacum Creek where beaver activity is already well-documented and undesirable, riparian project plans should include tree protection on all new buffer planting sites to prevent increasing available food supply—and ultimately, attractive new beaver habitat.

C*ages* or *textured paint* can be useful for protecting individually identified trees or entire sites of established trees. However, textured paint should not be used on thin barked species such as alder and birch trees. *Low Fences* can be used to protect entire sections of densely planted trees directly adjacent to stream channels. Plant protection devices will need to be regularly maintained to ensure they are still functioning and not affecting the health of the tree. While chemical repellants can be effective deterrents, they require regular and repeated application, which can be cost and time prohibitive (Harper et al. 2005). See *Chimacum Creek Adaptive Beaver Management Plan* for more details on plant protection BMP's.

Access for Maintenance

When beaver are active in a reach in which they can cause damage to infrastructure and/or working lands, land owners and managers need access for monitoring and maintenance of proper stream function and flow. In *Living with Beaver* and *Nuisance Beaver Zones*, monitoring and maintenance will always be required. To enable regular access by land managers for long term monitoring and maintenance, riparian project plans should include:

- Foot-passable corridors within forested buffers for perpendicular access to waterways
- A maintenance schedule for preserving access corridors that includes mowing tall grasses up to two times during the growing season and trimming low-hanging branches annually
- Long term site access permission and guidelines with each landowners or a commitment from landowner to perform regular maintenance and monitoring

By designing established access points through the riparian buffer to the waterway, landowners and land managers can prevent unintended damage to desirable riparian buffer vegetation and can make more frequent visits to monitor the flow and function of the waterway, which might reduce the cost and level of effort needed to address damage from beaver activities.

Evaluation and Management

As in the preventative planning process, conservation planners can adaptively manage impacted riparian buffers on two scales; first on the reach scale and then, by evaluating the individual beaver activity (Wheaton 2013). Evaluation of the reach scale activity (see page 12 of the *Adaptive Beaver Management Plan)* may determine that the best approach to beaver management is to remove beaver from the site through live trapping or lethal trapping but if the evaluation process concludes that 'living with beaver' is a viable option, then there are steps that can be taken to prevent flooding and damage to crops. These management strategies are highlighted below.

Flood Prevention

This section provides an overview of several known methods for controlling and preventing flooding caused by beaver activity. Of these examples, beaver deceivers and flow levelers were used in Chimacum Creek with varying degrees of success. These techniques require different levels of engineering and technical assistance to ensure function and fish passage is maintained. Installation of flow control devices is complicated and generally requires a permit. Please work with your local conservation district to determine steps that need to be made before installation.

Beaver Deceiver

Beaver deceivers or exclusion devices keep beavers from plugging culverts and other narrow constrictions in a waterway (Figure 11). Using fencing materials, beavers are kept a sufficient distance away from the culvert or constriction. The device reduces noise and the feeling of quickly moving water; two things that trigger beavers to build dams and clog culverts. By excluding beavers from this area, they are less compelled to dam the area and focus their work in more preferable places of the stream, away from infrastructure or sensitive lands.

Figure 11. Beaver deceiver installed to protect culvert along Chimacum Creek.

Flow Levelers

A flow leveler is simply a pipe through a dam. The pipe is set at a height that prevents further flooding, but retains enough water so that beavers can remain onsite. A cage is placed around the inlet of the pipe, often called a pre-dam, to prevent beavers from plugging the inlet with mud and sticks. These devices require a little routine maintenance (three to four check-ups per year), and can last many years. Unlike culverts, flow levelers do not need to be sized to handle heavy flow events because excess flow will run over the top of the pre-dam and through unblocked culverts and streams.

A *flexible leveler system* can be an effective method to protect culverts and lands adjacent to areas of beaver activity at risk of damage from flooding. Flexible levelers create a permanent leak through

beaver dams. They have to be constructed so beaver do not detect the flow of water through the pipe by surrounding the intake with a cylinder of fencing. The flexible leveler systems include one, or more flex pipes of large diameter (usually 10- or 12-inch) corrugated polyethylene pipes. The number of pipes used depends upon the size of the watershed and the stream gradient. The pipe inlet, which is protected by a pre-dam cage, is placed low enough, so that the bottom of the pipe will become the new upstream water level (Figure 12). Often a beaver will appear during the installation.

The beavers will then dam against the pre-dam fence while water continues to flow freely. If it is desired to keep beavers at the site, ensure that about three feet of water remains at their lodge or bank burrow. Be sure to check with the Washington State Department of Fish and Wildlife to obtain any required permits before installing a device.

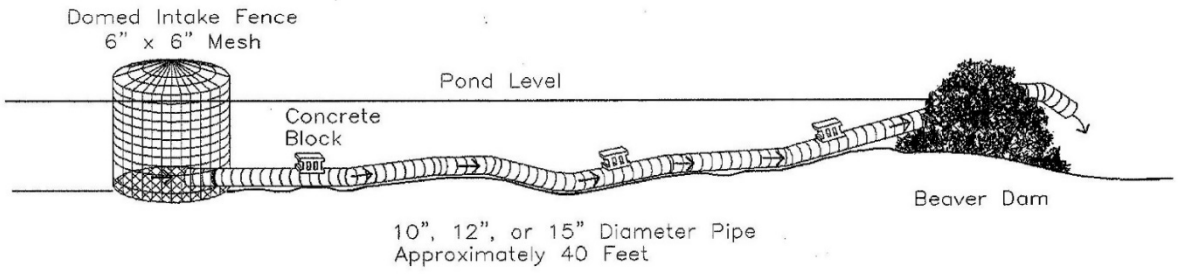


Figure 12. Fence and Pipe Flow Device**.** Reproduced courtesy of Mike Callahan, Owner Beaver Solutions LLC, "Working With Nature"

A Clemson leveler system (solid pipe) was designed to suppress the challenge of flooding agricultural and working lands, while maintaining some of the benefits of beaver ponds in a riparian ecosystem (Figure 13). The Clemson leveler works well managing water levels in small drainages like Chimacum. Larger watersheds require larger diameter PVC pipes, which weigh so much that heavy equipment may be needed to move them. That is why most professional installers prefer to use the light-weight flex pipes. This device may either be built, or purchased readymade.

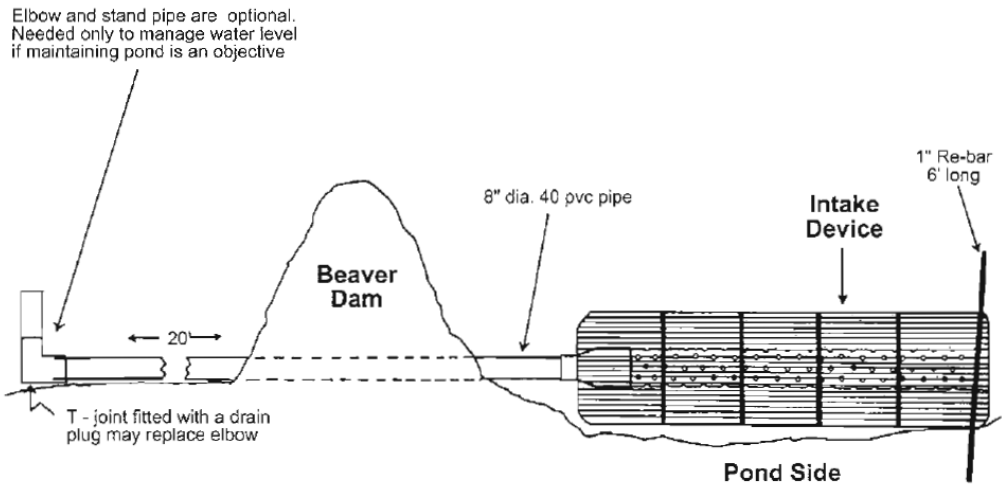


Figure 13. Clemson Pond Leveler Device**.** Reproduced courtesy of Clemson University Cooperative Extension Service.

Flood Mitigation

Flood mitigation is effective when beaver have either left an area or the landowner is in immediate need of flood reduction. Dam notching and trapping have been completed on Chimacum Creek. There has not been much success with either of these methods in the long-term as beaver often return to the sites and continue to build dams, however, these techniques are effective for short term flood reduction.

Notching-out Dam

Partial breaching or notching of dams enables land managers to control water levels and prevent flooding beyond desired areas, while maintaining some of the habitat and ecosystem benefits of beaver activities. **Notching is only effective where beaver are no longer active**, as they can repair a dam in a matter of hours (Wheaton 2013). That said, this BMP can be a short-term, visible response for landowners who want to see management support immediately and want to prevent immediate potential flooding of infrastructure or working lands.

Washington state law (RCW 77.55) requires a Hydraulic Project Approval (HPA) –a permit issued by Washington Department of Fish and Wildlife (WDFW)—to remove or modify a beaver dam. Jefferson County Conservation District applied for and has been issued a HPA for *Beaver Dam Modification in the Chimacum Creek Watershed* permitting land managers and landowners to respond to beaver activity that would likely cause flood damage to surrounding working lands and infrastructure. This HPA is effective from October 2014 through September 2019.

Trapping

Live or lethal trapping has traditionally been the primary response to addressing damage from beaver activity, though removing beaver is rarely a lasting solution. Neighboring populations often recolonize in the available suitable habitat. Trapping (lethal or live) should only be considered when all efforts to deter beaver activity in unsuitable areas fail (City of Portland 2010, Wheaton 2013).

The Washington State Department of Fish and Wildlife (WDFW) *Living with Beaver* webpage (http://wdfw.wa.gov/living/beavers.html) synthesizes current regulations and legislation related to beaver trapping:

- *The owner, the owner's immediate family, an employee, or a tenant of property may shoot or trap a beaver on that property if a threat to crops exists (RCW 77.36.030). In such cases, no special trapping permit is necessary for the use of live traps.*
- *A special trapping permit is required for the use of all traps other than live traps (RCW 77.15.192, 77.15.194; WAC 232-12-142). There are no exceptions for emergencies and no provisions for verbal approval. All special trapping permit applications must be in writing on a form available from the Department of Fish and Wildlife (WDFW).*
- *It is unlawful to release a beaver anywhere within the state, other than on the property where it was legally trapped, without a permit to do so (RCW 77.15.250; WAC 232-12-271).*

Live Trapping

Hancock or *Bailey* suitcase-type traps are the most commonly used live trap (Figure 14). Bait for live traps include freshly cut tree sprouts or branches of preferred plants, apples, or commercial scents and lures. It is important to relocate beaver to a site with plenty of available vegetation for food and dam-building material as it will encourage them to stay nearby. In particular, during the first year or two following relocation, beaver cut and a large number of trees for dam building, so providing a truckload of preferred trees near the release site may prevent some cutting (WDFW 2011). To help ensure the survival of trapped beaver, move them between August and October, their primary dam-building season (Link 2004). This time is optimal as it enables them to gather a food cache, but limits their time to explore and move before settling in for winter.

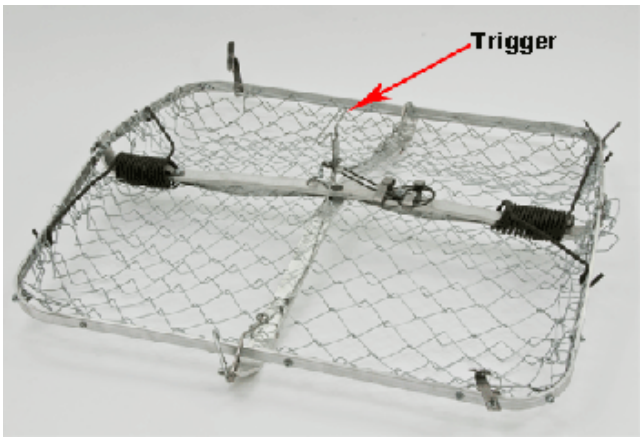


Figure 14. Bailey Beaver Live Trap (Wildlife Control Supplies 2015).

When live trapping, it is important to consider where the beaver will be relocated—beyond suitable habitat and food supply. If landowners or land managers plan to move beavers off their property, particularly to a site where other beavers are not already present, there must be coordination with adjacent landowners and the local WDFW office to consider all of the potential impacts of relocation**. A permit is required from WDFW to release beavers on any property other than the property on which it was caught.** For assistance acquiring this permit, land managers can contact the local conservation district or the local WDFW office.

Lethal Trapping

Washington Department of Fish and Wildlife certifies "Wildlife Control Operators" (WCOs) that have the skills, training, and regulatory understanding to trap, capture and remove nuisance wildlife, like beaver,

for private landowners. Certified WCOs work directly with landowners on a fee-for-service basis to resolve problem beaver situations through lethal (or live) trapping (WDFW 2011). To find WCOs working in the Chimacum Creek watershed, land managers can visit the WDFW Nuisance Wildlife webpage: http://wdfw.wa.gov/living/nuisance/damage_control.html

Outreach and Education Recommendations

Before discussing recommended outreach strategies, it's useful to have an idea of the types of past and current outreach activities in the Chimacum Valley conducted by the partner organizations. These include:

- Individual landowner contacts and relationship buildings.
- NOSC held an open meeting for Chimacum riparian landowners in 2011. The event was not well attended in spite of a good promotion. NOSC has information for landowners on their website and publish an email newsletter for their members and other interested individuals. Some landowners in the study area subscribe to the newsletter.
- JCCD has an annual newsletter that is mailed and posted online. The most recent edition (Winter 2016) lists services available with example photos and encourages readers to consider applying for programs.
- The WSU Small Farms Program has an agricultural producer's email list with over 300 subscribers. Regular emails about events and opportunities are sent. Some of the landowners interviewed are on the list and reported receiving emails. In addition, the program regularly provides educational workshops in the valley.
- JCNWCB mails letters to individual landowners on an as-needed basis regarding noxious weeds and is working on a monthly newsletter and more outreach.
- JLT has information for landowners on their website in the form of a FAQ sheet. They also have an email newsletter that promotes project successes and provides other relevant information.
- NOSC and JCCD held a beaver management workshop in February 2017 that was attended by over 40 landowners.

While these outreach activities are important in building and maintaining relationships with landowners, the social marketing research conducted for this project should allow the partner organizations to enhance their efforts.

Specifically, four outreach strategies are recommended:

- Enhance and expand collaboration among partner organizations.
- Raise landowner awareness of partner organization services.
- Increase understanding of Chimacum Creek issues and potential solutions.
- Build relationships with individual landowners.

Each strategy is described below.

1. Enhance and expand collaboration among partner organizations

The partner organizations can benefit from more overlap in common functions and activities. For example, joint efforts that raise landowner awareness can result in greater effectiveness and efficiency. Some specific ways to enhance and expand collaboration include:

Create or join an umbrella group: Landworks and Chumsortium are two models for this approach that have experienced local success in the past. Each group includes some, but not all of the grant partners. Ensuring all grant partners join into an established group or establishing a new one should be considered.

Joint messaging: Developing common messaging on key issues puts all of the partner organizations on the same page. Landowners will view organizations as unified in purpose, resulting in increased acceptance and co-operation. Partner organizations provided a collection of vetted facts (see Appendix A) which can form a basis for the messaging.

2. Raise landowner awareness of partner organization services

Partner organizations offer a myriad of beneficial services and programs to agricultural landowners. They were asked to provide list of the tools and incentives (services) they currently offer (see Appendix B). These services and programs may not be fully utilized by landowners based on interview comments such as the following:

- Unaware of services and programs an organization offered.
- Aware of some services but not others.
- Had difficulty locating services when they are needed.
- Believed program benefits were unevenly distributed.
- Did not receive assistance when it was needed.

There have been a few attempts to reach the Chimacum Valley agricultural producers with events and those have been sparsely attended. Currently, the most common way to engage a landowner is through a referral or a direct request. This “squeaky wheel” approach has worked well for the grant partners, but to grow the number of participants, more outreach will be necessary. There needs to be greater transparency with partner organization projects. This can be accomplished by regularly occurring outreach to everyone in the valley.

Online outreach tactics using Facebook, Survey Monkey, email lists, etc. will likely have limited effectiveness with some of the audience. Respondents seemed to favor more personal outreach efforts such as meetings, one-to-one contact, and personalized mailings (hand addressed letters).

Some specific actions to consider:

Regular contact: Ensure everyone in the audience is contacted at least once a year by mail. An annual mailing targeted to Chimacum Valley agricultural producers with a single phone number to call for information could make is easier for landowners to initiate contact. A mailing ensures that everyone is approached at the same time in the same way, reducing any perception of unfairness. A nicely designed, tested product, suitable for keeping or even hanging on the fridge (perhaps a magnet with a phone number) will keep organizations and their services offered front and center with the audience. Partners

can share the mailing and printing expenses, and use updated mailing addresses obtained from county records annually.

Based on studies in other areas, landowners have preferred that organizations repeat their 'ask' regularly; within reason, of course. People are busy and timing is everything. A landowner that isn't ready to engage this year, may think it over and when an annual reminder comes the next year, they'll make the call. Funding and priorities also change from year to year and an annual mailing will give the organizations the opportunity to introduce new opportunities.

While there is a tendency to rely on websites and email to "push" information due to cost and ease, it's worthwhile to ask if landowners are being over-saturated with online communications, and the mediums are losing their effectiveness.

Rotating presentations: Collaborate on marketing for a monthly or bi-monthly program at the Chimacum Grange or some other suitable venue. Each organization could take turns showcasing their services and programs by taking a month once a year and present their services and programs at an event, possibly in conjunction with a movie or some other form of community engagement. Outreach efforts in conjunction with the Chimacum Grange may have limited effectiveness at this time but could be worth the effort, especially in light of the desire to revitalize the Grange. Partners collaborating on a presentation series, with joint marketing, could spark greater attendance compared to single organization offerings.

Review all current outreach materials (websites, brochures, handouts, recent emails, etc.): From the perspective of an agricultural producer looking for assistance from your organization, how do your materials stack up?

Objectively, think about:

- How easy is it to find or access information? Is it buried on your website? Are the wording, site map, and navigation controls clear to this audience?
- What voice are the materials in? Are they speaking directly to your audience in a language they understand?
- Are you clearly explaining how to access the services?
- Do you have appropriate disclaimers? Do you have information to give people if they are not qualified, explaining why you aren't able to help them?

3. Increase understanding of common issues and potential solutions

Many landowners exhibit a high level of knowledge about their land, water quality, salmon habitat, noxious weeds, beavers, and other issues they deal with as agricultural producers on Chimacum Creek. However, not everyone has the same understanding of key issues. This can lead to challenges when discussing potential solutions. Furthermore, solutions that work on one part of the creek may not be effective in other areas due to soil, gradient, and other factors.

A common understanding of how the Chimacum Watershed functions and important issues of concern (such as growing trees in wet soils, beaver lifeways, and reed canarygrass control), can be discussed more effectively if everyone has the same basic understanding. Some actions that will help assure landowners all have base level information include:

- Ask landowners about their experiences, challenges and solutions
- Listen to and record landowner observations
- Compile local knowledge and scientific information
- Identify key experts on topics of interest and invite them to present
- Compile or create materials (fact sheets, Extension bulletins, brochures)
- Hold workshops, offer field trips, and make presentations to share knowledge
- Mail information to all households in the project area with fact sheets and information on common issues of concern

These actions may increase interest and participation in outreach activities that address common issues impacting the watershed. A variety of delivery methods are needed to ensure the largest number of landowners are reached.

4. Build relationships with individual landowners

Effective organizations recognize that working with private landowners is truly a partnership that benefits all. In *Riparian Forests: A Qualitative Analysis* (Appendix D), Dutcher, et. al emphasizes the following points:

- Use credible advisors who understand landowner needs.
- It can be more effective for planners and policy makers to encourage riparian landowners to develop and execute personal management plans that incorporate landowner interests than to expect landowners to buy into abstract, arbitrary goals for buffer widths and stream reaches.
- Readily available, nonthreatening information and assistance are essential for the many riparian landowners who would like to do right by their streams.

Some specific actions to consider include:

Site visits: Asking landowners for an invitation to visit with them on their land is a powerful way to build a relationship that could lead to partnering on riparian projects. Rather than request an invitation from landowners come to their land to provide information to them, a more open ended approach is recommended.

For example, ask landowners to share their experiences as agricultural producers on Chimacum Creek. Appropriate questions might include:

- What are your goals for your land?
- What challenges are you/have you faced?
- What solutions have you tried?

Understanding landowner goals, challenges, and solutions that landowners have tried provide partners with a better understanding of the land and its owner. From there, mutually beneficial assistance can be offered.

This technique is further described in Adam Wiskind's Master's Thesis titled: *Down by the Creek: Understanding Landowner Perspectives on Streamside Health and Management.* 2003, Oregon State University.

In the context of this project, sending a joint letter from partner organizations offering a site visit by more than one representative from the best suited organizations is recommended. A base map of the landowner's holdings and surrounding area could be printed from the Jefferson County assessor office website and brought to the farm for touring the land. Working with landowners, the creek flow, locations of past projects, and future opportunities could be mapped. A deadline for participating increases the chances of involvement and that the landowner's comments and concerns can be folded into the overall strategy for restoring and protecting the creek in that reach. JCCD is currently developing a rapid assessment tool to help with their farm plan process. Elements of this tool could possibly provide a framework for standardized partner organization land visits.

Further discussion among the grant partners is needed to determine if this activity is appropriate and needed for this project. Preparing for site visits and conducting follow-up will require a lot of resources.

Ensure outcomes are clearly understood by landowners: Organizations need to fully understand and carefully explain all the program requirements and clearly articulate any unknowns or potential unintended consequences.

Follow-up materials: Each organization should have printed material to provide to any landowner who does not qualify for a program or service. It is essential to get contact information for follow-up in case funding opportunities change in the future. Mailing or emailing the landowner after the initial contact and restating the reasons why assistance wasn't able to be provided at the time may help with acceptance, leaving the door open for future partnership.

5. Other landowner relationship-building suggestions

In addition to the recommendations presented above, here are some other suggestions that may be useful in building and maintaining relationships with landowners.

- Review the allowed cost estimates for national programs and if local costs are higher, ensure they are taken into account. Work with granting entities to raise cost estimates as needed.
- Take pictures of other projects to show landowners what the restoration will look like; including photos of newly planted and mature vegetation. Included photos of plants suggested for planting with height and other specifications.
- Supply photos or a brochure of likely present noxious weeds for the landowner to watch out for.
- Don't assume a landowner to have all conservative or all liberal viewpoints. Expect different answers depending on timing, phrasing and who is delivering the message.

- Use a representative of the partner organization the landowner is most comfortable with as the contact point.
- Create a notebook with pertinent information about all the partners and their services and provide to each organization.
- Disclose all the known benefits and potential consequences of a project. Employ active listening techniques to ensure they are understood.
- Determine if the landowner has a farm plan or succession plan and read through them to glean relevant information prior to a meeting.

Action Plan

This watershed plan is designed to tackle each problem through the four main approaches of research, education, protection and restoration. Future restoration and land conservation work in the watershed should integrate and utilize the public outreach, riparian restoration, beaver management and reed canarygrass control recommendations in this plan to their fullest extent. Through this collaborative strategy, we have built on the knowledge gained and projects completed over the last several decades to develop a more comprehensive approach to protecting Chimacum Creek from existing and emerging threats to the creek and adjacent lands. The specific restoration and protection recommendations identified below have been developed to manage and reduce the impacts to agricultural landowners and protect and restore valuable habitat within the watershed. These actions will provide protection from the individual site level all the way to actions that can have watershed wide impacts.

The real strength of this watershed protection effort comes from the collaboration amongst the many organizations working to protect the watershed. The groups that developed this plan work together closely, collaborating on projects and facilitating communication with the community. The relationships that have been deepened as a result of the development of this document will allow for partners to share a single vision for future restoration and protection actions in the watershed.

Ultimately, protection of the watershed relies on the support of watershed residents. This plan is intended to be used by the entire watershed community to improve the health and habitat of the creek, and expand the local economy and well-being of the community. Through involvement of the entire watershed community, our legacy can be one of collaborative, inclusive management and a healthy Chimacum Creek that supports our community. To date, many small actions have led to significant improvements to the watershed and we intend to maximize the impact of our future work by prioritizing parcels and reaches for protection and restoration based on potential habitat gain, landowner willingness, and readiness to proceed.

Prioritized Protection and Restoration Actions

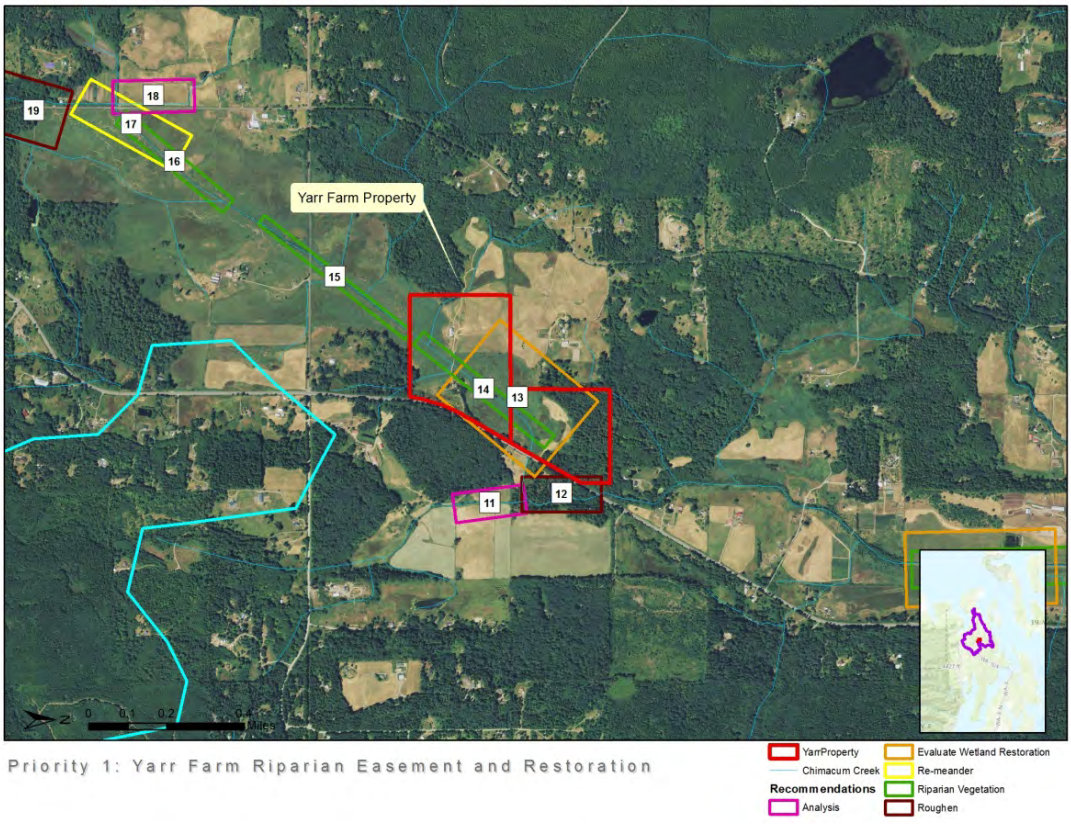
Through a collaborative process between project partners, we determined properties of high conservation and restoration importance within the planning reach. The following provides information and maps of the prioritized parcels for riparian protection and restoration within the Chimacum Watershed.

Priority 1. Yarr Farm Riparian Easement and Restoration

The Yarr Farm is located on ~RM 7.4-7.7 on the main stem of Chimacum Creek and consists of 154 acres of wetland and upland habitat. A substantial portion of the property is situated at low elevation relative to Chimacum Creek, and is therefore frequently inundated from overbank flooding or high local groundwater levels. Approximately 19 acres of the property is located below the local water elevation in the channel and 37 acres is within 2 feet of the relative water surface elevation. Historic data from Government Land Office surveys during the mid-1800s also suggests that most of the valley floor within the property would have been inundated by water either seasonally or perennially (Bahls & Rubin, 1996). The historic riparian forest has been entirely cleared and there are no riparian buffers. Reed canarygrass grows in and around the channel. The channel has little to no complexity and has been straightened and ditched through the project area.

NSD, Inc. conducted a preliminary assessment of this property for restoration potential. They found that the geomorphic setting of this property lends itself to the restoration of a low gradient, highly sinuous channel that includes large in-channel wood, along with re-planting of riparian forest. This type of project would utilize a substantial portion of the lowland that is likely not currently viable for agriculture due to the lack of drainage.

The current landowners are interested in riparian restoration and riparian easement potential. The unused development rights on this property have been permanently extinguished.

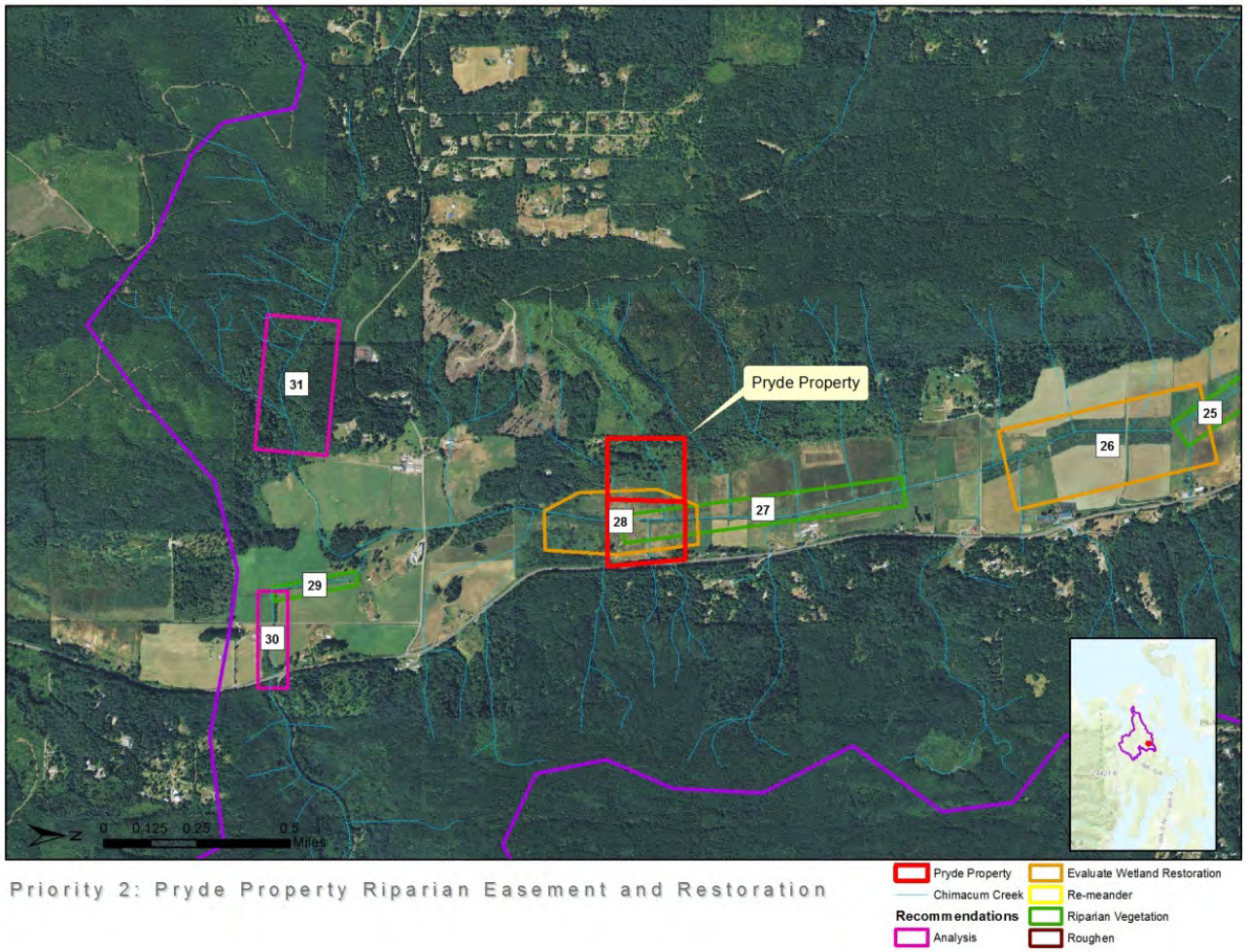


Priority 1: Yarr Farm Riparian Easement and Restoration

Priority 2. Pryde Property: Kodama Farm Riparian Easement and Restoration

Kodama Farm is located on RM 4.3 of the East Fork of Chimacum Creek and encompasses approximately 45 acres. Approximately 1,100 lineal feet of Chimacum Creek runs through the middle of the property, with a majority of the adjacent creek land being perennially wetland habitat utilized by beaver and juvenile salmon. Based on the NSD, Inc. list of recommended restoration actions, this site would benefit from re-meandering and woody debris placement as this stretch of the East Fork lacks habitat complexity and has been straightened (see #28 in Table 3). The riparian habitat is currently degraded with little to no riparian buffer on the creek. Reed canarygrass and beaver activity is present within the riparian area.

The current landowners and leaseholders are amenable to a wetland restoration and selling a riparian easement (pers. comm. Sarah Spaeth 2017). The farm is currently used for permaculture practices.



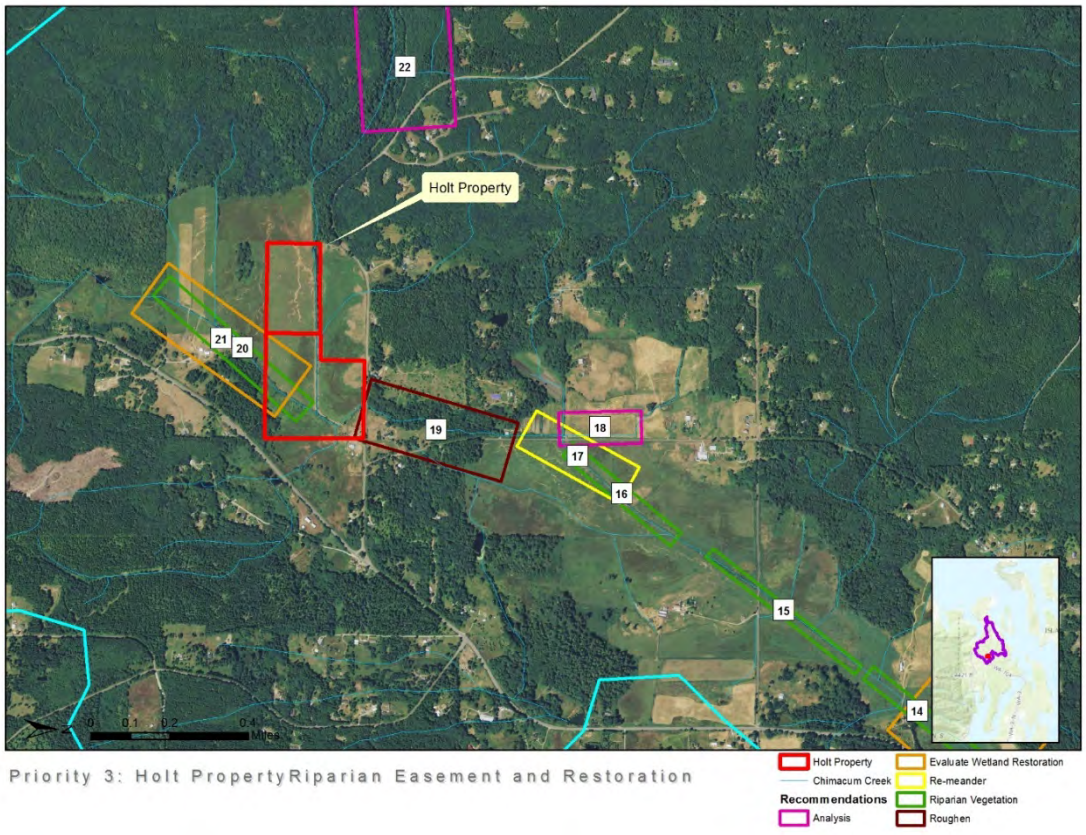
Priority 2: Pryde Property Riparian Easement and Restoration

Priority 3. Holt Property; Fastlane Farm Riparian Easement and Restoration

A total of 3,069 lineal feet of Chimacum Creek mainstem (RM 9.4-9.9) and 826 lineal feet of tributary (Barnhouse Creek) flow through the Holt Property. Stream and habitat improvements would include a re-meander of the channelized creek through an existing wetland pasture. In 1985, a historic landslide deposited large amounts of sediment onto this stretch of the creek. JCCD installed a sediment basin in 1986 to capture the sediment but it has since filled in; the creek is now filling in with sediment and is causing habitat degradation and erosion of the stream banks into the neighboring property where cattle are pastured.

Restoration of riparian and in-stream habitat on this reach of the creek is considered a high priority by NSD, Inc. Fastlane Farm is a high priority site for the Jefferson County Conservation District, identified through an Environmental Protection Agency (EPA) funded Pollution Identification and Correction (PIC) survey in 2013 with water quality readings and visual inspection. There are continual exceedances of water quality standards at the confluence of Barnhouse Creek and the mainstem. NSD Inc. recommends riparian planting as a minimal treatment for this reach but it should be evaluated for wetland restoration since it is the site of a historic perennial wetland.

The current landowners engaged the Jefferson County Conservation District in restoration design. A preliminary design was developed in 2014 but a project has never been implemented due to lack of funding. The farm is currently used for hay production and livestock grazing.

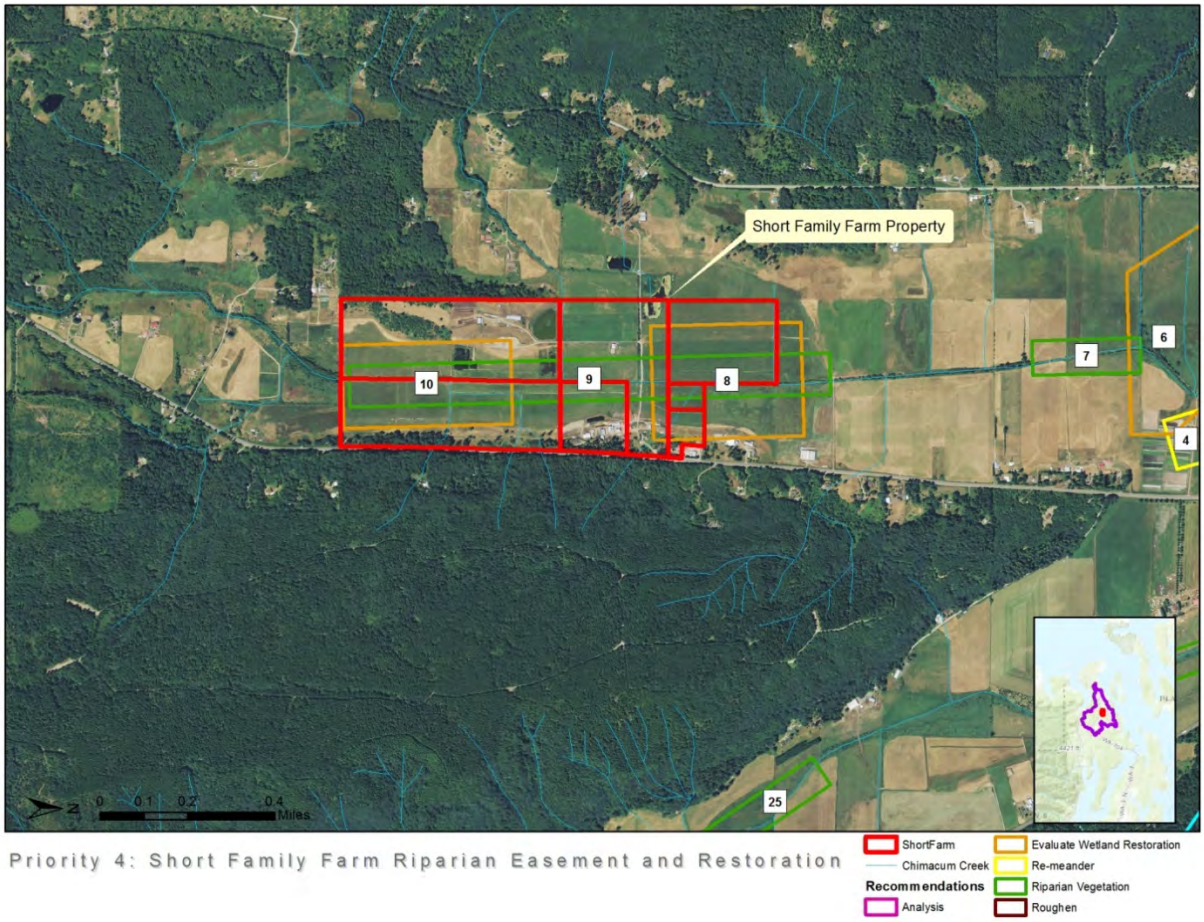


Priority 4. Short Property; Short's Family Farm Riparian Easement and Restoration

This 254-acre farm is one of Jefferson County's largest active farms. Approximately 1 mile of Chimacum Creek and the mouth of Naylor's Creek, an important tributary for coho spawning, runs through this property. The landowner has a Conservation Reserve Enhancement Program (CREP) buffer along Naylor's Creek but Chimacum Creek has little to no vegetated buffer. The property has areas that remain perennially wet and in the winter, most of the property is flooded. The site provides excellent forage opportunities for trumpeter swans.

Temperature exceedances occur regularly along this reach. NSD Inc. recommends vegetated buffers along the creek and ditches to improve creek health. Due to chronic water quality issues, this property was deemed a high priority for restoration. Restoration would entail a re-meander and placement of woody debris to improve habitat diversity within this reach. Finnriver Farm is immediately upstream of this reach and a successful habitat restoration project was able to reduce reed canarygrass within the riparian area and provide spawning habitat for coho salmon.

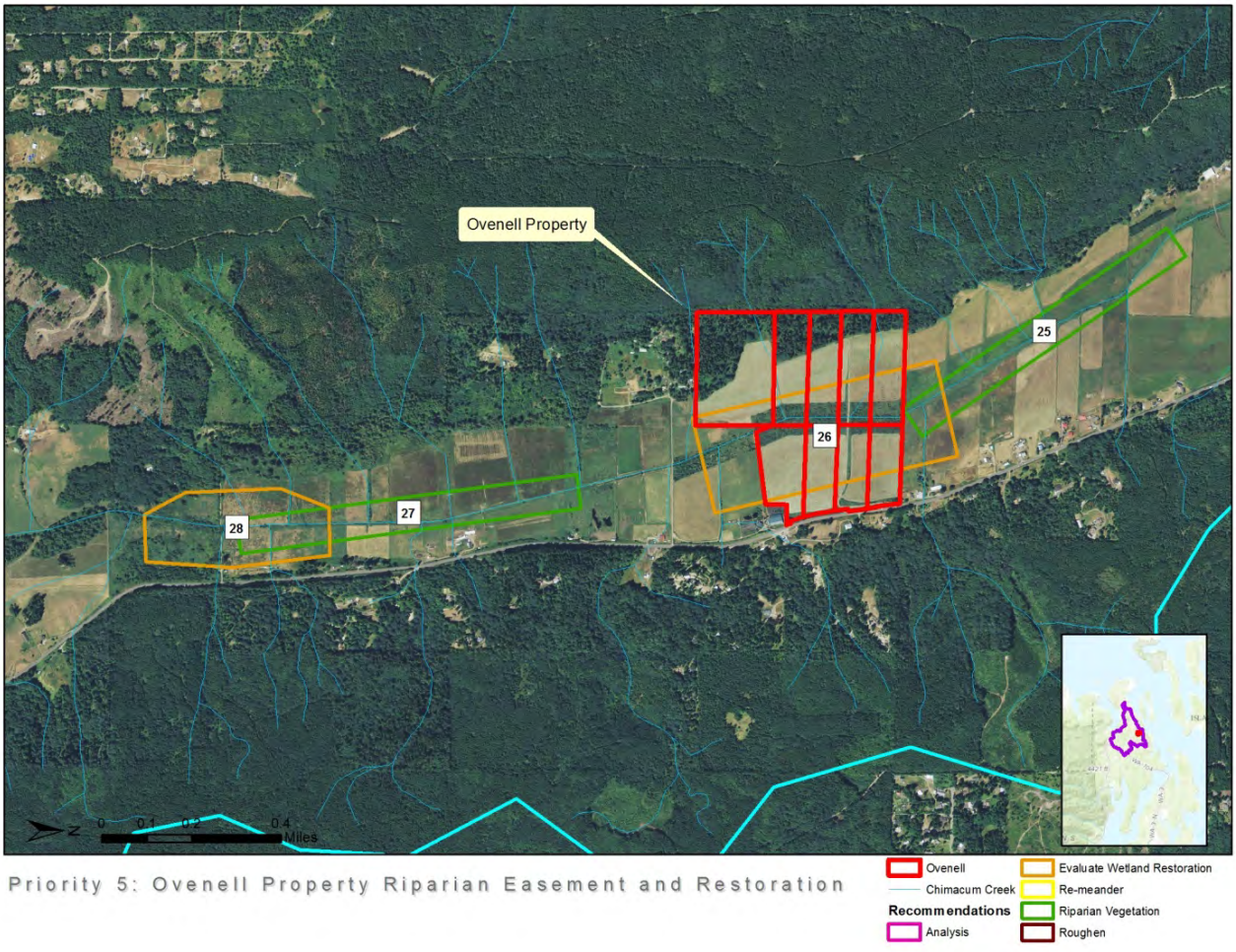
The property had its development rights purchased by the Jefferson Land Trust in 2016, so it will remain in agriculture in perpetuity. The landowner has expressed interest in planting a buffer to manage the reed canarygrass and improve water quality but will only do so if it is effective.



Priority 5. Ovenell Property; Ovenell Farm Property Riparian Easement and Restoration

Approximately 1,751 feet of the East Fork of Chimacum Creek (RM 3.4-3.8) flows through the Ovenell Farm property. Ovenell Farm was planted in 2002 and 2003 as part of CREP and retired from receiving CREP funding in 2014. The riparian habitat consists of dense willow and is occupied by multiple beavers which have contributed to flooding of adjacent fields and damage to crops. Reed canarygrass is present on the outer edge of the planting but the dense willow has precluded infestation from the buffer. Analysis of this reach indicates the site is the location of a historic perennial wetland. NSD, Inc. recommends restoration to increase complexity and connectivity along this stretch of the east fork.

The owner of the property leases his fields to another local farmer for hay production. However, due to flooding and beaver activity, large portions of the property have been deemed unproductive for hay and the landowner has indicated willingness to participate in protection of the property but they have not been approached but have not indicated willingness for wetland restoration (Pers. comm. Sarah Spaeth 2017).

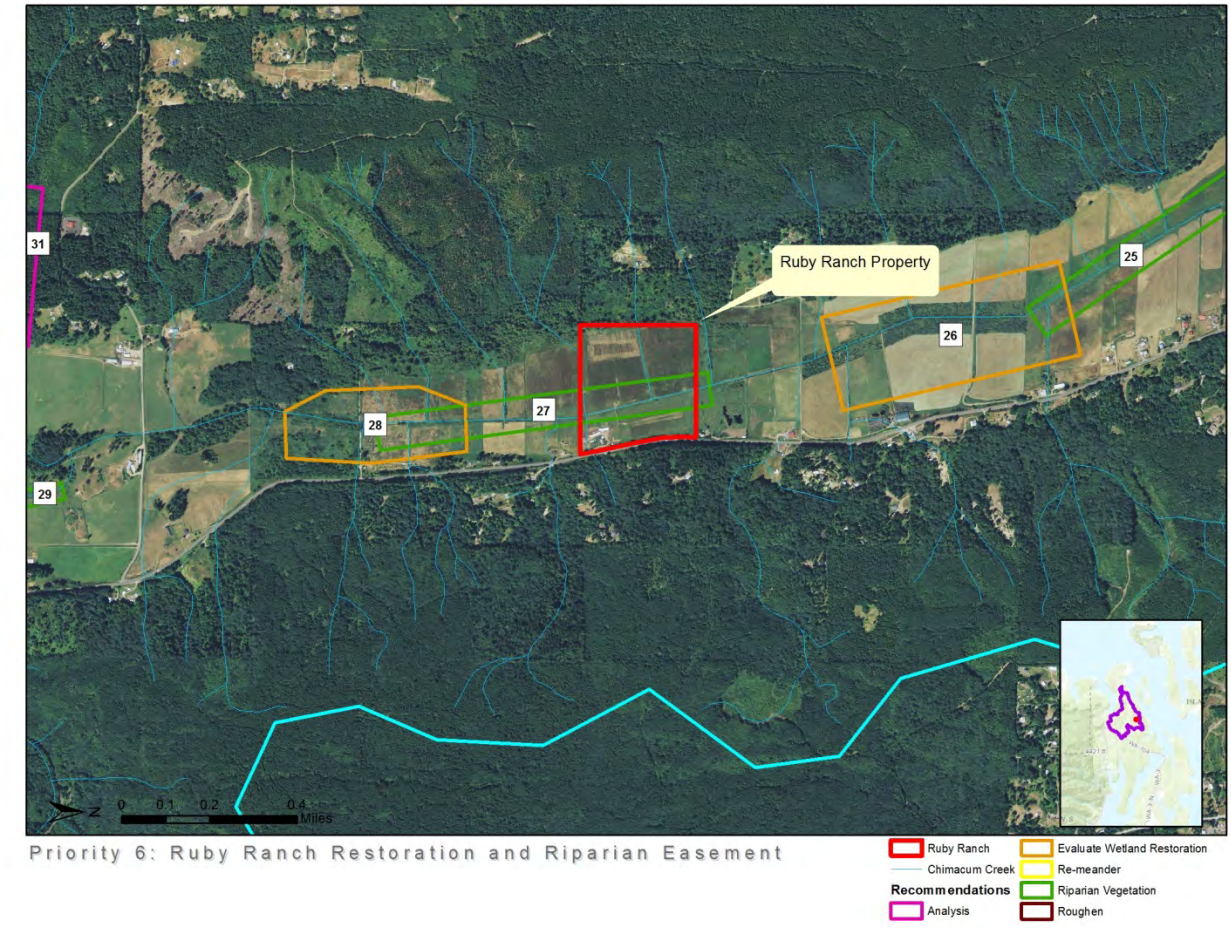


Priority 5: Ovenell Property Riparian Easement and Restoration

Priority 6. Goularte Property; Ruby Ranch Riparian Easement and Restoration

The property is a 60+ acre agriculturally zoned piece of land. Five acres of the land is dedicated to a residential home with the remaining 55+ acres divided into 5 large fenced paddocks for livestock. Approximately 2,000 lineal feet of East Fork of Chimacum Creek flows through the center of the property. The creek is fully fenced to prevent livestock access but native vegetation is not present. NSD Inc., believes this property to be of medium priority with a need for riparian restoration.

The current landowners have expressed willingness to conserve the agricultural values of this property. They have not been approached for riparian restoration and protection.



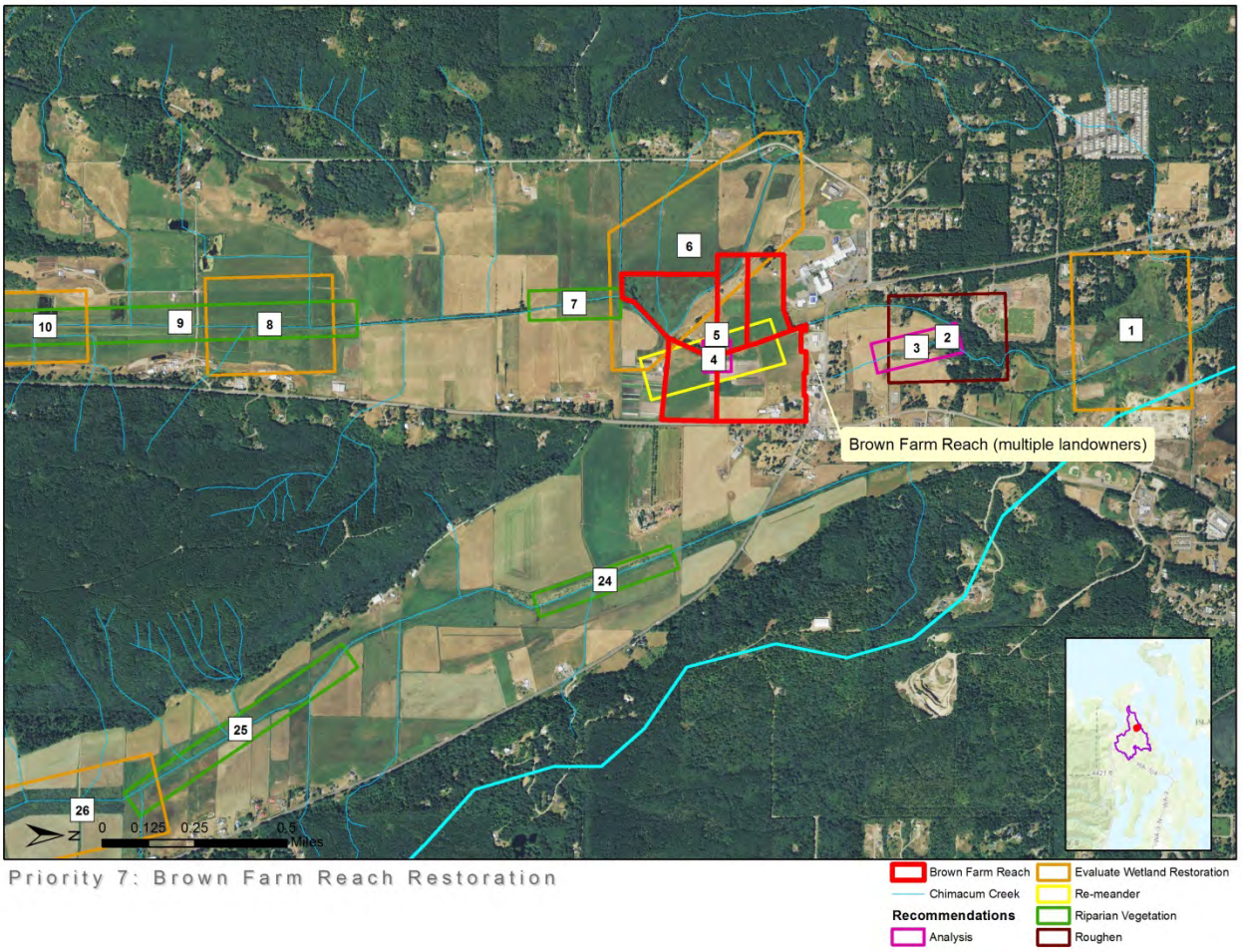
Priority 6: Ruby Ranch Restoration and Riparian Easement

Priority 7. Brown Farm Reach Scale Restoration

The Brown Farm reach consists of 4 different landowners along 2,109 feet of Chimacum Creek main stem. The creek is deeply incised and disconnected from the floodplain on this reach. The right bank has been planted with a riparian buffer in 2009 but the left bank is un-vegetated. There is an irrigation control structure on the lower end of this reach that would need to be analyzed for impact to creek processes.

Due to deep incision of the creek along most of this reach, channel re-meandering and/or excavation of an inset floodplain may help improve connectivity of the creek to its floodplain. This restoration strategy is appropriate in this reach due to the presence of relict channel features and potential room for channel migration and side channel engagement. Topographic survey and 2- dimensional hydraulic modeling are recommended to assess potential for re-engagement and to guide restoration design on this reach.

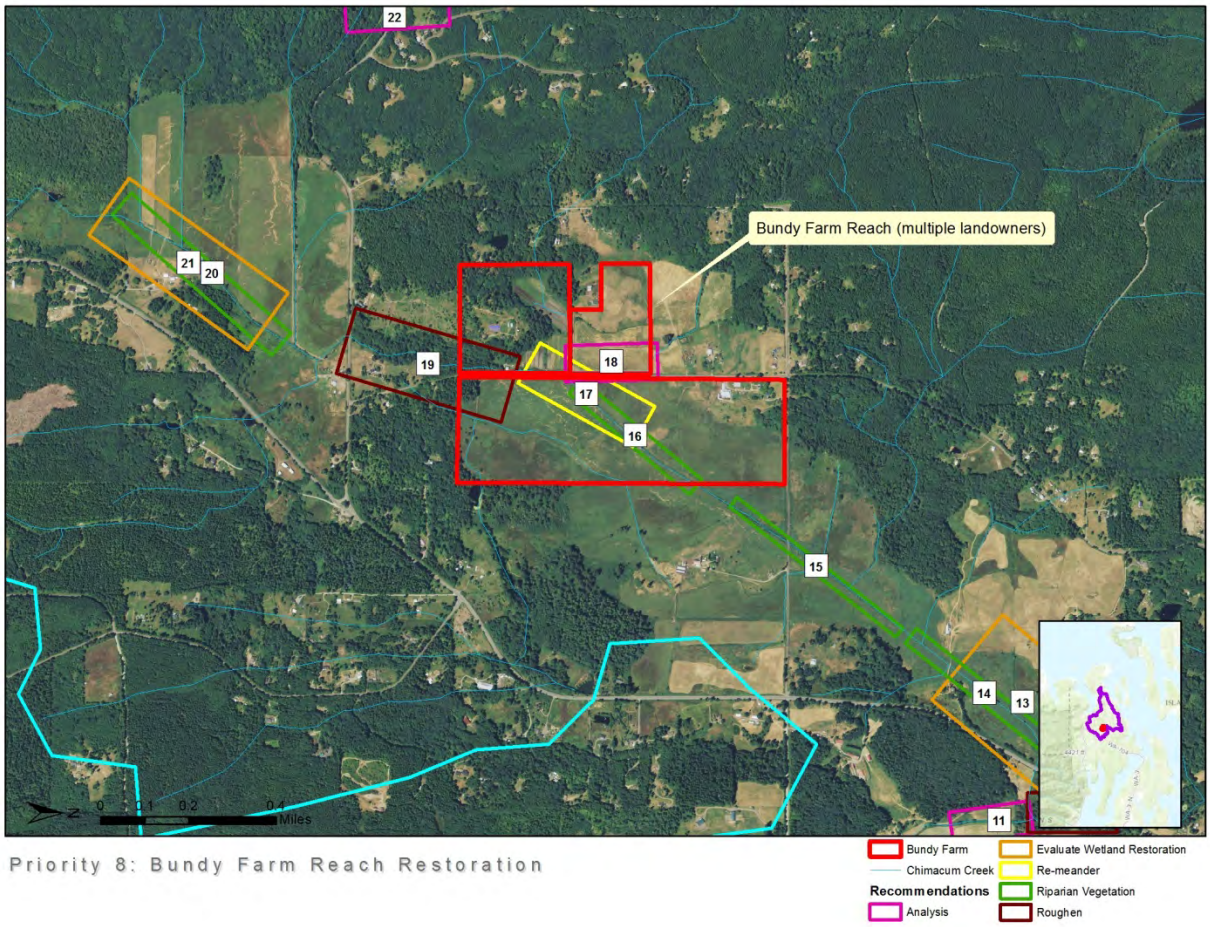
The owners of Brown Farm have expressed interest in restoration and currently have a conservation easement on the property. The other 3 landowners on the left bank of the creek have not been approached about restoration.



Priority 8. Bundy Farm Reach Scale Restoration

The Bundy Farm Reach Scale Restoration consists of 3 different landowners, with the Bundy Farm being a significant property within the project area. The 115-acre Bundy Farm is located on RM 8.7 of the main stem of Chimacum Creek. Approximately 1,900 lineal ft. of Chimacum Creek flows through this property. The creek has been ditched and straightened and has an un-vegetated buffer of approximately 10-15 ft. NSD Inc. recommends re-meander and channel roughening to restore salmon habitat within this reach.

The current landowner of Bundy Farm has enrolled in the CREP for fencing and riparian planting and is working with Washington Department of Fish and Wildlife to replace a fish passage barrier on the property. The land is currently used for a beef cattle operation. One landowner within the project area has had a fish passage barrier replaced on his property but has not indicated willingness for riparian restoration. The third landowner has never been approached for restoration or protection.



Priority 8: Bundy Farm Reach Restoration