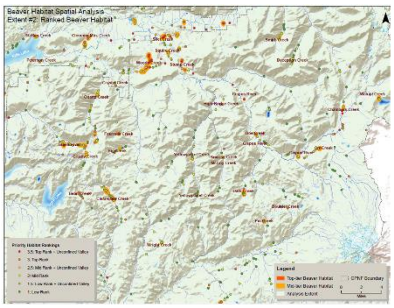
A FRAMEWORK FOR BEAVER REINTRODUCTION

A CASE STUDY OF THE CASCADES BEAVER REINTRODUCTION PROJECT







Prepared by Shiloh Halsey, Amanda Keasberry, and Suzanne Whitney

CASCADE FOREST CONSERVANCY
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Overview

The Cascade Forest Conservancy (CFC), in partnership with Cowlitz Indian Tribe (CIT), embarked on a multi-year beaver reintroduction project in the spring of 2017. As of December 2019, the project team surveyed approximately 120 potential reintroduction sites in and around the Gifford Pinchot National Forest (GPNF), engaged 181 adult volunteers and 339 students in habitat surveys and other fieldwork, and released 21 beavers to four different sites in the GPNF.

A variety of organizations and groups are interested in reintroducing beavers to improve ecosystem health and resilience. This framework is intended to help clarify process steps and answer questions for those interested in carrying out this type of work. It is also intended to serve as a foundation for future work for the Cascades Beaver Project. In this framework, we outline the project steps, lessons learned, and recommendations for similar efforts.

Beavers were once abundant in the waterways of the southern Washington Cascades (and throughout North America). They were an instrumental force in forming many of the aquatic, riparian, and topographic forms and features we see on the landscape today. Their dam-building activities created wetlands, ponds, and habitats for a multitude of different invertebrate, amphibian, fish, and avian species. In the Washington State Stream Habitat Restoration Guidelines, it is estimated that beaver populations in the United States were near 60-400 million before European settlement and are now estimated at 6-12 million. This reduction in population numbers is the result of intensive nationwide trapping in the 1700s and 1800s. With this decrease in beaver populations has come a loss of the wide variety of ecosystem services that result from beaver activity on the landscape and a dramatic shift in aquatic and riparian habitats over the subsequent years. As far back as the early 1900s, researchers and land managers

> In addition to mitigating climate change-related decreases in stream flow, via surface water storage, beaver increase the amount of groundwater storage and aquifer recharge (Pollock et al. 2003, Westbrook et al. 2006). This ultimately may be the most important beaver-related factor in mitigating effects from climate change because groundwater is released more gradually than surface water and has no evaporative losses. In areas where groundwater is being depleted faster than it is being recharged naturally, beaver ponds may help to offset the aquifer depletion, especially when beaver activity is occurring at the reach or watershed scale. Furthermore, increased groundwater storage may help to offset rising stream temperatures associated with the increase in open-water surface area. Cold pockets of water have been found downstream of beaver dams, possibly from the upwelling of groundwater and an increase in hyporheic exchange (Pollock et al. 2007). This is particularly important for aquatic species that require cold water. For example, Weber et al. (2017) reported finding that, in central Oregon, maximum summer stream temperatures were reduced in stream sections feature a high density of beaver dams.
> –From the Beaver Restoration Guidebook v2.01

have explored beaver translocation as a strategy for reestablishing beaver populations on formerly occupied landscapes. Beavers are increasingly being viewed as an important force for restoration and for building climate resilience. Beaver reintroductions are cost-effective and the positive impacts can extend to new areas and multiply as beavers make new homes and families.

The mission of the Cascade Forest Conservancy is to protect and sustain forests, streams, wildlife, and communities in the heart of the Cascades through conservation, education, and advocacy. During this time of climate change, CFC is committed to exploring and implementing creative strategies for building resilience and overall ecosystem health. During the researching and writing of our Wildlife and Climate Resilience Guidebook in 2016, it became clear that beaver reintroduction was a meaningful way to improve the health and resilience of aquatic and riparian ecosystems in the region. Specialists with the Gifford Pinchot National Forest supported this idea and offered specific information about areas where beavers once lived and where their reintroduction could make a positive impact on local aquatic systems. At the time we were writing the climate guidebook and outlining initial recommendations for beaver work in the region, biologists with the Cowlitz Indian Tribe were exploring similar ideas. We decided to work together as a team on beaver reintroduction.

Benefits of beavers on the landscape

Our overarching goal was to improve climate resilience for aquatic and riparian habitats in the southern Washington Cascades. This was to be accomplished through beaver reintroduction and the positive impacts beavers can have on ecosystems, such as reconnecting and expanding floodplains, improving the health and vitality of riparian corridors, raising water tables, increasing water storage, increasing hyporheic exchange, attenuating flows, decreasing water temperatures, increasing channel complexity, capturing fine sediment, and creating deep pools for fish habitat. These benefits can help in creating new areas of climate refugia and enhancing connectivity for both terrestrial and aquatic wildlife, which will be increasingly important as climate impacts alter ecosystems in the region. The streams and riparian areas of the southern Washington Cascades provide critical habitat for fish and amphibians, some of which are designated as Threatened under the Endangered Species Act.

> The Washington Department of Fish and Wildlife outlines the observed upstream and downstream impacts of beaver reintroduction: “1) an elevated water table upstream of the dam, which in turn improves vegetation condition, reduces water velocities, reduces bank erosion, and improves fish habitat (increased water depth, better food production, higher dissolved oxygen, and various water temperatures), 2) reduced sedimentation downstream of the dam, 3) increased water storage, 4) improved water quality, and 5) more waterfowl nesting and brooding areas.” –From the Washington State Stream Habitat Restoration Guidelines

Many local habitats are under threat from projected changes in the hydrologic cycle, warming water temperatures, increased sedimentation, and decreases in channel complexity. Beavers have the potential to mitigate some of these negative impacts.

Spatial Model

Considering the pressing need to improve and diversify aquatic habitat on a broad scale, we conducted a spatial analysis in ArcGIS to identify and prioritize project sites for beaver reintroduction. Our goal for the spatial model was to develop a ranking of potential beaver habitat so that we could prioritize field surveys to areas where there was the greatest potential for suitable beaver habitat (and places more likely to have been previously occupied by beavers). The model considered a variety of factors that are likely to contribute to survival of beavers and overall habitat quality, such as slope, bankfull width, valley confinement, stream discharge, and road or trail access (the last of which is to ensure accessibility for surveys and release). In order to simplify this process for others, we have diagramed the steps of the spatial model below. In addition to locations identified by the spatial model, potential reintroduction areas were suggested by Forest Service biologists and other partners. Please see the next page for a schematic diagram of the Cascades Beaver Project spatial model.

The spatial model identified more sites than we were able to visit in the first two years of survey work, which means that we now have a set of sites in need of further investigation, i.e., we have a roadmap for future beaver habitat surveys and releases. We see this as an opportunity and a resource not only for the partners involved with the Cascades Beaver Project but also as a starting point for other groups looking to do beaver work in the region. Being that the long-term goal is to expand this work and dramatically improve the health and resilience of aquatic habitats in the region, it is important to us that this information is clear and transferable.

The maps on pages 7-10 display the results of the spatial model. These maps are in a wide extent and at a resolution where some localized data is not viewable so we recommend downloading the shapefiles (available here: https://cascadeforest.org/beaver-habitat-spatial-model/), which contain all of the point data. To display the model results on stream segments, we averaged the final rankings of the point features to derive a new rank for linear stream segments, which were based on the ‘reach code’ in the National Hydrography Dataset. The creek names are displayed for the waterways that have a high habitat ranking. Major rivers were included to provide context for connectivity.

Analysis steps for Cascades Beaver Habitat Model

Using the 2018 National Hydrography Dataset (NHD, USGS), we created points along all perennial streams within our area of interest to be able to extract the desired data.

We derived **slope** from a digital elevation model and determined **bankfull width** through a regression equation using **drainage area** and **average annual precipitation** as inputs. Intermittent and ephemeral streams were not used in this analysis.

Slope	Score
<1%	**4**
<2%	**3**
<4%	**2**
<6%	**1**
<10%	**0.5**
>10%	**0**

+

Bankfull Width	Score
<7m	**4**
<10m	**3**
<18m	**2**
<24m	**1**
>24m	**0**

→

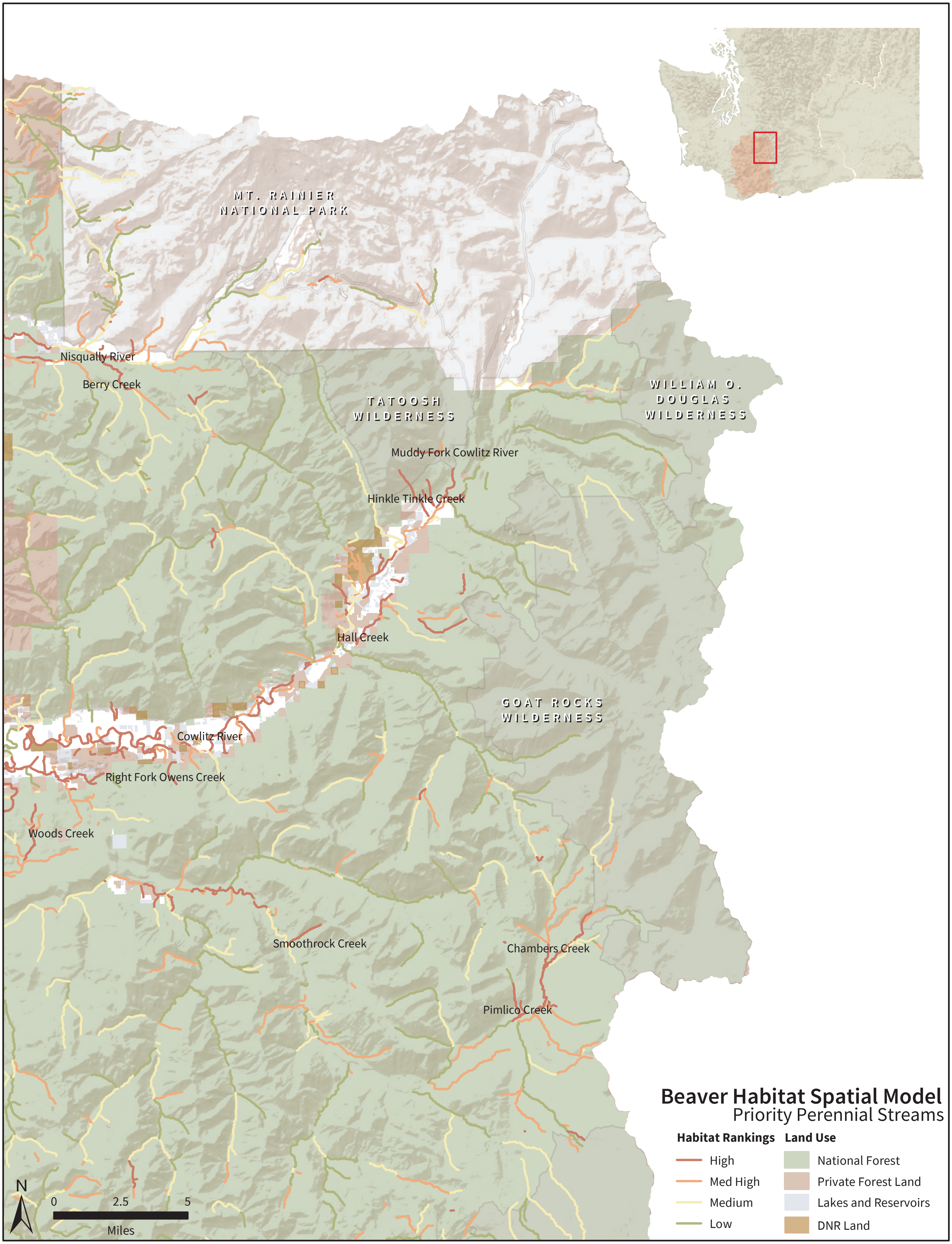
Cumulative Score	Adjusted Score	In an Unconfined Valley
7 – 8	3	+ 0.5
6 – 7	2	
5 – 6	1	
0 – 5	0	

→

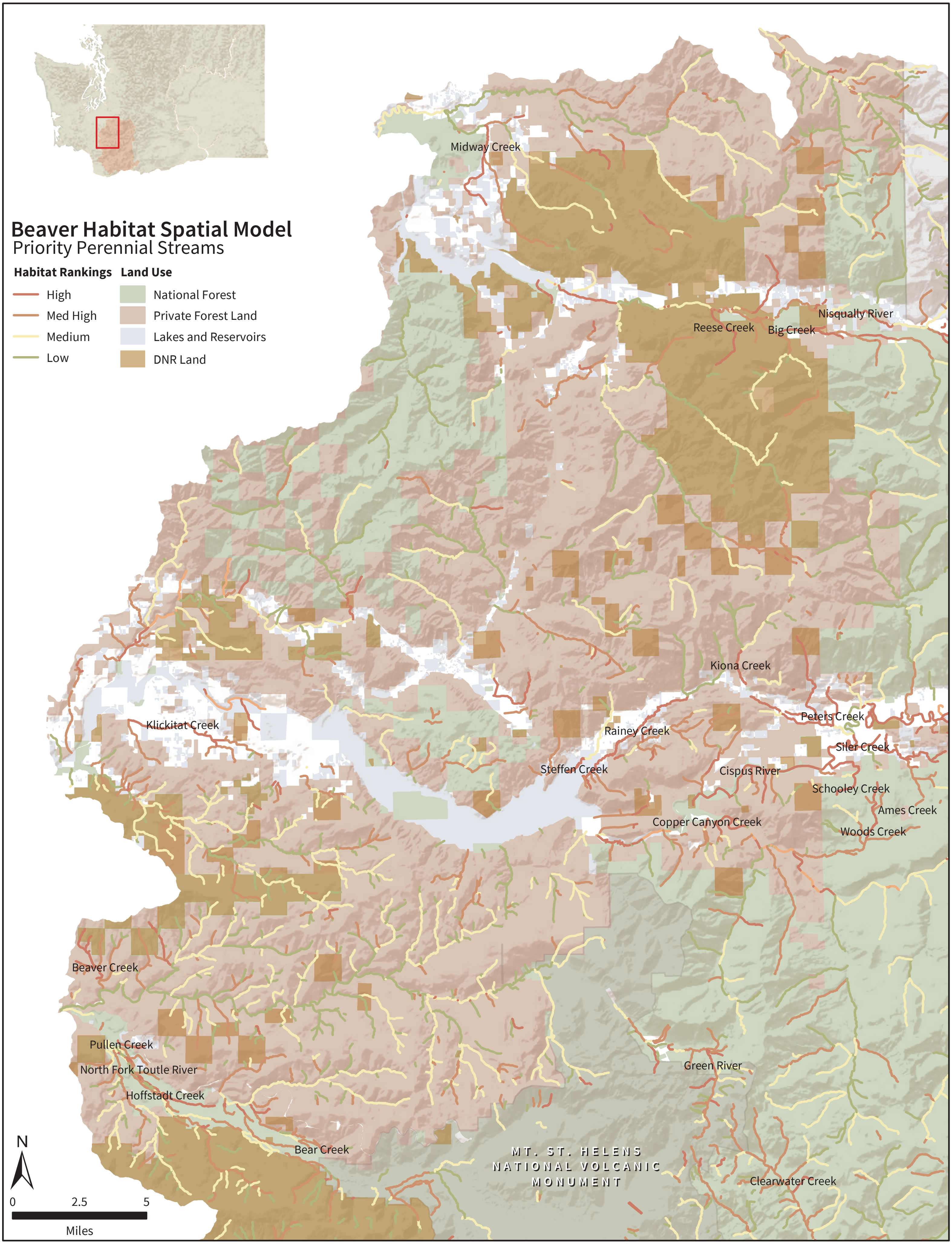
Readjusted Score
3.5 – High rank and in an unconfined valley
3 – High rank
2.5 – Medium rank and in an unconfined valley
2 – Medium rank
1.5 – Low rank and in an unconfined valley
1 – Low rank
0 and 0.5 – No rank

Remove points that are difficult to access, i.e., points beyond a quarter mile from roads and beyond a half mile of road-trail junctions. Remove points that are within a half mile of a highway.

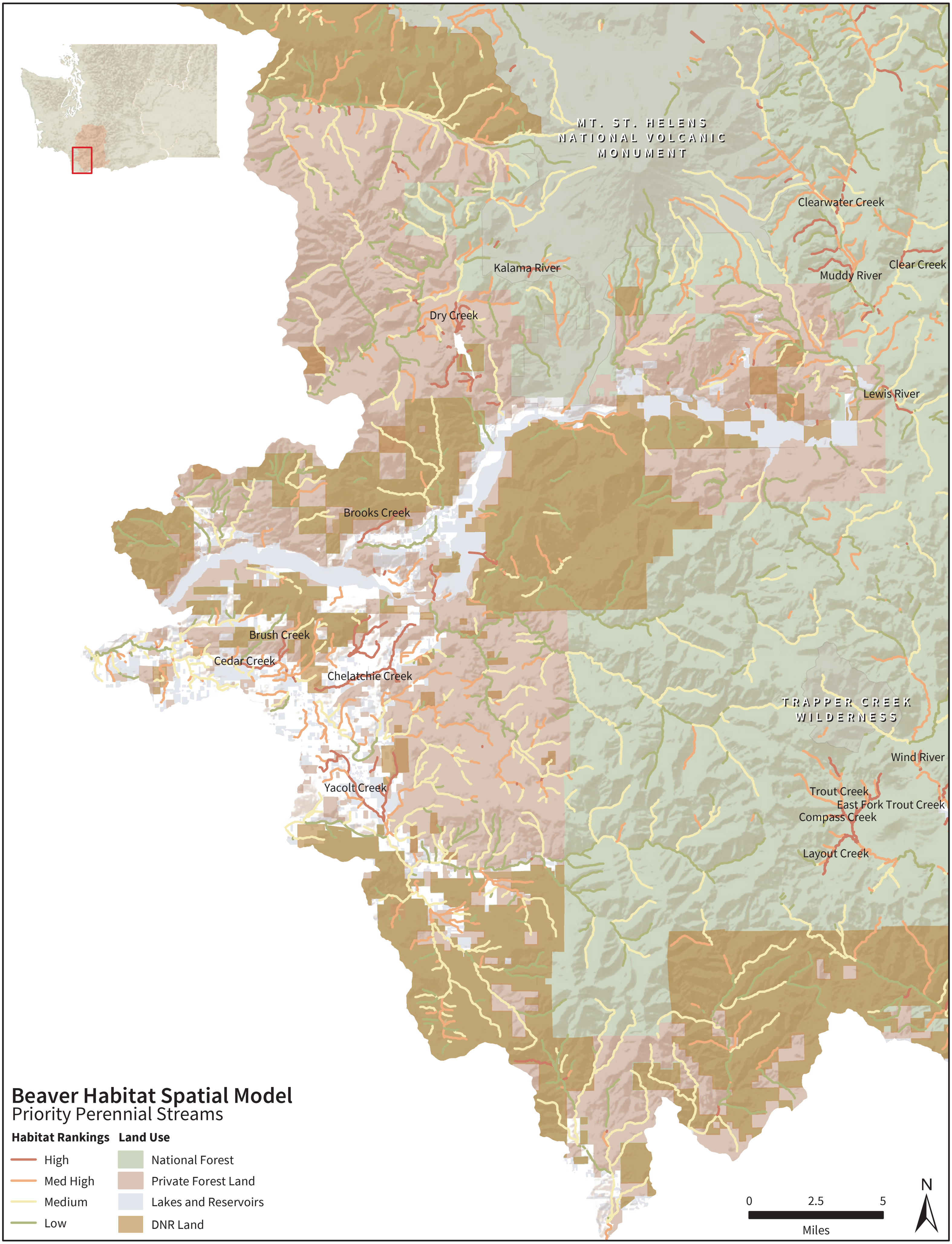
Point data can be left as is or points can be averaged along stream segments to highlight areas with dense aggregations of suitable habitat points.



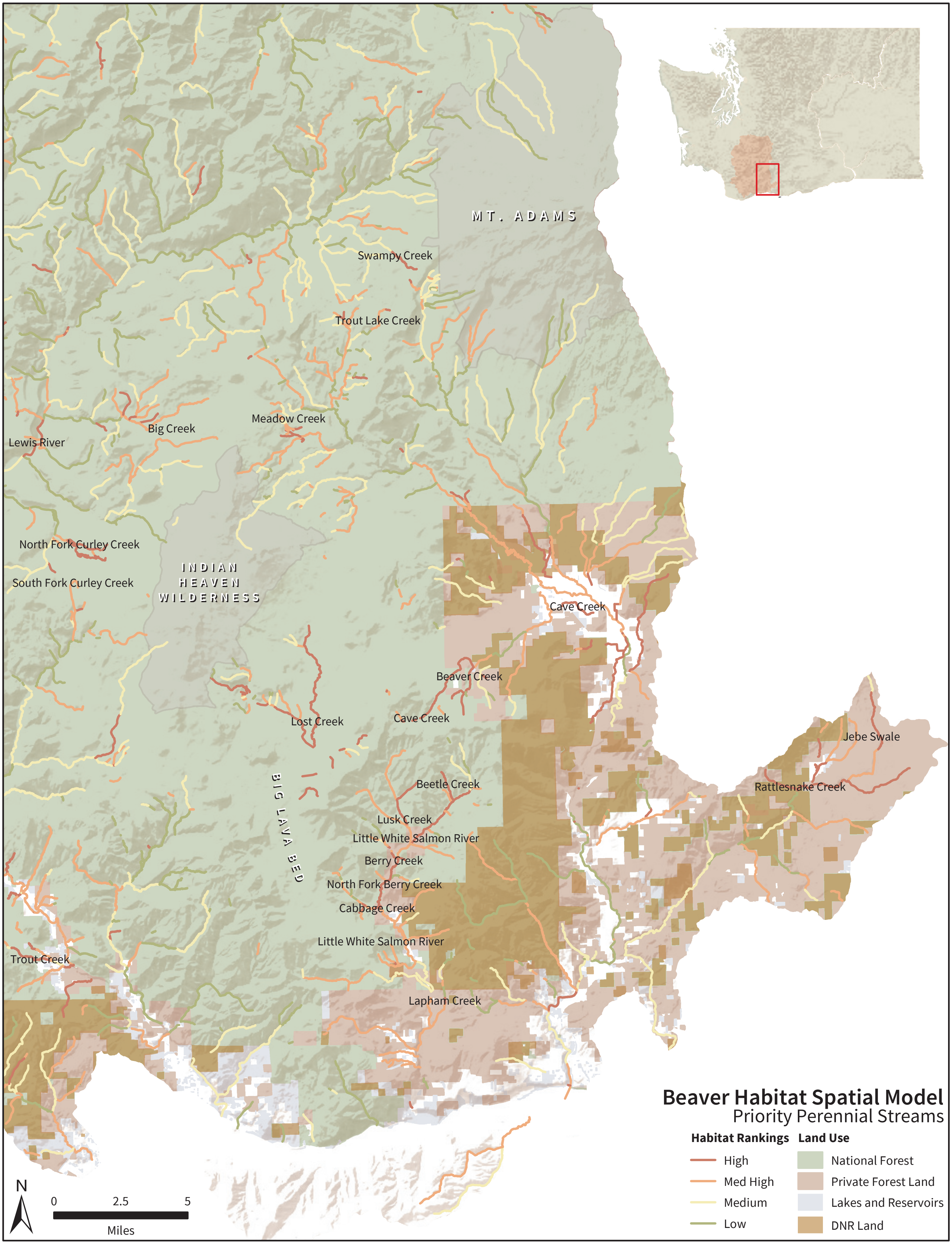
MT. RAINIER NATIONAL PARK
TATOOSH WILDERNESS
WILLIAM O. DOUGLAS WILDERNESS
GOAT ROCKS WILDERNESS
Nisqually River
Berry Creek
Muddy Fork Cowlitz River
Hinkle Tinkle Creek
Hall Creek
Cowlitz River
Right Fork Owens Creek
Woods Creek
Smoothrock Creek
Chambers Creek
Pimlico Creek
N
0
2.5
5
Miles
Beaver Habitat Spatial Model
Priority Perennial Streams
Habitat Rankings
High
Med High
Medium
Low
Land Use
National Forest
Private Forest Land
Lakes and Reservoirs
DNR Land



Beaver Habitat Spatial Model
Priority Perennial Streams
Habitat Rankings
High
Med High
Medium
Low
Land Use
National Forest
Private Forest Land
Lakes and Reservoirs
DNR Land
Midway Creek
Reese Creek
Big Creek
Nisqually River
Kiona Creek
Peters Creek
Rainey Creek
Siler Creek
Klickitat Creek
Steffen Creek
Cispus River
Schooley Creek
Ames Creek
Copper Canyon Creek
Woods Creek
Beaver Creek
Pullen Creek
North Fork Toutle River
Hoffstadt Creek
Green River
Bear Creek
MT. ST. HELENS NATIONAL VOLCANIC MONUMENT
Clearwater Creek
N
0
2.5
5
Miles



Beaver Habitat Spatial Model
Priority Perennial Streams



Beaver Habitat Spatial Model
Priority Perennial Streams
Habitat Rankings
High
Med High
Medium
Low
Land Use
National Forest
Private Forest Land
Lakes and Reservoirs
DNR Land
N
0
2.5
5
Miles
MT. ADAMS
Swampy Creek
Trout Lake Creek
Meadow Creek
Big Creek
Lewis River
North Fork Curley Creek
South Fork Curley Creek
INDIAN HEAVEN WILDERNESS
Cave Creek
Beaver Creek
Cave Creek
Lost Creek
BIG LAVA BED
Jebe Swale
Rattlesnake Creek
Beetle Creek
Lusk Creek
Little White Salmon River
Berry Creek
North Fork Berry Creek
Cabbage Creek
Little White Salmon River
Trout Creek
Lapham Creek

As we found during our field surveys, the model proved to be an effective tool for predicting suitable beaver habitat. So, we hope these maps and results (available online as downloadable shapefiles and PDFs) will be used to help streamline and improve future efforts to locate suitable beaver reintroduction sites.

As noted above, many of the sites identified through the model and mapped here have yet to be surveyed and are candidates for either future efforts of partners that are currently part of the Cascades Beaver Project or efforts initiated by other interested stakeholders, such as Washington Department of Fish and Wildlife, Lower Columbia Fish Enhancement Group, or other agencies or non-profits. A handful of sites on these maps are on state land or land owned or managed by Columbia Land Trust or Pope Resources. In many of these areas, heavy logging has severely impacted the local ecosystems, and beaver restoration would be particularly meaningful for ecosystem recovery. Many of the potential beaver reintroduction sites on the map on Page 10 are located on national forest or state land that overlaps Yakama Nation ceded land. Yakama Nation already has a strong aquatics program, which includes beaver work and a restoration partnership with Mid-Columbia Fish Enhancement Group, so this framework could serve as a complement to their current work—a means of model validation for analyses already undertaken and/or as a starting point for future efforts in new restoration areas.

Development of the Habitat Survey Protocol

For field surveys, we chose to employ a modified version of the habitat survey protocols of previous beaver projects—the Methow Beaver Project and the Tulalip Beaver Project. We modified the Site Scorecard used by these groups into a form we thought would work well for our region and our approach to survey work, which included working with groups of volunteers to survey a large number of areas. Throughout the two years, we made a number of changes to the site scorecard. We will outline the shifts here and highlight our final scorecard design so that future efforts can benefit from what we learned through our fieldwork and data aggregation. This is by no means a final word on what we feel would be an ideal site scorecard; we still consider it a work in progress. Additionally, the Washington Department of Fish and Wildlife has recently developed a similar scorecard that could be used alongside or instead of this version. However, we have yet to test that scorecard in the field.

GPNF Beaver Reintroduction Project—Beaver Site Assessment Surveys

Instructions: For each category, select a score within the range that is provided. Explanations of each category can be found on the back.

Using the results of the spatial habitat model as a guide, choose a starting survey point along the waterbody of interest. This starting point will serve as your location to visually assess the criteria below. The survey area is loosely the 360˚ view that you can see from where you stand. When searching for deep pools it is best to move about the area to locate them (approx. 20 yards upstream & downstream).

Date: ________________ Coordinates: ____________________ ˚N ____________________ ˚W

Observer(s): ___________________________________ Waterbody Name: ___________________________

_______ **Woody food—willows and cottonwoods, seedling to mature (Scale 0—20)**

⓪ No willows and/or cottonwoods ⑳ >20 willows and/or cottonwoods

_______ **Woody food—all hardwoods (e.g. willow, cottonwood, maple, alder, aspen), seedling to mature (Scale 0—10)**

⓪ None to few hardwoods ⑩ >50 hardwoods

_______ **Leafy food—small plants and grasses (Scale 0—10)**

⓪ 0 –1 different species, any amount ⑩ More than 5 species and more than 50 individual plants

_______ **Woody building materials—all trees (i.e. conifers and hardwoods), ≥10 cm DBH (Scale 0—5)**

⓪ Few or absent ⑤ Abundant building material

_______ **Water cover—deep pools in stream, >1m deep and wide (Scale 0—10)**

⓪ No pools in stream ⑩ >5 pools in stream

_______ **Water discharge (Scale 0—10)**

⓪ Non-wadeable flows ***OR*** waterbody is dry ⑩ Slow-moving, year-round flow ***OR*** water held year-round

_______ **Floodplain structure (Scale 0—20)**

⓪ Narrow & steep bank, 'V' shaped stream channel ⑳ Wide and flat stream channel, adjacent floodplain area

_______ **Muddy substrate available (Scale 0—5)**

⓪ No mud or fine soil particles for building and digging ⑤ Abundant mud or fine soil particles for building and digging

_______ **Historic beaver use (Scale 0—10)**

⓪ No evidence of previous use ⑩ Old structures present **TYPE OF EVIDENCE:** ____________________________

____

_____ / 100: TOTAL SCORE **Excellent:** > 75 **Good:** 75—50 **Fair:** 49—25 **Poor:** < 25

☐ Check box if habitat modification is necessary or would be beneficial

Modified water cover score

If deep pools and/or substrate rank is low, would the installation of one to three small dam structures work here and could it be expected to create five or more deep pools? If so, **add 15**.

Modified vegetation score

If vegetation rank is low, would willow or cottonwood planting work here without conifer or alder thinning? If so, **add 20**.

_____ / 100: TOTAL MODIFIED SCORE **Excellent:** > 75 **Good:** 75—50 **Fair:** 49—25 **Poor:** < 25

The goal of the scorecard was to walk surveyors through an investigation of habitat features whose presence or absence could help determine the success of reintroduction. The scorecards measured number of deep pools; floodplain width; abundance of hardwoods, conifers, and general vegetation; amount of water; type of substrate; and evidence of past beaver presence. The higher score each habitat feature received, the more suitable it was considered.

We initially defined the survey area as a 100 X 20 meter plot along the bank of the waterway of interest. Within that area, surveyors create three smaller 20 X 20 meter plots in which they assess the abundance of beaver forage. The rest of the survey area, including the stream itself, was then assessed for the other habitat features aforementioned. Over time, we realized that setting this boundary was too much of a limitation and decided that opportunistic surveying would be a better approach, i.e., using the spatial model as a guide for locating a general area/stream reach and exploring the area until finding an optimal survey location. This skews the scores to higher values, but considering the goal is to find and examine high quality habitat, as opposed to validating the pinpoint accuracy of the model, this is a suitable bias to introduce.

Field Surveys

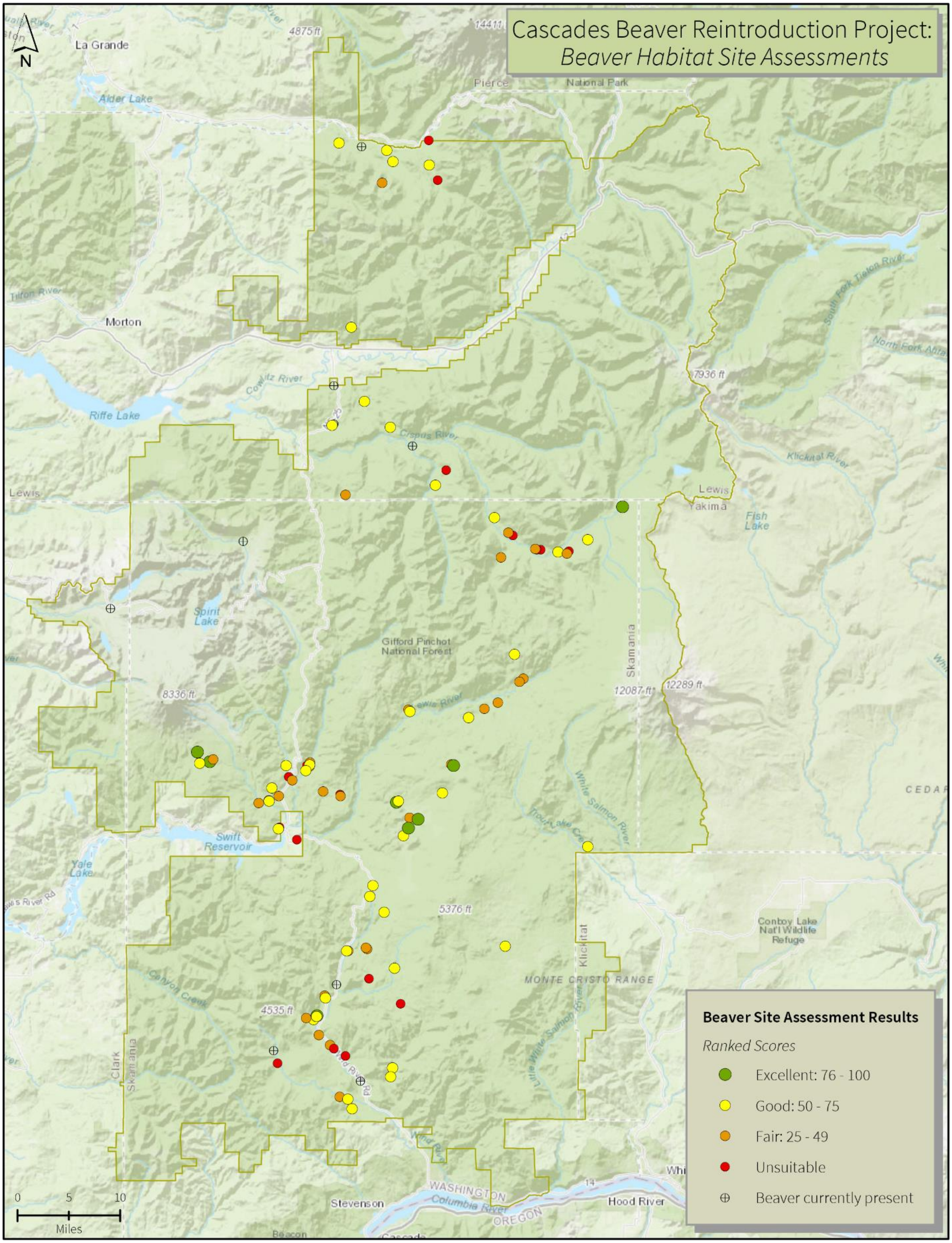
During the 2018 and 2019 field seasons, CFC staff, Cowlitz staff, volunteers, and students from local middle and high schools surveyed 123 potential reintroduction areas. Survey teams explored areas in the Gifford Pinchot National Forest (the main focus area), in nearby state-owned land, and on land managed by Columbia Land Trust. Of the 123 sites visited or surveyed, 15 were deemed unsuitable, 37 were deemed “fair,” 53 were deemed “good,” and eight were deemed “excellent.” We prioritized reintroduction to sites deemed good and excellent. Ten of the sites we surveyed had beaver currently present or there was evidence of beaver being present

SCORECARD VARIABLES

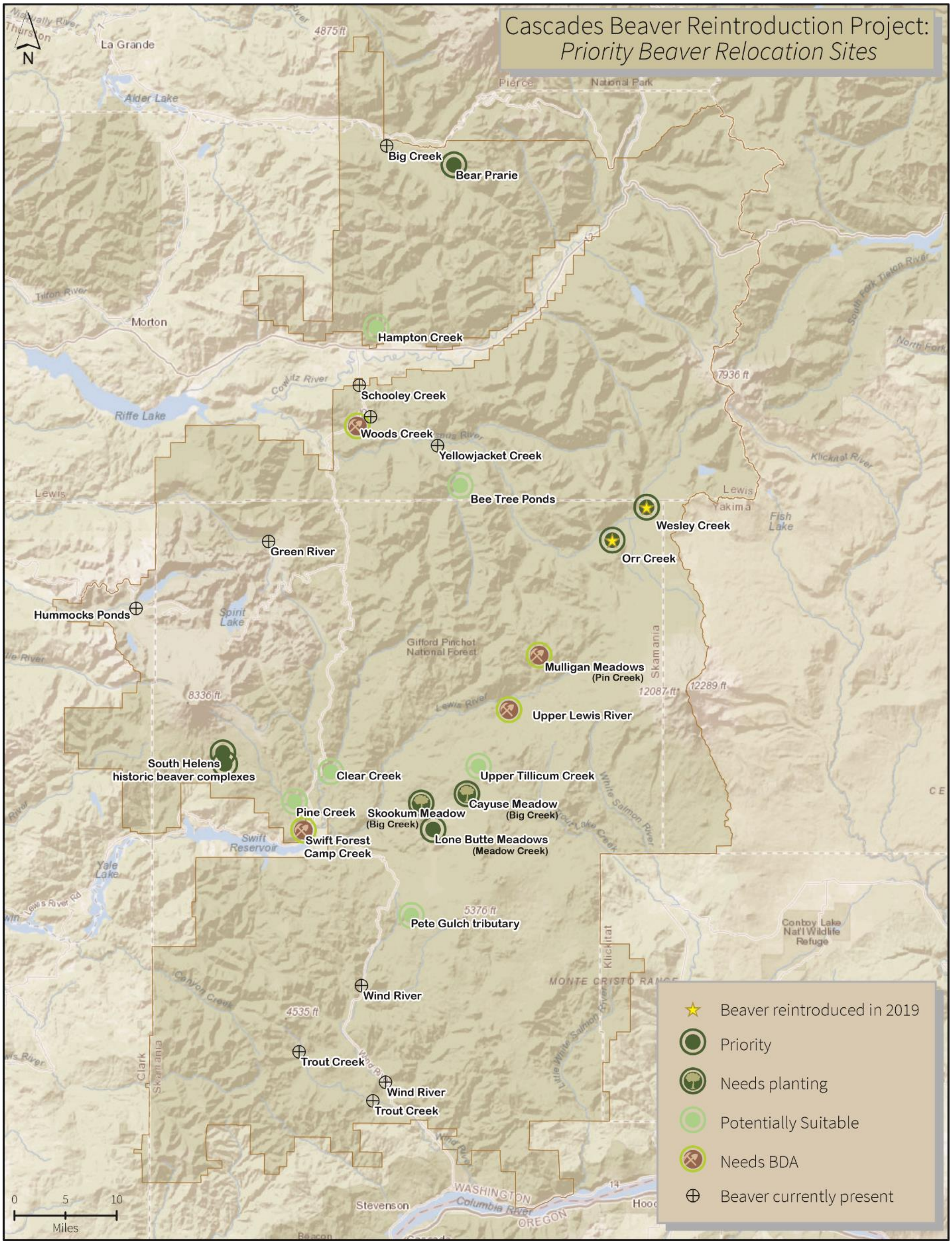
- Deep pools are needed as escape from predators.
- Wide floodplains allow for expanded aquatic areas—wetlands, side-channels, and ponds.
- Hardwoods are beavers preferred choice of food; willows and cottonwoods are their favorites, but they will take to other hardwoods when necessary.
- Although conifers are not a preferred food, they are used as building materials for dams and lodges.
- Stream discharge needs to be slow enough for beavers to be able to build a dam—regularly fast flowing water is not practical for dam building.
- Muddy substrate, as opposed to cobble, is used by beavers to build parts of their dams and lodges.
- Locating historic beaver evidence can be a telltale sign that the area can sustain beaver populations, but it does bring us to speculate about why the beaver are no longer there.

there within the few years. Although there is interest in boosting the number of beavers even in areas where they are currently present, our focus is on areas where there are no beavers and where connectivity with current populations is limited—in order to find sites where unassisted recolonization is less likely. Our prime target areas for release are high quality habitat areas with evidence of past beaver activity yet no signs of beaver presence in the last several years or decades.

Site visit with the U.S. Forest Service to an area that used to be a beaver pond but is now dry.



Cascades Beaver Reintroduction Project:
Beaver Habitat Site Assessments
N
La Grande
Alder Lake
Pierce
National Park
Morton
Tilton River
Cowlitz River
Riffe Lake
Cispus River
Lewis
Yakima
Fish Lake
Klickitat River
South Fork Tieton River
North Fork Ahtanum
7936 ft
4875 ft
Spirit Lake
Gifford Pinchot National Forest
Skamania
12087 ft
12289 ft
8336 ft
Lewis River
White Salmon River
Trout Lake Cr
Swift Reservoir
Yale Lake
5376 ft
Conboy Lake Nat'l Wildlife Refuge
Klickitat
MONTE CRISTO RANGE
Canyon Creek
4535 ft
Little White Salmon River
Wind River Rd
Clark
Skamania
Stevenson
WASHINGTON
Columbia River
OREGON
Hood River
CEDAR
0 5 10
Miles
Beaver Site Assessment Results
Ranked Scores
Excellent: 76 - 100
Good: 50 - 75
Fair: 25 - 49
Unsuitable
Beaver currently present


Cascades Beaver Reintroduction Project:
Priority Beaver Relocation Sites
Big Creek
Bear Prarie
Hampton Creek
Schooley Creek
Woods Creek
Yellowjacket Creek
Bee Tree Ponds
Wesley Creek
Orr Creek
Green River
Hummocks Ponds
Mulligan Meadows
(Pin Creek)
Upper Lewis River
South Helens
historic beaver complexes
Clear Creek
Upper Tillicum Creek
Pine Creek
Skookum Meadow
(Big Creek)
Cayuse Meadow
(Big Creek)
Swift Forest
Camp Creek
Lone Butte Meadows
(Meadow Creek)
Pete Gulch tributary
Wind River
Trout Creek
Wind River
Trout Creek
Beaver reintroduced in 2019
Priority
Needs planting
Potentially Suitable
Needs BDA
Beaver currently present
0 5 10
Miles

After visiting a variety of sites, we realized some sites would likely be suitable for beavers only after habitat modifications to prepare the site for reintroduction. For example, otherwise suitable sites might lack hardwoods for forage or deep pools to serve as escape cover from predators. In those cases, habitat modification would include planting hardwoods one or more years before release to increase forage (which we did at a variety of sites we knew of before the field surveys) or installing beaver dam analogues (BDAs) to serve as anchor points for beavers. These semi-ephemeral structures attract beavers and create deep pools in the short-term to serve as protection from predators. We therefore adapted the scorecard to include *potential habitat modification needs*. Subsequently, each site surveyed had a base score and (potentially) a second score that represented suitability *after* habitat modifications took place. With that information, we are able to more directly outline plans for release or habitat modifications, the latter of which requires another level of stakeholder engagement or permitting.

> The absence of expansive willow complexes limits the potential for beaver recruitment even with active reintroduction because of limited food. Moreover, absence of beavers may diminish the recovery potential of willow complexes, even with aggressive planting, if water tables are depressed due to lack of beaver dams and limited recharge of shallow aquifers exists. A combination of immediate actions, including riparian planting and beaver reintroduction, may be necessary to jump start the restoration trajectory and accelerate natural recruitment.
>
> Similarly, even with aggressive planting efforts, more humid stream systems that historically had old-growth conifer forests on the floodplain may benefit from the addition of wood structures to stabilize the channel bed and provide habitat during the decades to centuries that may be necessary to restore their full habitat potential and biological productivity through natural processes.
>
> -From the 2012 Washington State Stream Habitat Restoration Guidelines (WA Department of Fish and Wildlife)

Upon visiting sites, we found some creeks to have a low flow or no water at all. Some of these sites were optimal in every other way. Discovering the lack of water during the summer months highlighted a potential positive impact that reintroduced beavers could make on water storage and attenuating flows. But, with little water and the resulting lack of deep pools, these sites are not suitable for reintroduction without the installation of a BDA or unless there is a deliberately timed release schedule to accommodate low flows in late summer. In this case, a spring release—when water is higher—may be more appropriate as long as the site and surrounding area have been surveyed in spring and early summer to verify the presence of deep pools. There are examples of beavers, released in spring, changing the hydrologic nature of waterways in such a way that creeks that were previously intermittent are now functioning as perennial waterways. August is the driest month, so if there are sites where fall release is a consideration and the site has only been surveyed in spring, early summer, or winter, we recommend surveying this area at the peak of drought to gain a better understanding of the low flow period.

Reintroduced beaver have transformed some intermittent streams back to perennial streams (Dalke 1947, Pollock et al. 2003), and recolonizing beaver have transformed slightly losing stream reaches to gaining reaches (Majerova et al. 2015). Losing streams are characterized by surface water flowing into the subsurface and not returning to the channel, usually associated with local water tables that are lower in elevation than the stream surface. Gaining streams, conversely, are characterised by high local water tables where subsurface water flows into the stream. Additionally, the ponded water expands the saturated surface area of riparian zones, converting previously upland plant communities into wetland plant communities. Thus, beaver create wetlands. Slower water velocities, lateral spreading, and larger areas of soil saturation contribute to increases in both the surface and subsurface water present in a watershed (Naiman et al. 1986, Syphard and Garcia 2001, Pollock et al. 2003, Cunningham et al. 2006, Westbrook et al. 2006, Hood and Bayley 2008).

-From the Beaver Restoration Guidebook 2.01

Beaver Housing and Release

It was useful and necessary to have a beaver holding facility for multiple reasons. For the Cascades Beaver Project, we were working with nuisance beavers from waterways close to urban centers that were trapped and donated to the project. The process of being trapped causes stress for the beavers. The release of stress hormones and physiological sensitivities related to this reaction precipitate the need for a recovery period for beavers before being released into the wild. Additionally, use of a holding facility allows for beavers to be paired before release. Releasing beavers as a matched pair (male and female) can increase reintroduction success because paired beavers are more likely to remain at the reintroduction site rather than moving to less suitable areas to find a mate and because there are more individuals to assist with dam building upon release. A third benefit that the holding facility offers is the chance to increase the beaver's fat reserves while being separated from threats of predation. Lastly, a short period at a holding facility can be useful for keeping families together if they are not all trapped on the same day.

Wildlife biology staff for the Cowlitz Indian Tribe (CIT) established a holding facility on CIT land. Other beaver projects have used empty fish runs at local hatcheries. Regardless of the location, a high standard of care is necessary when housing beavers. At the holding facilities, caretakers are needed to ensure that beavers have daily food and fresh water. Beavers at holding facilities should have access to enough water to enable them to partly submerge at all times. While housing can be important for recovery and pairing, it is important that beavers are not housed for too long as they can become overly accustomed to being fed on a daily basis and they can also start to exhibit behaviors that suggest they are feeling the negative effects of confinement. Partners of the Methow Beaver Project found it is best to keep beavers at holding facilities no more than 22 days. In the Washington State Stream Habitat Restoration Guidelines, the Washington Department of Fish and Wildlife suggests ten days or less as the ideal timeframe for beaver holding before release. The average stay for our beavers was eight days.

Many practitioners recommend releasing beavers during their primary dam building period of August to October so that they get right to work building dams and have time to gather a food cache before winter. However, a lack of water in systems experiencing temporary drought can be an issue during the earlier part of this range. Fall releases, though, are most common as this is the time of year when nuisance beavers in urban settings are causing issues related to flooding.

For a thorough overview of beaver relocation protocols related to handling and moving beavers, we recommend a review of Chapter 5 of the Beaver Restoration Guidebook version 2.01 published April 10, 2018 (https://www.fws.gov/oregonfwo/Documents/2018BRGv.2.01.pdf). This document was put together by the U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, University of Saskatchewan, and U.S. Forest Service. Permit requirements for beaver work (e.g. trapping and relocation) differ among regions and land ownerships so we recommend checking with local groups and agencies to identify suitable routes for permitting. Washington Department of Fish and Wildlife requires permits for trapping and moving beavers through the Washington Administrative Code 232-12-271.

Beaver Monitoring

Transplanted beaver can be radio tracked using tail-mounted transmitters if there are suitable array sets in the area, which there was not in our project area. Implanted trackers or collars are a tracking option too, but this route is expensive, intrusive for the animals, and can potentially decrease survival, either through direct mortality or changes to their agility in the water. CFC and CIT agreed that we would take the less invasive approach, which is a method using ear tags and an array of wildlife cameras to track their movements.

On the day of the beaver release, we set up wildlife cameras at multiple sites along the main stem of the waterway and along any tributaries that would allow them to leave the release site. The locations of the cameras were mapped using ArcGIS Collector so they were easy to find upon return. The number of cameras placed depended on the sites and the accessibility up and downstream, but ranged from three to eight. Cameras were checked on average every two weeks. If cameras proved to be in a poor location, we would move the cameras and document the change on the map. On occasion, we set 'food traps' where we would bring cut willow to the site and pile it nearby the water. Two of the three times we did this, beavers removed some of the cut willow.

In addition to the wildlife cameras, we looked for physical evidence in the form of fresh beaver chew and beaver slides—two of the more obvious pieces of evidence a beaver leaves behind. When a piece of fresh chew was discovered, a photo was taken and it was mapped in ArcGIS Collector. Traversing the banks of the streams proved to be difficult in many locations and using waders to walk in the stream to look for beaver evidence proved most effective.

Because of the watershed scale at which beaver populations are maintained, and the multiple physical and biological processes that are affected by beaver dams, beaver restoration efforts usually require a collaborative effort by multiple organizations. Creating a cooperative relationship among organizations also helps diversify implementation of the tasks at-hand.

Some partners may have access to solutions that others don't. For example, state wildlife agencies may have the most expertise at handling beavers. Typically, they are trained, equipped, and permitted to trap and move beavers, whereas other organizations might face logistical or regulatory hurdles. Other agencies or non-governmental organizations may have ready access to geographical information system (GIS) data.

Identifying which permits are needed for the project may guide you to potential collaborators. Developing positive, collaborative relationships with agencies from which you will need permits is always a good strategy. In addition to permit facilitation, people from other organizations may have access to labor, expertise, and funds. Perhaps most important of all, they may have already established relationships with the managers or owners of the land where you would like to engage in restoration actions.

Identifying available collaborators and incorporating them and the resources they bring into the restoration effort is an ongoing and dynamic process that may require you to modify the initial project goals. Clarifying roles and commitments is an important part of any collaborative process, and developing written cooperative agreements and funding instruments is essential for projects to function over the long-term.

-From the Beaver Restoration Guidebook version 2.01

Stream and Vegetation Monitoring

Seeing the beavers on camera and signs of their activity is certainly a rewarding experience, but the ultimate measure of success will be found through the biological monitoring that takes place once the beavers begin to build their dams and lodges. We developed methods to monitor riparian stand conditions and stream channel characteristics. Before the release, we documented deep pools, stream width, and average stream depth along transacts, and mapped current side channels so we would have baseline data of the site. A survey of the vegetation was also conducted. Post-release measurements will then be collected up to twice a year (early summer and late summer) over the next two to four years. Through time, we will be compiling the results and putting the information on our website for partners, members, and stakeholders to view.