CHIMACUM CREEK ADAPTIVE BEAVER MANAGEMENT PLAN

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Prepared by
Jefferson County Conservation District

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PROJECT PARTNERS

North Olympic Salmon Coalition

Jefferson Land Trust

Jefferson County Weed Control
Protecting Native Ecosystems & Natural Resources
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Contents

Background and Purpose

North American Beaver (*Castor canadensis)* have widespread distribution throughout most of North America. They play a significant role in building complexity into riparian ecosystems— improving habitat and water quality for fish and other wildlife. Despite benefits of beaver in riparian ecosystems, there is no question that beaver can have destructive impacts on infrastructure and working lands when they live in close proximity to people.

Beaver have a historic presence in the Chimacum Creek Basin –hence *Beaver Valley* from which the east fork of Chimacum Creek drains (Figure 1). However, by the early 1900's, the local beaver population was greatly reduced as a result of increased trapping and habitat loss from watershed-scale alteration of the forested, meandering, and braided stream (Latham 2004). Jumping ahead to 2000, Washington State passed a trapping initiative (713) that banned body-gripping traps (RCW 77.15.194), which reduced trapping activity. Also around that time, beaver pelt prices fell to around five dollars per pelt (Cochrane 2016). Likely a result of these factors, local beaver populations have grown over the past decade. The establishment of forested buffers through the Conservation Reserve Enhancement Program (CREP) and other tree planting grant programs—beginning in the 1990's— coincided with increased beaver activity in the Chimacum Watershed. Beaver dams in reaches of Chimacum Creek that flow through agricultural lands have regularly caused flooding that killed trees within riparian buffers and reduced the acreage of productive farm and pastureland beyond riparian buffers.

The purpose of this document is to assist landowners and local conservation planners in making management decisions regarding beaver activity in the Chimacum Creek watershed that balance habitat needs of beaver and associated wildlife and the need to protect private property and resources – with a focus on agricultural lands. This 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, so a flexible adaptive management plan is well-suited to address beaver-related resource concerns.

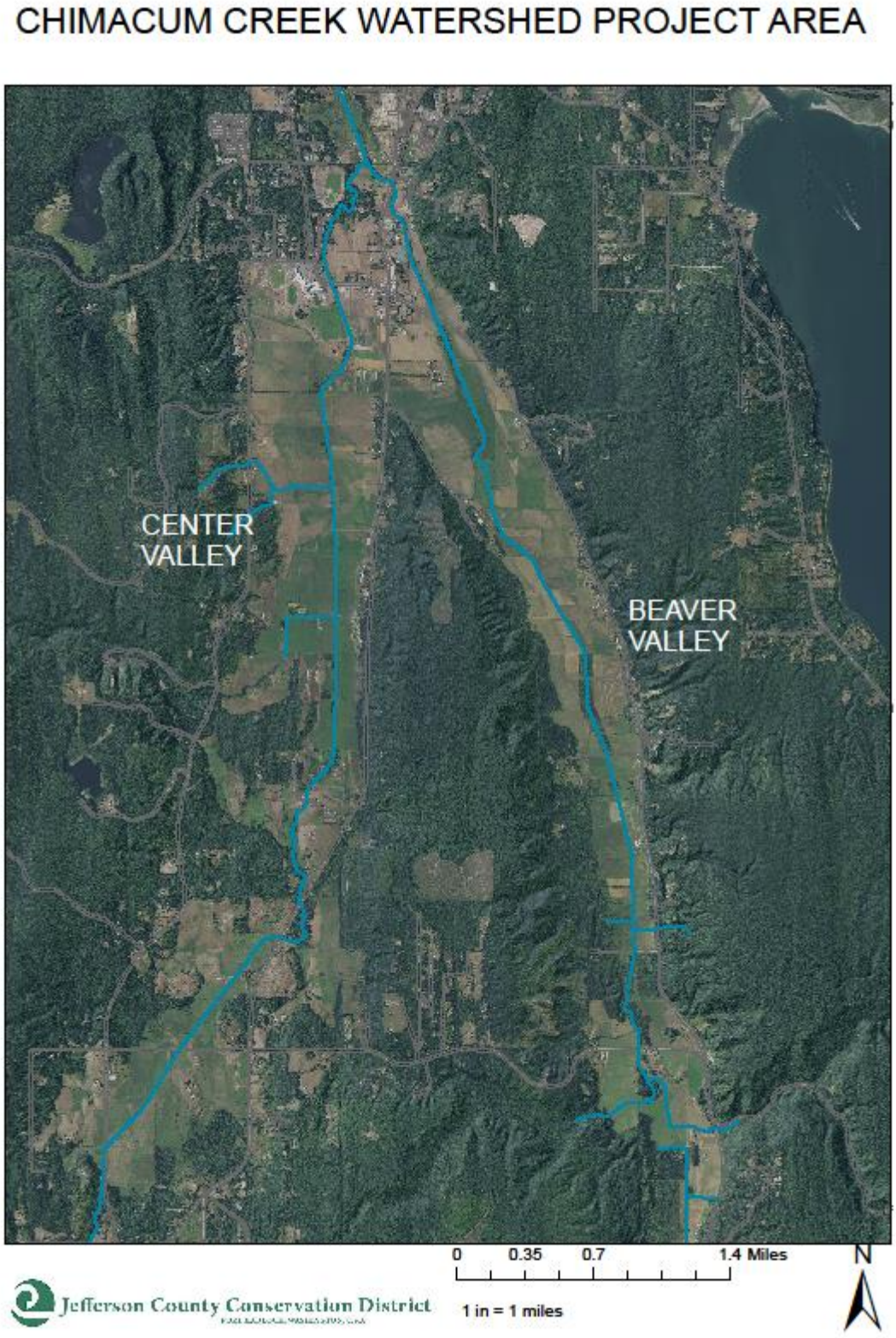


Figure 1. This map shows the main stem of Chimacum Creek flowing through Center Valley and the east fork of Chimacum Creek flowing through Beaver Valley.

Beaver: Life History and Ecological Impacts

Life History

Beaver are the largest rodents in North America—adult beaver typically weigh between forty-five and sixty pounds and are three to four feet long (Hall and Cannon 2013). They can live up to twenty-five years in the wild, but more commonly live five to ten years (WDFW 2011). Beaver stay active for most of the year— mating during winter months and typically producing a litter of two to five kits four months later in the spring. Their colonies include two adults and the young of the year. Beavers are territorial and, generally, do not allow another beaver or colony to live close to theirs—studies have shown that, on average, one mile of stream can support up to two colonies (Hawley-Yan 2016). Their territorial nature, thus, restricts beaver population growth, as they reproduce only where there is available habitat to support them.

The Oregon Department of Fish and Wildlife identified the following general characteristics of suitable beaver habitat (City of Portland 2010):

- Small, year-round streams with an active channel width thirteen to twenty feet wide;
- Valley width greater than two times the active channel width;
- Less than six percent stream gradient;
- Stream canopy cover twenty-five to fifty percent;
- Abundant food supply of primarily deciduous shrubs adjacent to the stream.

More generally, beaver habitat requires two key components, water and wood. With those, they are capable of engineering the environment to meet their needs. The semi-aquatic mammal inhabits freshwater lakes, ponds, year-round marshes, rivers and small streams. In settings where the water is relatively deep, beaver engineer burrows into banks with underwater entrances that angle up above the water level. Where water is shallow (i.e. small streams), beaver build dams out of harvested trees and woody shrubs to raise the water level. Building lodges and dens with underwater entrances enable beaver to quickly escape predators and to store food during cold winter months. In addition to using woody riparian vegetation to engineer their homes, beaver are herbivores—they eat herbaceous vegetation, mostly in the spring and summer, and cambium layers of woody shrubs and trees, in the fall and winter (Muller-Schwarze 2011). In the Pacific Northwest, preferred species include alder, apple, birch, cherry, cottonwood, poplar and willow (City of Portland 2010, Beaver Solutions LLC). Occasionally, conifers are eaten, but, more often, beaver will girdle and kill trees for dam building materials or to make room for preferred food plants (Cochrane 2016).

Ecological Impacts

Beaver have been long-recognized as keystones species in riverine and riparian ecosystems because of the role that they play in building complexity into these systems. Through dam-building and forested buffer management, beaver improve or maintain healthy watersheds in the following ways:

- Trapping sediment to repair incised streams, and to improve downstream water quality;
- Creating wetlands and increasing connectivity within a floodplain;
- Slowing the flow of water to extend summertime stream flows;
- Increasing aquifer and groundwater recharge;

- Creating ponds for fish and wildlife habitat and more diverse vegetation (Wheaton 2013, Hall and Cannon 2013).

In agricultural areas where beaver live in close proximity to people, they can be destructive to infrastructure and working lands. Beaver harvest trees in riparian buffers (often planted to improve fish habitat and water quality) in order to engineer dams that can clog culverts and free-flowing waterways, which, can result in the flooding of surrounding pastures and farm fields. Not only can flooding destroy riparian plantings, crops, and infrastructure, but it can put water in contact with livestock manure and other pollutants that would, otherwise, not come in contact with the stream.

Beaver in the Chimacum Creek Watershed

History of beaver presence and activity

Beaver have been 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, meandering, and braided stream. At that time, most of the lowlands in the watershed were cleared of coniferous forests and were converted to pasture; and, much of Chimacum Creek and its tributaries were channelized for the purpose of improving drainage and agricultural use (Bahls and Rubin 1996). The channelization resulted in some reaches of the low-gradient channel being slightly higher in elevation than adjacent pasture lands. The combination of habitat loss and increased trapping resulted in a beaver population that was greatly reduced. Beaver likely stayed in areas outside the main channel or in limited sections of the main channel that remained unaltered and forested.

In the late 1990's, tree and shrub buffers were 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. Some reaches of the channel that have been dredged semi-annually for many years or have steep, incised banks cause beaver to have more trouble accessing the planted trees for forage and building materials. These locations, even when dams are built, have not caused major issues for landowners because, water has stayed in the channel without flooding the buffer plantings or adjacent pastures. The less incised reaches are more suitable for dam building and have resulted in localized trouble spots for beaver activity in the watershed.

Local challenges

While the ecological impacts of beaver are consistent throughout their broad habitat range, those impacts cause more damage in regions where beaver live in close proximity to sensitive infrastructures and/or resources. Prime agricultural soils in the Chimacum Valley are those in the floodplains; and most of these soils are wetland soils, so drainage management has always been a challenge and a priority for local agricultural producers (McNamara and Simmons 2016). Therefore, in addition to local beaver populations existing in close proximity to agricultural resources and infrastructure, poorly draining soils make this area particularly at risk for flooding.

Further impacting drainage and the likelihood of flooding into adjacent buffer and pasture is the extensive presence of invasive reed canary-grass (RCG) along much of Chimacum Creek. RCG in the creek reduces stream velocity, which causes build-up of sediment that creates more habitat for the invasive weed. Especially during the summer growing season, RCG infestations clog the creek and

interrupt proper flow and function of the waterway. Then, decay of RCG results in lower dissolved oxygen in the creek (degradation of fish habitat). As described in the *Chimacum Creek Riparian Management Plan,* RCG was planted as a forage crop for cattle in the 1950's. Until livestock producers began to fence livestock out of Chimacum Creek in the 1980's to address water quality concerns, cattle grazing prevented the weed from establishing the dense monoculture that now clogs much of the creek. Local beaver populations have even utilized RCG to engineer dams—further clogging and infesting the stream.

Because most of the land adjacent to Chimacum Creek is privately owned, landowner support and interest in watershed restoration and enhancement is essential. Therefore, landowner perceptions about beaver and related factors are just as important a consideration as the tangible impacts of beaver populations to infrastructure, resources, and watershed function and health.

Landowners in the Chimacum Creek Watershed have the following general perception about beaver in Chimacum Valley:

While beaver have always been in the area, some said tree planting programs, like CREP, have encouraged them to come back in larger numbers. They have seen that when beaver dams are removed from one site, they are rebuilt in another nearby location. While short-term flooding (from beaver) is viewed as tolerable, long-term flooding has resulted in loss of crops and pastureland. (McNamara and Simmons 2016)

Based on the above feedback, it is important to highlight that local landowners are not opposed to living with beaver. Instead, they want to address the impacts of beaver and related factors on drainage and long-term flood prevention on agricultural lands.

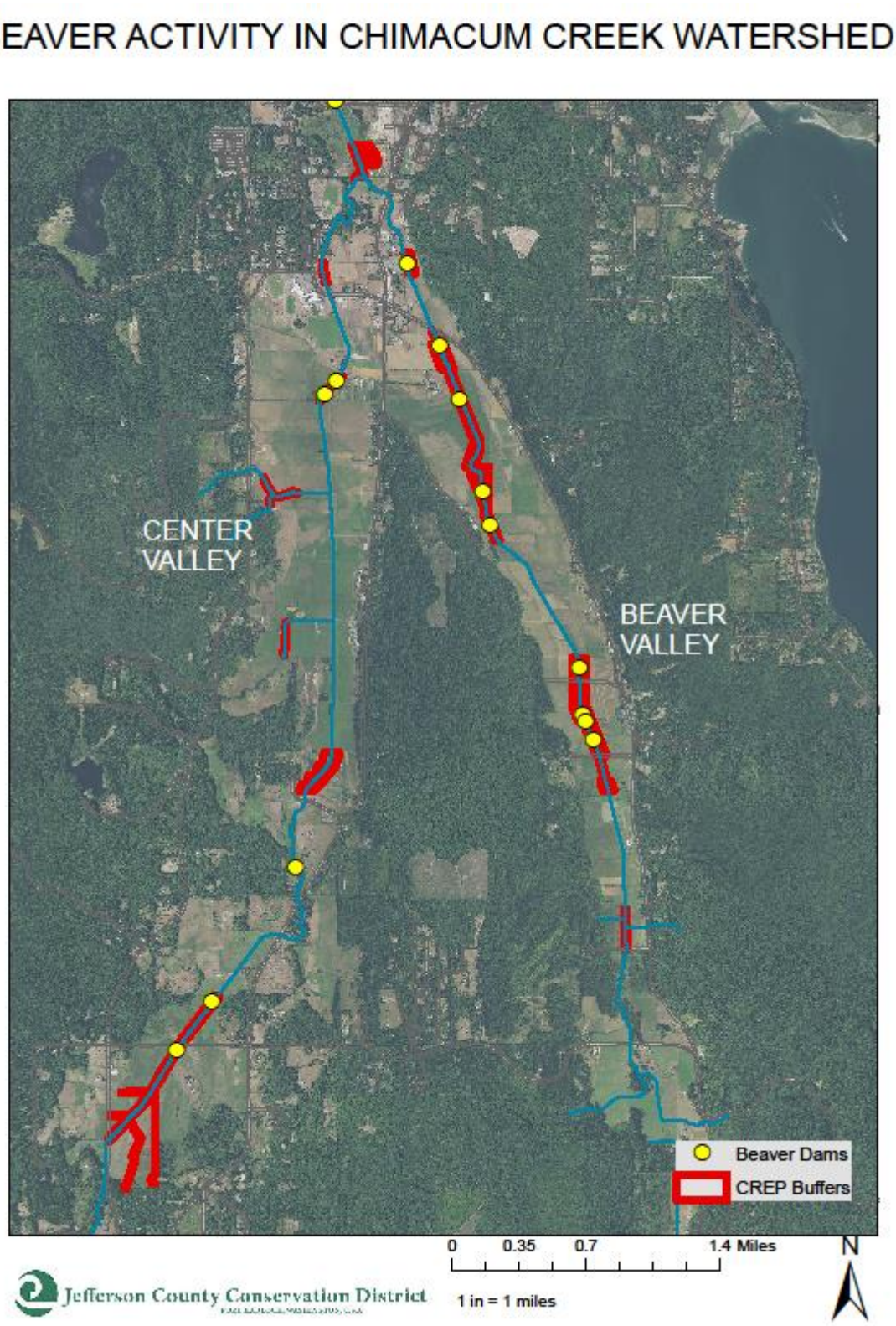


Figure 2. Map of Chimacum Creek Watershed showing established CREP buffers and sites with known beaver activity.

Preventative Planning for Riparian Buffer Projects

The first step in adaptive beaver management is preventative planning for future riparian restoration and enhancement projects. Conservation planners in partnerships with private landowners have been planting riparian buffers throughout the Chimacum Creek watershed since the late 1980's with a marked increase in 2002 with the implementation of CREP. Monitoring results and empirical evidence from established riparian buffer projects have shown increased beaver activity in these newly forested buffers—as they create model beaver habitat. Using lessons learned from existing riparian buffers, conservation planners can take preventative action on both the watershed and site-specific scale. On the watershed scale, conservation planners can identify areas within the Chimacum Creek Watershed that will, likely, support beaver populations without threat of significant damage to infrastructure or working lands. On the site-specific scale, conservation planners can design riparian restoration and enhancement projects with access for maintenance related to beaver activity and by selecting plants that are less preferred by beaver.

Classification of Suitable Beaver Habitat

This *Adaptive Beaver Management Plan* is one element of the collaborative project by local organizations to develop *The Chimacum Creek Protection and Restoration Plan*. The comprehensive plan includes a hydrologic assessment that includes the identification and classification of suitable beaver habitat along the Creek. In the project area, where agricultural land dominates the landscape along Chimacum Creek, *suitable* is defined as reaches that have, both, habitat characteristics that can support beaver populations and where potential damage to resources and/or 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:

- *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 not encouraged.

Designing Riparian Restoration and Enhancement Projects with Beaver in Mind

Discouraging beaver from colonizing an area that has been identified as a *Living with Beaver Zone* or a *Nuisance 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 or shrub species (native and non-native) that beaver find most desirable;
2. Protect newly planted or desirable trees in riparian buffers where beavers are likely to inhabit.

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

Species selection and placement

By reducing or eliminating desirable plants, conservation planners can select plant species that are *not preferred* or that 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 1. 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 –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 outcompete 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 (Table 1). 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). Alternatively, trapping or transporting beaver maintains the food supply, which, therefore, preserves attractive habitat. Plant protection also prevents mortality to newly established tree 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 (Figure 2), 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 individual identified trees or entire sites of established trees. *Low Fences* can be used to protect entire sections of densely planted trees directly adjacent to stream channels. While chemical repellants can be effective deterrents, they require regular and repeated application, which can be cost and time prohibitive (Harper et al. 2005).

Plant Protection Best Management Practices (BMPs)

Cylindrical cages are the best way to protect individual trees. They can be constructed from sturdy 2x4 inch welded wire fencing, about three feet high. Cages should encircle the trunk, leaving about six inches between the tree and the fencing, but not space between the bottom of the cage and the

ground (Beaver Solutions LLC 2016). Cages can be fastened using the cut ends of the fencing as prongs to connect the two ends in a circle. Zip ties can also be used to connect the cylinder. Chicken wire or plastic tubes are less reliable, but can be used as temporary measures, or to protect many small trees.

Low fences can be used to protect groups of trees close to banks of the waterway, since beavers dislike being separated from the water. A 3-4 foot-tall fence should be fit tightly to the ground and trail toward the water. Beavers are good diggers, so low fences need to be monitored often for burrowing, especially right after installation.

A textured paint mixture can be used as an alternative to cage protectors for larger groups of trees or bigger trees –though not as effective as wire cages. This deterrent is a more aesthetic protection method. Coating tree trunks in a mixture of latex exterior paint and fine mason sand (30mil-70mil) can be somewhat effective in deterring beavers from chewing on mature trees and shrubs (at least six feet tall). Using a ratio of five ounces of sand per one quart of paint, trees or shrubs can be painted from the base to about four feet (Hawley-Yan 2016). This BMP can be implemented with little financial or time investment and does not need to be re-applied for a number of years.

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

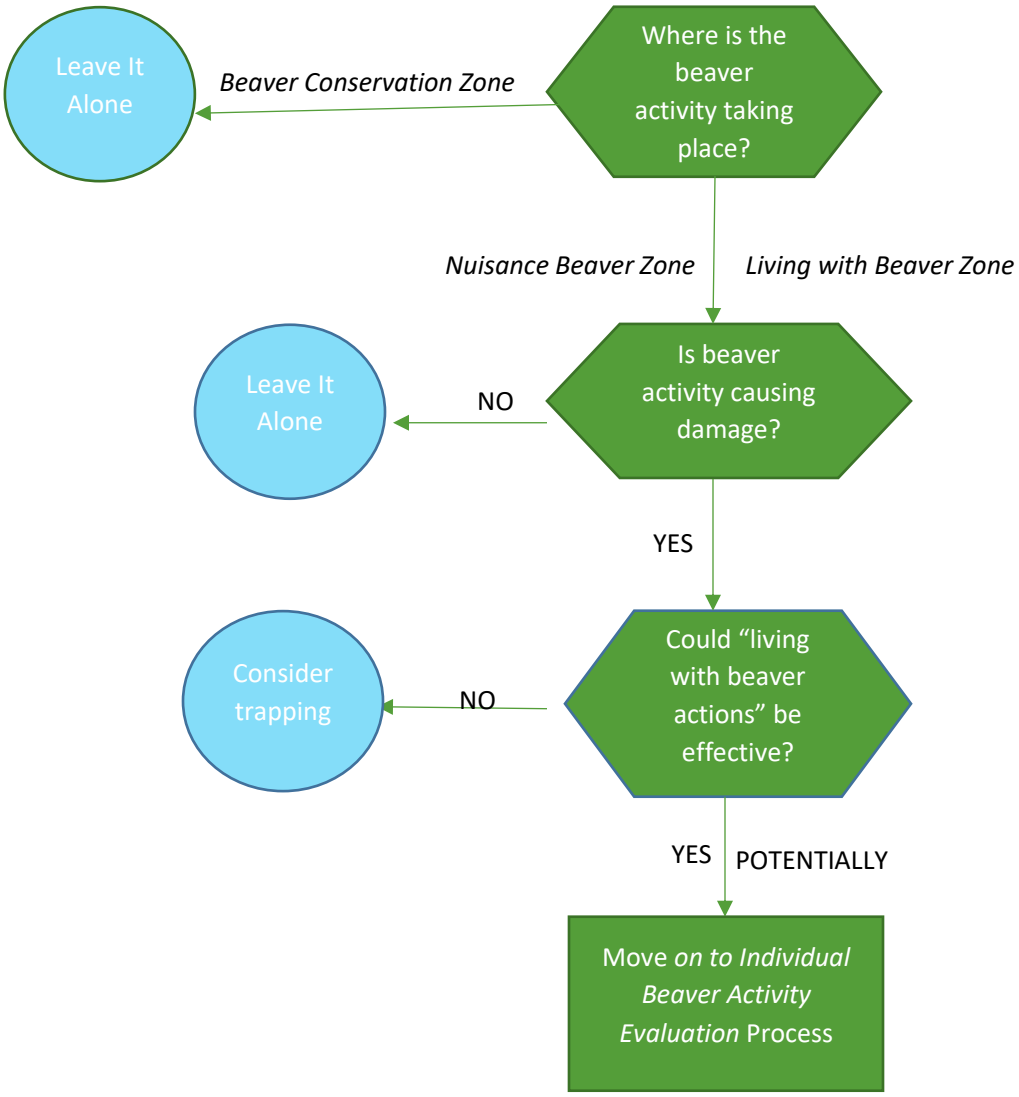
By designing established access points through the riparian buffer to the waterway, landowners and land managers can prevent unintended damage to desirable riparian buffer vegetation and can make more frequent visits to monitor the flow and function of the waterway, which might reduce the cost and level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

Adaptive Management Process

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).

Reach-scale Evaluation Process

Using the beaver habitat suitability classification categories, landowners and conservation planners begin to identify appropriate beaver management response(s) by conducting a simple evaluation at the reach-scale.



Individual Beaver Activity Evaluation Process

If the *Reach-scale Evaluation Process* determines that "living with beaver" actions could be effective, then, landowners and conservation planners move onto the site-specific evaluation of beaver activities. This evaluation results in specific beaver management recommendations to address the impact(s) of beaver activities in that location. "Living with beaver" actions will be described in detail following this section.

"Living with Beaver" Best Management Practices (BMPs)

The following section outlines the suite of BMPs available for preventing or responding to harmful impacts from beaver activities.

Resource Concern	Suggested Best Management Practice
Protection of Individual Trees	Cylindrical Cages
	Textured Paint Mixture
Protection of Planting Site	Low Fences
	Species Selection and Placement
Flood Prevention	Beaver deceiver
	Flow leveler
Flood Mitigation	Dam notching
	Trapping

Table 2. Summary of BMP response options by resource concern

Plant Protection

Plant protection alters beaver habitat by reducing available food supply. When beaver exhaust their food supply, they will eventually relocate (Beaver Solutions 2016). *Cages* or *textured paint* can be useful for protecting individual identified trees or entire sites of established trees. *Low Fences* can be used to protect entire sections of densely planted trees adjacent to stream channels.

Specific guidance for implementation of tree protection BMPs is described in the *Preventative Planning for Riparian Buffer Project* section of this plan.

Flood Prevention

Beaver Deceiver

Beaver deceivers or exclusion devices keep beavers from plugging culverts and other narrow constrictions in a waterway (Photo 1). Using fencing materials, beavers are kept a sufficient distance away from the culvert or constriction to reduce noise and the feeling of quickly moving water; two things that trigger beavers to build dams. 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.

Photo 1. 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 by creating 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 3). 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.

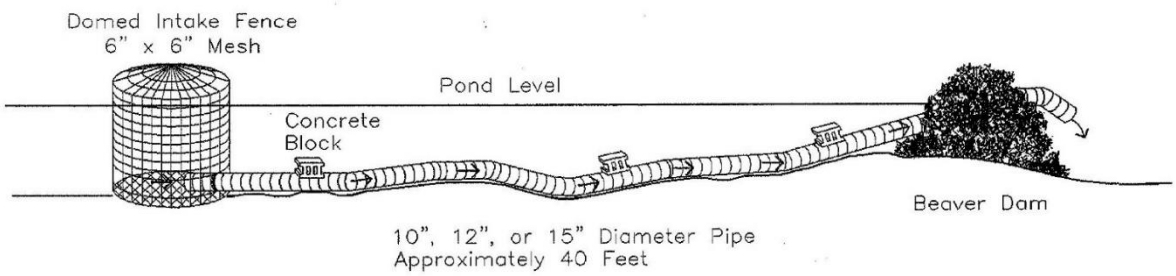


Figure 3. **Fence and Pipe Flow Device.** Reproduced courtesy of Mike Callahan, Owner Beaver Solutions LLC, "Working With Nature"

Photo 2. Installation of a fence and flow device along Chimacum Creek.

Photo 3. Fence and Pipe flow device installed along Chimacum Creek to address an area with frequent beaver activity.

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 4). The Clemson leveler works well managing water levels in small drainages. 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.

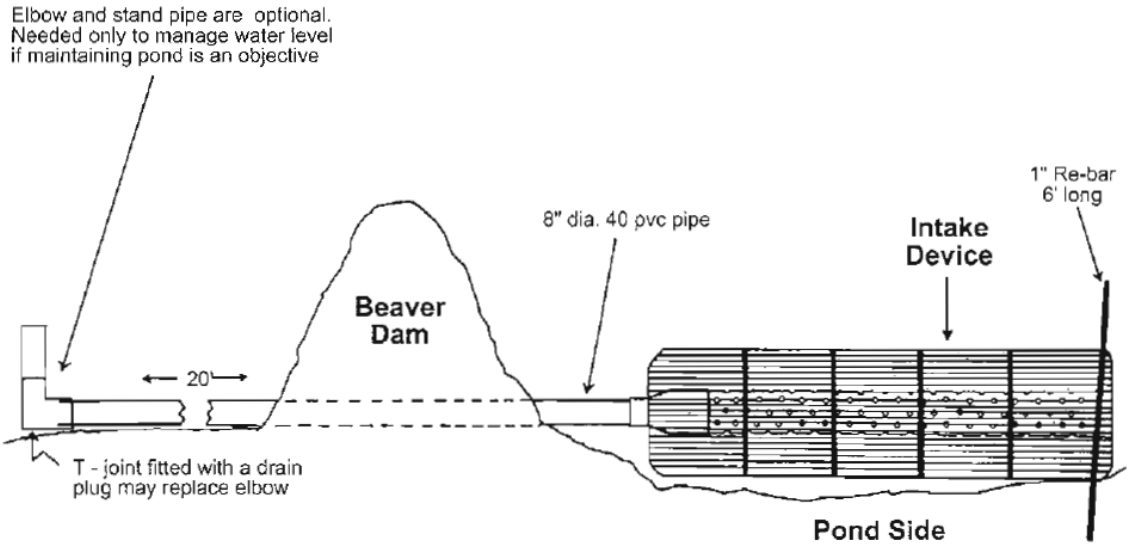


Figure 4. **Clemson Pond Leveler Device.** Reproduced courtesy of Clemson University Cooperative Extension Service.

Flood Mitigation

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 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 (Photo 4). 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.

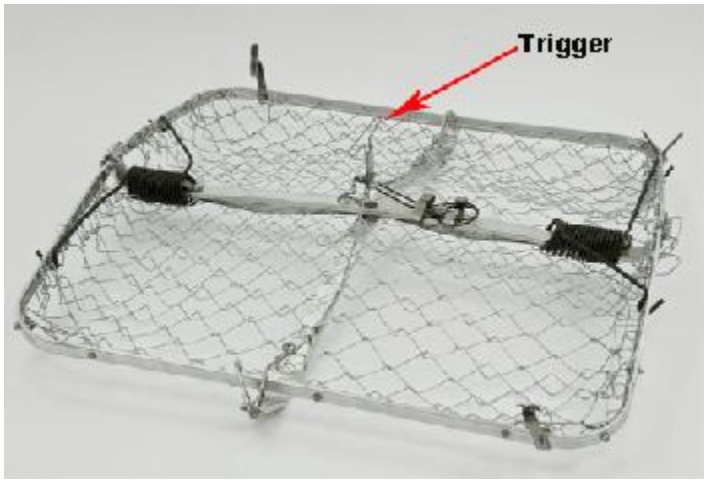


Photo 4. Bailey Beaver Live Trap (Wildlife Control Supplies 2015).

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 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 it was

caught on. 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

Monitoring

Essential to an adaptive management strategy is a monitoring plan that continually evaluates beaver activity in the Chimacum Creek watershed and the management practices being used to address those activities. The monitoring plan recommended for Chimacum Creek includes two components:

- Biannual evaluation of the identified *Living with Beaver and Nuisance Beaver Zones* would consist of walking those sections of the creek, documenting if and where beaver activity is occurring, and recording the locations with a GPS unit. Documented beaver activity would then be evaluated using the *Individual Beaver Activity Evaluation Process* that was outlined in a previous section of this plan. Response recommendations will be made based on this process.
- Rapid response evaluations would occur when a landowner contacted Jefferson County Conservation District or North Olympic Salmon Coalition with specific concerns about beaver activity along Chimacum Creek. After documenting the landowner's concern and recording the location of beaver activity with a GPS, a conservation representative would identify the reach classification of beaver habitat for the property in question and, then, conduct evaluations of the activity using the *Reach Scale Evaluation* and the *Individual Beaver Activity Evaluation Process.* Response recommendations will be made based on this process.

Monitoring and evaluation will be conducted by conservation planners or trained volunteers.

Education and Outreach

Also essential to effective and collaborative beaver management in the Chimacum Creek watershed is the need for a shared knowledge and understanding of beaver (life history, habitat and ecological significance). With a common foundation, all members of this community living with beaver can determine how best to manage this important, yet, controversial species.

Using the *Chimacum Creek Audience Research and Outreach Strategy: Building Relationships for the Future,* conservation planners are developing a series of fact sheets and outreach materials that will seek to build a shared knowledge about beaver in our watershed while engaging community members in the process of living with beaver.

Future Research and Recommendations

Alternative Species Selection and Planting Plan Considerations

While there is a good deal of existing literature that offers guidance on plant species that are *not preferred* or are *beaver resistant* (City of Portland 2010, Harper, et al. 2005, etc.), the Chimacum Creek watershed is unique— as described in the *Chimacum Creek Hydrologic Assessment.* One key management challenge in the Chimacum watershed is the combination of damaging beaver activities and infestations of reed canarygrass. Over time, RCG can be shaded out by a forested buffer, but requires regular access and maintenance during the interim plant establishment period to clean invasive vegetation out of the creek to prevent it from becoming clogged. Willow stakes have been found to be particularly effective competitors with RCG and respond to beaver browse with vigorous re-growth (Kim et al. 2006). However, it is this vigorous re-growth in the Chimacum watershed that has made it difficult and frustrating for landowners and managers to access the creek to monitor and mitigate flooding from beaver activity (McNamara and Simmons 2016).

It would be valuable to install and study test plots along sections of Chimacum Creek where beaver and RCG are causing challenges for land managers. The study would test alternative planting plan considerations:

- Alternative (to willow spp.) species that are either *beaver resistant* or *not preferred* and that thrive in the saturated soils of the Chimacum Creek watershed;
- Alternative planting plan layouts that retain access to the creek and streambank for monitoring and maintenance activities, while battling RCG infestations:
    - Nucleus Approach: Densely planted clusters or islands of trees and shrubs surrounded by low fences with unplanted space between for monitoring and maintenance access;
    - Multi-layer Approach with Corridors: Systematic access corridors running perpendicular to the creek/buffer approximately every seventy-five feet (unless site conditions require less or greater distances), with willow spp. concentrated at the median points between corridors (i.e. furthest from access areas). The multi-layer approach focuses on smaller or less aggressive shrubs and trees near edges of access corridors and larger or more aggressive plants near the median of the segmented buffers.

Volunteer Program Development

The Chimacum Creek watershed would benefit from establishing a small group of trained volunteers that could conduct beaver-related monitoring or mitigation activities. North Olympic Salmon Coalition (NOSC) coordinates a volunteer program that conducts salmon spawning surveys in Chimacum Creek. Volunteers receive training and orientation around the unique ecology of Chimacum Creek and also how to work safely in riparian buffer environments. Some of these volunteers might be well-suited to conduct seasonal monitoring in the *Living with Beaver* and *Nuisance Beaver Zones* of Chimacum Creek and to respond to dam-notching requests from landowners who need immediate assistance to prevent or mitigate flooding.

Conclusion

The Chimacum Creek Adaptive Beaver Management Plan strives to assist landowners and local conservation planners in making management decisions regarding beaver activity in the Chimacum Creek watershed that balance habitat needs of beaver and associated wildlife and the need to protect private property and resources – with a focus on agricultural lands. This plan outlines a transparent evaluation process for determining the most appropriate management responses to beaver activity. The evaluation process takes place at the *reach scale* and at the *individual beaver activity site* scale. Recommendations range from no action with continued monitoring to preventative planning for riparian buffer enhancement projects to installations of flood mitigating devices. Integral to adaptive management is ongoing monitoring and evaluation of beaver activity and implemented management practices. Finally, community-based management of beaver in the Chimacum Creek watershed is dependent on shared understanding and commitment to living with beaver, while protecting the infrastructure and working lands of the people in this community.

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