

Environment and Climate Change Canada

**Canada Nature Fund: Community-Nominated Priority Places for
Species at Risk**

**Kootenay Connect: Bonanza Biodiversity Corridor –
Beaver Habitat Assessment Project**

Year 2 (2020–2021)

PRESENTED TO:

Slocan Lake Stewardship Society
Box 87, New Denver BC, V0G 1S0

and

Kootenay Conservation Program
Project: Kootenay Connect Priority Places

PRESENTED BY:

EcoLogic Consultants Ltd.
Unit 4 - 252 East 1st Street
North Vancouver, BC V7L 1B3
Phone: 604 803-7146



Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

Columbia
Basin **trust**



SLOCAN
LAKE
STEWARDSHIP
SOCIETY

ACKNOWLEDGEMENTS

The Bonanza Ecosystems Enhancement Projects are sponsored and administered by the Slocan Lake Stewardship Society (SLSS) in New Denver, BC. In 2017, the Bonanza Biodiversity Corridor (BBC) was formally recognized as a key and critical corridor for conservation in the BC Kootenays. With the ongoing support of the Kootenay Conservation Program through its Kootenay Connect initiative, the BBC is now recognized as a Priority Place under the Canada Nature Fund, as administered by Environment and Climate Change Canada. Additional project funding has also been awarded through the Columbia Basin Trust, under their Ecosystems Enhancement Program.

This report was prepared by Ryan Durand, MSc., R.P.Bio. (EcoLogic Consultants) and Claire Peyton, B.Sc. (Upstream Environmental Consulting).

TABLE OF CONTENTS

Acknowledgements..... i

Table of Contents..... ii

 List of Figures ii

 List of Tables..... iii

 List of Plates iii

1. Introduction 1

 1.1 Project Objectives..... 1

 1.2 Study Area 1

 1.3 Ecological Overview..... 1

2. Methods 5

 2.1 Literature Search 5

 2.2 Evidence of Use 5

 2.3 Habitat Mapping..... 8

 2.4 Population Estimates..... 9

3. Results 10

 3.1 Evidence of Use 10

 3.2 Habitat Mapping..... 17

 3.3 Population Estimates..... 21

4. Summary 23

5. References..... 24

List of Figures

Figure 1.1-1. Bonanza Biodiversity Corridor study area. 3

Figure 2.1-1. Location of wildlife cameras in the Bonanza Biodiversity Corridor..... 7

Figure 3.1-1. Beaver lodges and dams in the northern portion of the Bonanza Biodiversity Corridor..... 12

Figure 3.1-2. Beaver lodges and dams in the southern portion of the Bonanza Biodiversity Corridor..... 13

Figure 3.2-1. Overview of beaver habitat suitability in the Bonanza Biodiversity Corridor. 18

Figure 3.2-2. Beaver habitat suitability in the northern portion of the Bonanza Biodiversity Corridor..... 19

Figure 3.2-3. Beaver habitat suitability in the southern portion of the Bonanza Biodiversity Corridor..... 20

Figure 3.3-1. Beaver colonies and dams in the Bonanza Biodiversity Corridor 22

List of Tables

Table 3.2-1. Summary of beaver habitat suitability mapping..... 17

Table 3.3-1. Beaver population estimate based on lodges..... 21

Table 3.3-2. Beaver population estimate based on colonies..... 21

List of Plates

Plate 1.1-1. The Bonanza Corridor looking north from Slocan Lake..... 2

Plate 2.2-1. Wildlife camera placement..... 6

Plate 3.1-1. Lodge near Summit Lake that was active in 2019, then inactive in 2020 due to trapping. 10

Plate 3.1-2. Apparently inactive lodge near Hunter Siding..... 11

Plate 3.1-3. Active beaver lodge identified via drone surveys in Bonanza Marsh..... 11

Plate 3.1-4. Large active dam on Bonanza Creek in Upper Bonanza..... 14

Plate 3.1-5. Old dams with recent activity near Hunter Siding..... 14

Plate 3.1-6. Old beaver dams forming a series of ponds near Summit Lake..... 15

Plate 3.1-7. Fresh channel construction and scent mounds near Summit Lake..... 15

Plate 3.1-8. Adult beaver creating a channel at Upper Bonanza..... 16

Plate 3.1-9. Adult beaver repairing dam at Upper Bonanza..... 16

Plate 3.1-10. Adult and juvenile beavers repairing a dam at Upper Bonanza..... 17

1. INTRODUCTION

The Beaver Habitat Assessment Project is a three-year sub-project of the Kootenay Connect – Bonanza Biodiversity Corridor Ecosystems Enhancement Projects funded through the Canada Nature Fund: Community-Nominated Priority Places for Species at Risk. This report is the summary of the first two years of the project.

1.1 PROJECT OBJECTIVES

The objective of the Beaver Mapping and Assessment Project is to “*inventory and map all wetlands and structures, identifying lodges and estimating occupied and unoccupied beaver habitats in the Bonanza Corridor to develop a plan for beaver restoration where appropriate.*” The project will also lead to an incorporation of current and historic beaver use in the wetland enhancement projects.

1.2 STUDY AREA

The Bonanza Biodiversity Corridor (BBC) includes the 15-km-long valley along Bonanza Creek between Slocan and Summit lakes. It encompasses an area of 12,865 hectares (ha) that link Slocan and Summit lakes within the upper Slocan Lake watershed (Figure 1.1-1; Plate 1.1-1).

Wetland and riparian ecosystems in the BBC, occurring mainly along Bonanza Creek between Slocan and Summit lakes, are sensitive ecosystems with high biodiversity values. These wetlands support a wide range of aquatic and terrestrial habitats and contribute significantly to the hydrologic functioning of the Slocan Lake Watershed. At a landscape level, the wetland and riparian complexes targeted in this project are vitally important to the BBC, providing this region of long lakes and steep terrain one of the key hydrologic corridors in the Slocan Lake Watershed. The historic Canadian Pacific Railway (CPR) berm that runs the length of the BBC’s valley bottom acts as a linear dam and, over time, has negatively impacted the dynamic wetland-riparian-floodplain system of Bonanza Creek and its tributaries.

1.3 ECOLOGICAL OVERVIEW

The ecological importance of this landscape is described in the *High-level Overview of the Bonanza Biodiversity Corridor* (Mahr 2018), which states:

The Bonanza Biodiversity Corridor represents a broad range of the diversity present in the Inland Temperate Rainforest. It is characterized by productive interior cedar-hemlock and high elevation spruce-subalpine fir forests. The BBC’s valley bottom contains a diversity of wetland types (e.g., swamps, marshes, and fens) that contain some rare assemblages of plants (Durand 2015; Mahr and Durand 2015). The Bonanza Biodiversity Corridor is an important wildlife corridor within the Slocan Lake Watershed because in addition to providing good quality wildlife habitat, it is a permeable feature in a valley that is otherwise filled up with Slocan Lake that forms an enormous movement barrier to

terrestrial wildlife. This corridor is also ecologically important because it functions both longitudinally (north–south) and laterally (east–west) across the valley.

The corridor contains seven biogeoclimatic units, with the Slocan Moist Warm Interior Cedar-Hemlock (ICHmw2) covering the majority of the area, including all of the valley bottom and wetland complexes. The ICHmw2 is one of the most common biogeoclimatic units in the Southern Interior and it includes the valley bottom to mid-slopes along most of Slocan Lake. It typically occurs from valley bottom to around 1,200 metres (m) where it transitions into the Engelmann Spruce Subalpine Fir (ESSF) zones. The ICHmw2 is located in a climate that is characterized by warm, moist summers and cool, moist winters with moderately deep, persistent snowpacks. The ICHmw2 is both productive and species-rich. Mature and old zonal forests are typically dominated by western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*), with minor amounts of Douglas-fir (*Pseudotsuga menziesii*) and western larch (*Larix occidentalis*). Early seral stands and sites in drier areas can contain trembling aspen (*Populus tremuloides*), lodgepole pine (*Pinus contorta*), and paper birch (*Betula papyrifera*). Wetter sites and higher elevation areas typically contain Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*), while floodplains are often dominated by black cottonwood (*Populus balsamifera* ssp. *Trichocarpa*). The ICHmw2 supports a wide range of habitats, with mature and old stands in particular providing habitat for numerous species, including species at risk (MacKillop and Ehman 2016).

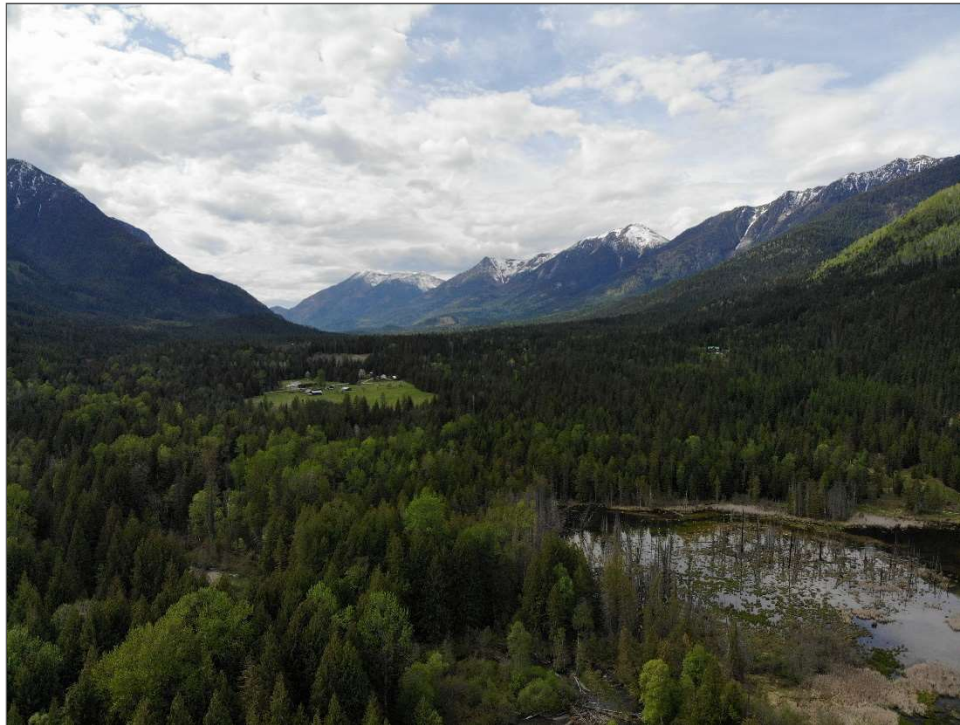
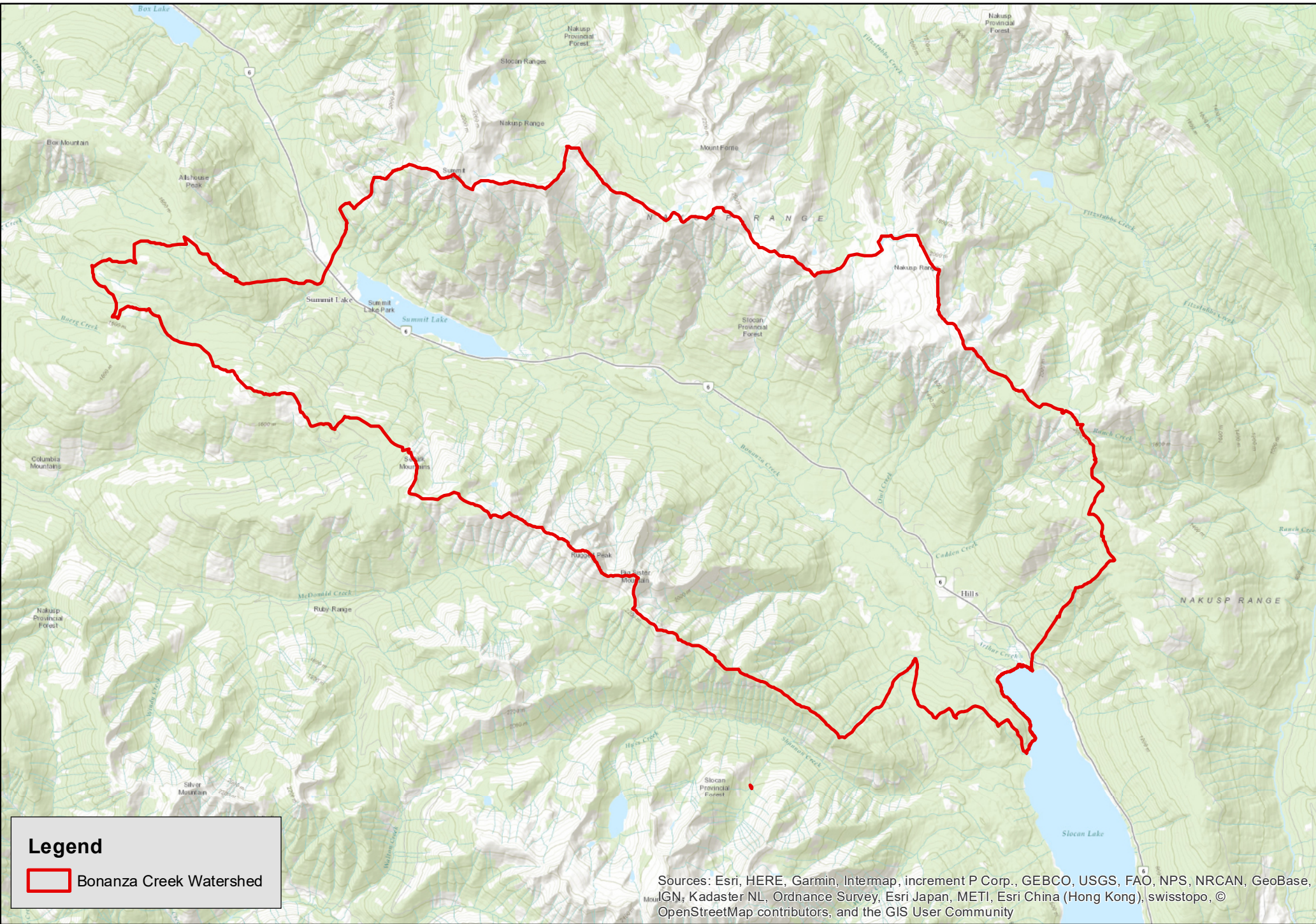



Plate 1.1-1. The Bonanza Corridor looking north from Slocan Lake.

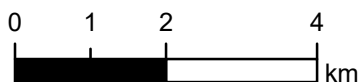


Legend

 Bonanza Creek Watershed

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Figure 1.1-1 Bonanza Biodiversity Corridor Study Area



Coordinate System: NAD 1983 UTM Zone 11N
 Projection: Transverse Mercator
 Datum: North American 1983
 Map Number: BBC-BH03
 Date: 2021-03-02



The Bonanza Corridor is well known as a biodiversity hot spot, with 992 species confirmed to date (Durand and Ehlers 2021). Of those, 15 are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) list (4 Endangered, 1 Threatened, and 10 Special Concern) and 19 are on the provincial Conservation Data Centre lists as Species-at-Risk (2 Red-listed and 17 Blue-listed). There are an additional five species that are confirmed or likely to occur that have recently been de-listed by the CDC, although they are still considered locally rare in the Kootenays (Durand and Ehlers 2018). Fourteen Red- and Blue-listed ecosystem with known or potential occurrences were identified for the project area, 13 of which are wetland ecosystems (Durand and Ehlers 2018).

Beavers (*Castor canadensis*) inhabit portions of the riparian and wetland areas in the BBC, but the actual distribution of this species is unknown. These “ecosystem engineers” have the power to drastically alter riparian habitats by building dams, creating open water, cutting down trees and shrubs, digging canals, and building beaver lodges (Haemig 2012). These activities increase stream complexity, improve water storage, moderate stream temperatures, reduce stream velocities, create habitat, and reduce flooding (Kinas et al. 2017). Beaver impoundments play a critical role in maintaining ecological diversity and successional changes within streams (Ministry of Environment, Lands and Parks 2001).

Around the world, beavers are being recognized for their role in watershed health and ability to act as a tool for climate change adaptation and species-at-risk recovery efforts (Kinas et al. 2017). They can increase the biodiversity of riparian ecosystems through transforming running water into ponds and wetlands (Wright et al. 2002). Their primary habitat comprises both terrestrial and aquatic zones in the riparian area (Taylor et al. 2017).

2. METHODS

2.1 LITERATURE SEARCH

Peyton (2020) completed a background report that included a comprehensive literature search on beaver biology, habitat requirements, methodologies for determining beaver populations, information on setting up wildlife cameras to gain a deeper understanding of the local beaver population, and how to mitigate beaver obstructions. This background research was used to design the beaver mapping and habitat assessment described in this report and to develop population estimate methods.

2.2 EVIDENCE OF USE

Field surveys were completed from May to October 2020 throughout the BBC. The initial survey utilized aerial drones to reconnoiter potential sites and plan survey routes. Each route was then surveyed on foot to search for any current or historic evidence of use and assess for potential habitat. Areas with high active use along Bonanza Creek were re-checked multiple times throughout the field season, with an emphasis on the fall months when beavers are most active, and recent construction of dams, lodges, and larders (winter food storage sites) is more obvious (Province of British Columbia Ministry of Environment Wildlife Branch 1988).

The active search targets included the following evidence of use:

- ◆ vegetation cutting,
- ◆ scent mounds,
- ◆ dams,
- ◆ soil excavation,
- ◆ lodges,
- ◆ larders, and
- ◆ trails and runs.

The majority of Bonanza Creek and adjacent wetland and riparian areas were photographed using a DJI drone to survey for dams, lodges, or other beaver modifications. Field surveys were focused on identified habitat; all evidence of current and historic beaver use was recorded.

In addition to surveys for evidence of use, a wildlife camera system was installed in the spring of 2020 and retrieved in October 2020. A total of 10 Reconyx HyperFire 2 cameras (Plate 2.2-1) were installed throughout the BBC in areas where current or historic beaver use was observed (Figure 2.2-1). The cameras were set up at lodges and dams to determine if the structures were active in an attempt to capture images of live individuals. Camera were programmed to take time-lapse photos every hour from

dawn to dusk. They were also set to take photos and short videos using the motion-capture setting, 24 hours a day.



Plate 2.2-1. Wildlife camera placement.

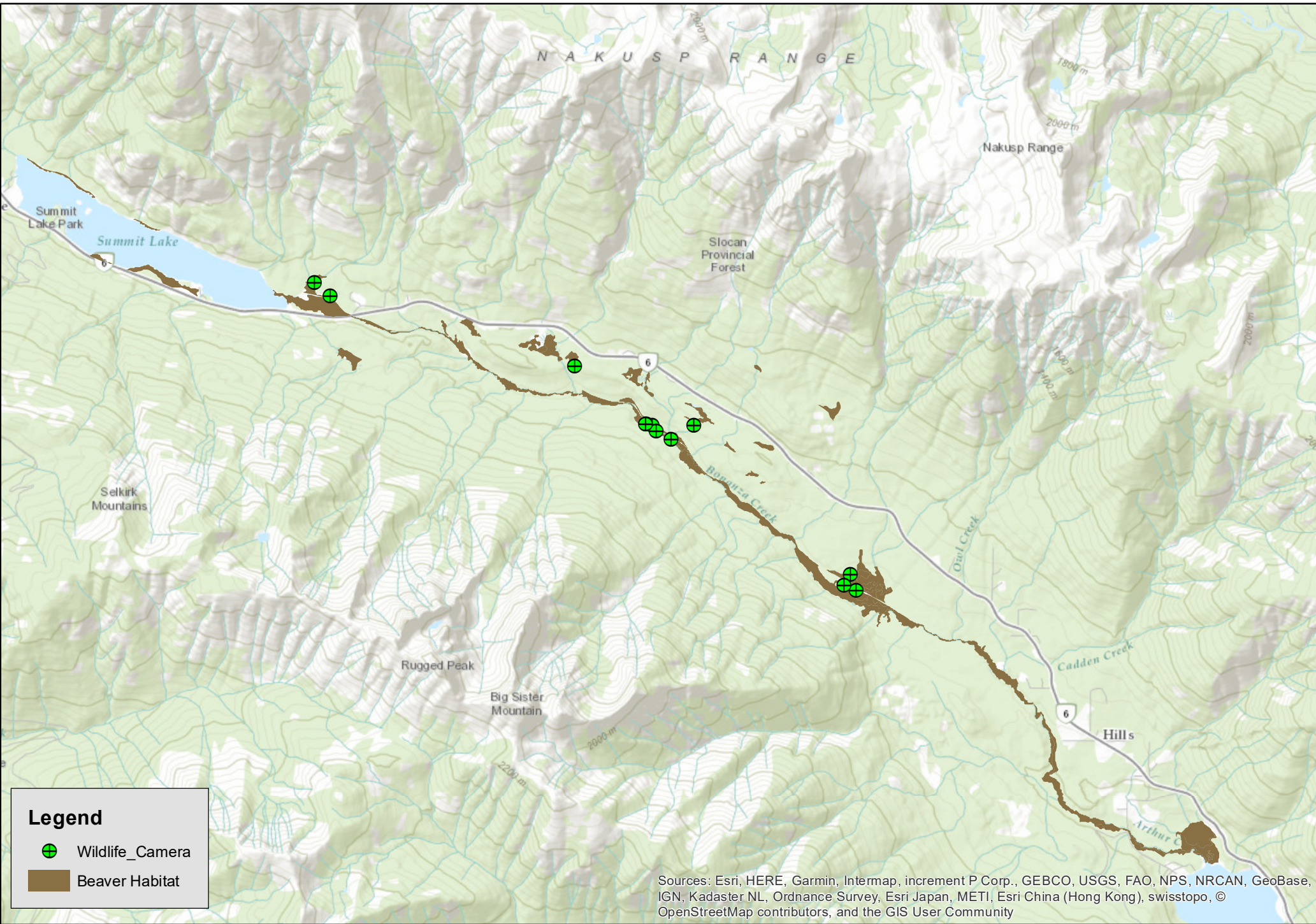


Figure 2.1-1 Location of Wildlife Cameras in the Bonanza Biodiversity Corridor



2.3 HABITAT MAPPING

Beavers primarily select habitat based on the availability of food (Slough and Sadleir 1977) and suitability for building dams and lodges. They typically inhabit lower elevations near perennial water and in close proximity to preferred food, including willow (*Salix* spp.), trembling aspen, alder (*Alnus* spp.) and cottonwood (*Populus* spp.; Smith et al 1996; Slough and Sadleir 1977; Hall 1960).

Riparian areas with muddy shores and bottom areas are preferred by beavers as it makes burrowing, channeling, and damming easier than in areas with rocky substrate (Hatler and Beal 2017). Beavers build dams to create deep water that allows them to escape from predators as well as provide access to their underwater food cache in winter (Novak 1987). Site selection for dams is primarily based on topography and food supply (Beaver Solutions 2020). Beaver dams are often correlated with low-lying areas with shallow, moving water. They prefer low-gradient streams (less than 6% slope) and generally populate the lowest gradient sites first (slope less than 1 to 2%; Pollock et al. 2017). Beavers will utilize natural features such as a fallen log, a constriction in the streambed, or a tree stump to anchor their dams. In general, if the stream is deeper than two feet (60 cm) or has a strong current, they will find another spot to dam (Beaver Solutions 2020).

A beaver colony will usually create one large pond where they build their lodge and then create a series of smaller dams up- and downstream to create other ponds for safe passage as they forage for food. On average, a colony will dam just under 1 km of a small stream (Beaver Solutions 2020).

Generations of beavers may continuously inhabit high-quality habitat, building dams, lodges, and canals to float food from inland cutting sites (National Trappers Association 2012). Only when food supplies are exhausted do beavers relocate. Even in optimal habitats, beaver colonies will stay well-separated from each other. Average population densities in British Columbia rarely exceed one colony per kilometer of shoreline (Hatler and Beal 2017), and beavers typically defend about 1 km (Boyce 1980) from their lodges (including adjacent food-gathering areas).

Habitat mapping was completed in conjunction with terrestrial ecosystem mapping (TEM). All ecosystems that contained features conducive to beaver use (larger creeks, ponds, wetlands, floodplains, and shrub-dominated areas close to water) were considered to be potential beaver habitat. Field surveys targeted the majority of the identified areas from the TEM to assess for actual and historic use, as well as potential unused areas.

The following habitat categories were mapped:

- ◆ Active Use. Areas with active dams, lodges, and other evidence of use. This includes beaver modified area, as well as adjacent ecosystems with preferred food sources.
- ◆ Potential Use. Areas with suitable water (still and moving, soft substrates, low gradients), and adjacent preferred food sources.

- ◆ Historic Use. Areas with historic beaver modifications including ponds, dams, and lodges, and evidence of past tree- or shrub-cutting.
- ◆ No Suitable Habitat. Areas with water features but unsuitable conditions, or areas lacking preferred food sources.

2.4 POPULATION ESTIMATES

There are multiple ways of measuring and estimating beaver populations, including aerial surveys to count lodges and larders (Novak 1987; Smith et al. 1996), field surveys, and live traps (Pollock 2017). Population estimates were determined by multiplying the number of active lodges by the assumed average number of beavers per colony (Hatler and Beal 2017). In North America, the average beaver colony size is estimated to be five to six individuals (Novak 1987; Fitch 2016; Hatler and Beal 2017).

Population estimates also considered the expected number of colonies within the mapped beaver habitat, if lodges could not be located. Individual colonies were mapped using the assumption that beaver colonies maintain separation from each other, with Hatler and Beal (2017) suggesting they are normally at least 1 km apart (riverine and foraging habitat), and that a single colony will typically dam less than 1 km of a given stream (Beaver Solutions 2020).

3. RESULTS

3.1 EVIDENCE OF USE

A total of nine lodges were located in the BBC, but only five lodges were confirmed to be active (Plates 3.1.1 to 3.1.3; Figures 3.1-1 and 3.1-2). Sixty-one dams were mapped, 27 of which had signs of active maintenance (Plate 3.1-4), and all but 5 of the dams were at least partially functional (Plate 3.1-5 and 3.1-6). Scent mounds (Plate 3.1-7), new and old channels (Plate 3.1-8), larders, and evidence of cut shrubs and trees were common throughout the assessed habitat. The wildlife cameras captured beavers working on dams and channels in the Upper Bonanza area, including several nights of an adult building a dam on Bonanza Creek with a juvenile beaver (Plates 3.1-9 and 3.1-10).



Plate 3.1-1. Lodge near Summit Lake that was active in 2019, then inactive in 2020 due to trapping.



Plate 3.1-2. Apparently inactive lodge near Hunter Siding.

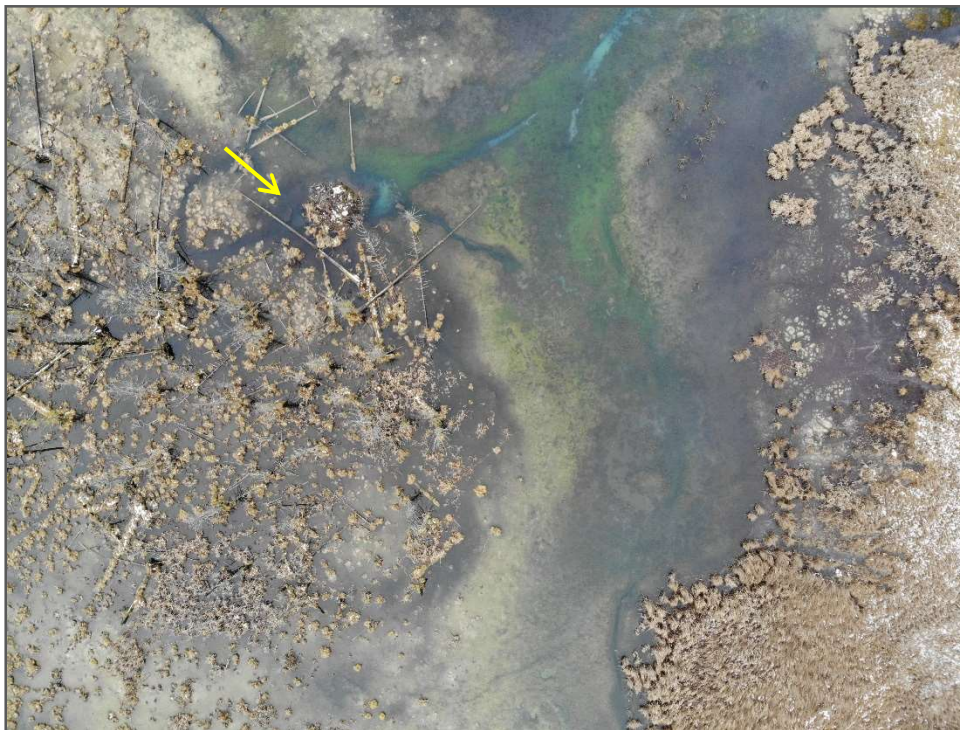
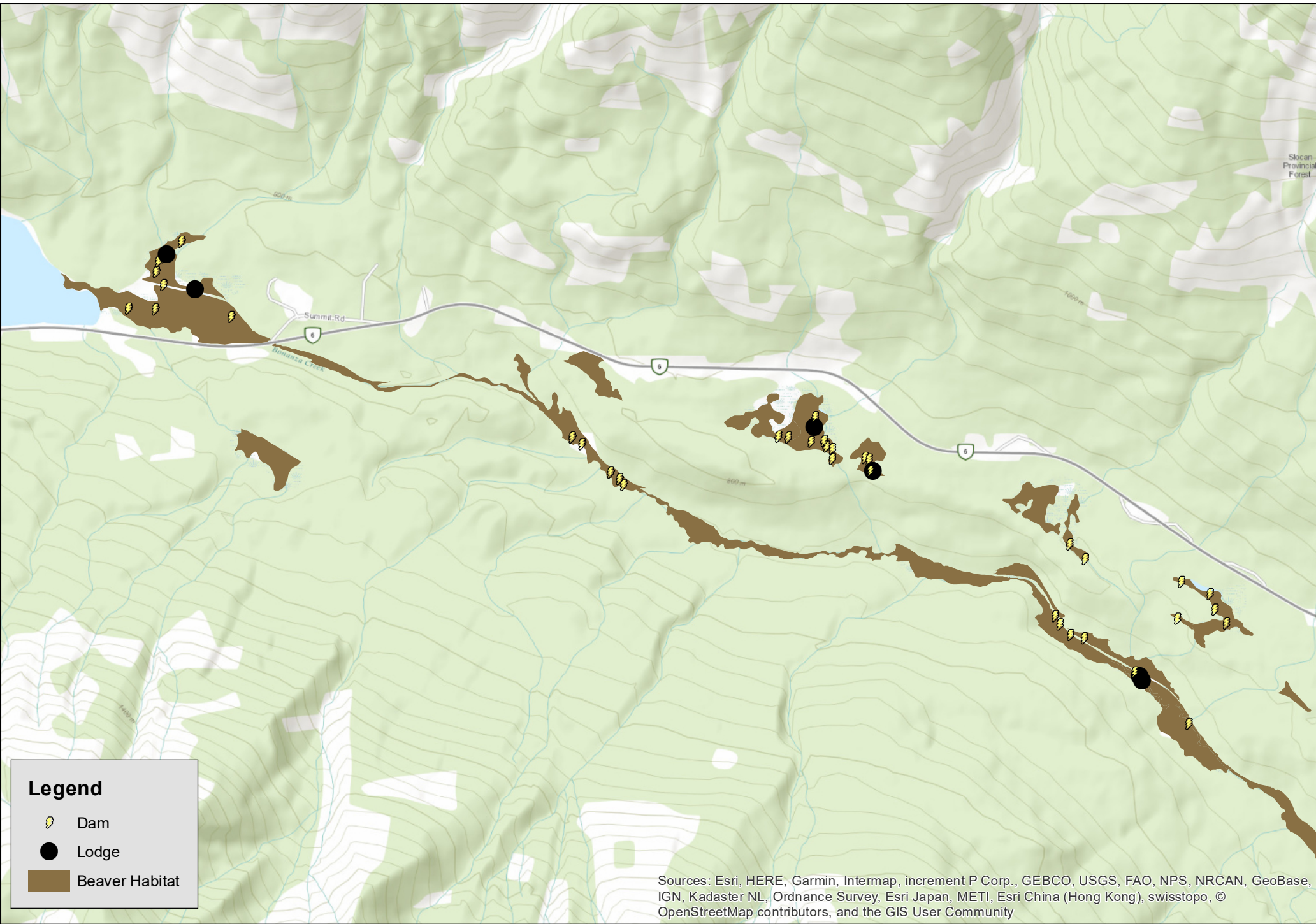





Plate 3.1-3. Active beaver lodge identified via drone surveys in Bonanza Marsh.

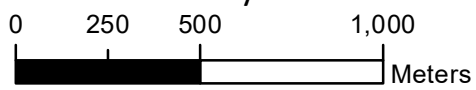


Legend


-  Dam
-  Lodge
-  Beaver Habitat

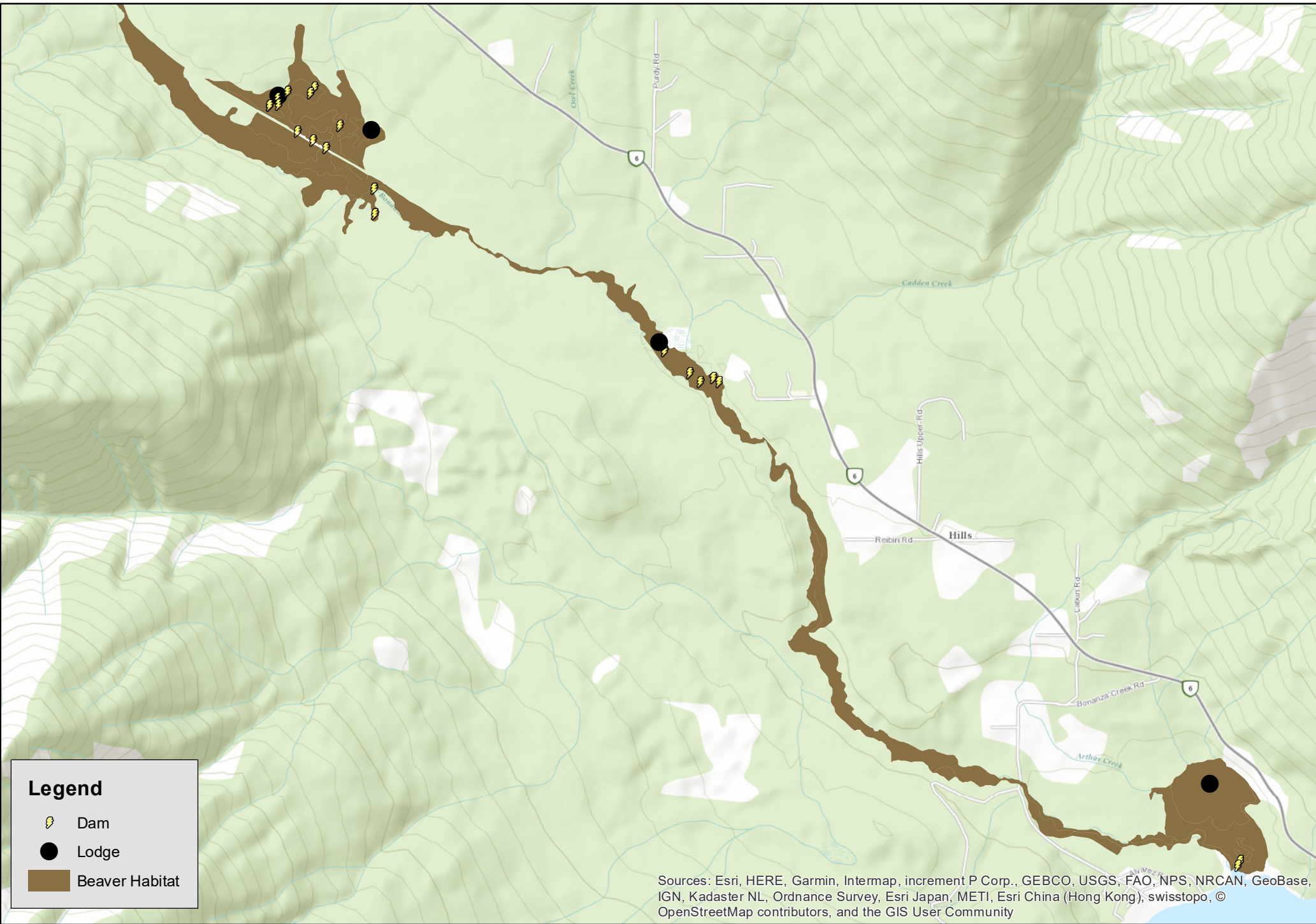
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Figure 3.1-1 Beaver Lodges and Dams in the Northern Portion of the Bonanza Biodiversity Corridor



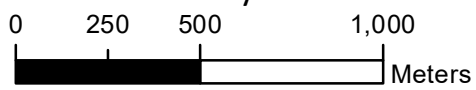
Coordinate System: NAD 1983 UTM Zone 11N
 Projection: Transverse Mercator
 Datum: North American 1983
 Map Number: BBC-BH02
 Date: 2021-03-02





Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

Figure 3.1-2 Beaver Lodges and Dams in the Southern Portion of the Bonanza Biodiversity Corridor



Coordinate System: NAD 1983 UTM Zone 11N
 Projection: Transverse Mercator
 Datum: North American 1983
 Map Number: BBC-BH02
 Date: 2021-03-02





Plate 3.1-4. Large active dam on Bonanza Creek in Upper Bonanza.

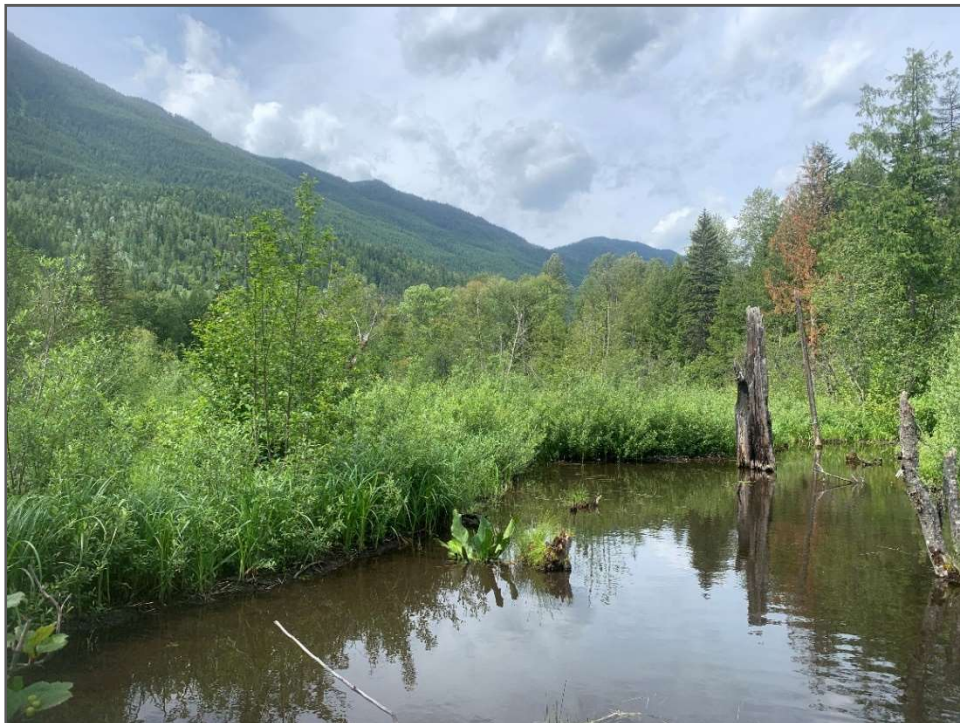


Plate 3.1-5. Old dams with recent activity near Hunter Siding.



Plate 3.1-6. Old beaver dams forming a series of ponds near Summit Lake



Plate 3.1-7. Fresh channel construction and scent mounds near Summit Lake.



Plate 3.1-8. Adult beaver creating a channel at Upper Bonanza.



Plate 3.1-9. Adult beaver repairing dam at Upper Bonanza.



Plate 3.1-10. Adult and juvenile beavers repairing a dam at Upper Bonanza.

3.2 HABITAT MAPPING

A total of 143.8 ha of habitat was assessed in the BBC (Table 3.2-1). Of that, 63.5 ha of active use were mapped, along with 59.8 ha of potential habitat and 13.1 ha of habitat that contained evidence of historic use (Figures 3.2-1 to 3.2-3). Unsuitable habitat, mainly the portion of Bonanza Creek that has limited floodplain, bedrock, or boulder/cobble bank morphology, or has a steeper gradient with fast-moving water, was mapped on 5.6 ha. This habitat assessment suggests that active beaver populations occupy 47.2% of the suitable habitat in the BBC.

Table 3.2-1. Summary of beaver habitat suitability mapping

Habitat Potential	Hectares
Active Use	65.3
Potential Habitat	59.8
Historic Use	13.1
No Suitable Habitat	5.6
Total	143.8

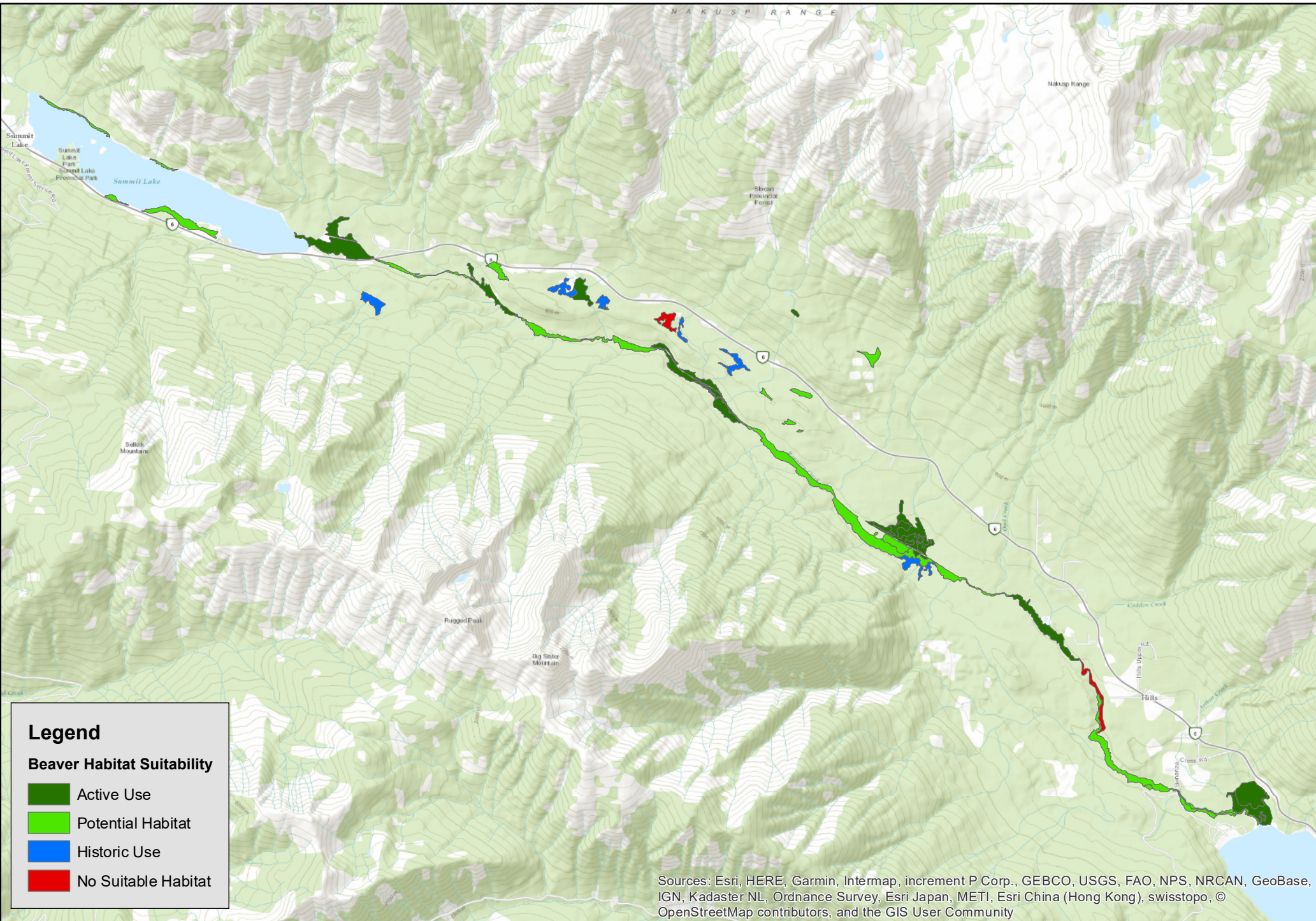


Figure 3.2-1 Overview of Beaver Habitat Suitability in the Bonanza Biodiversity Corridor

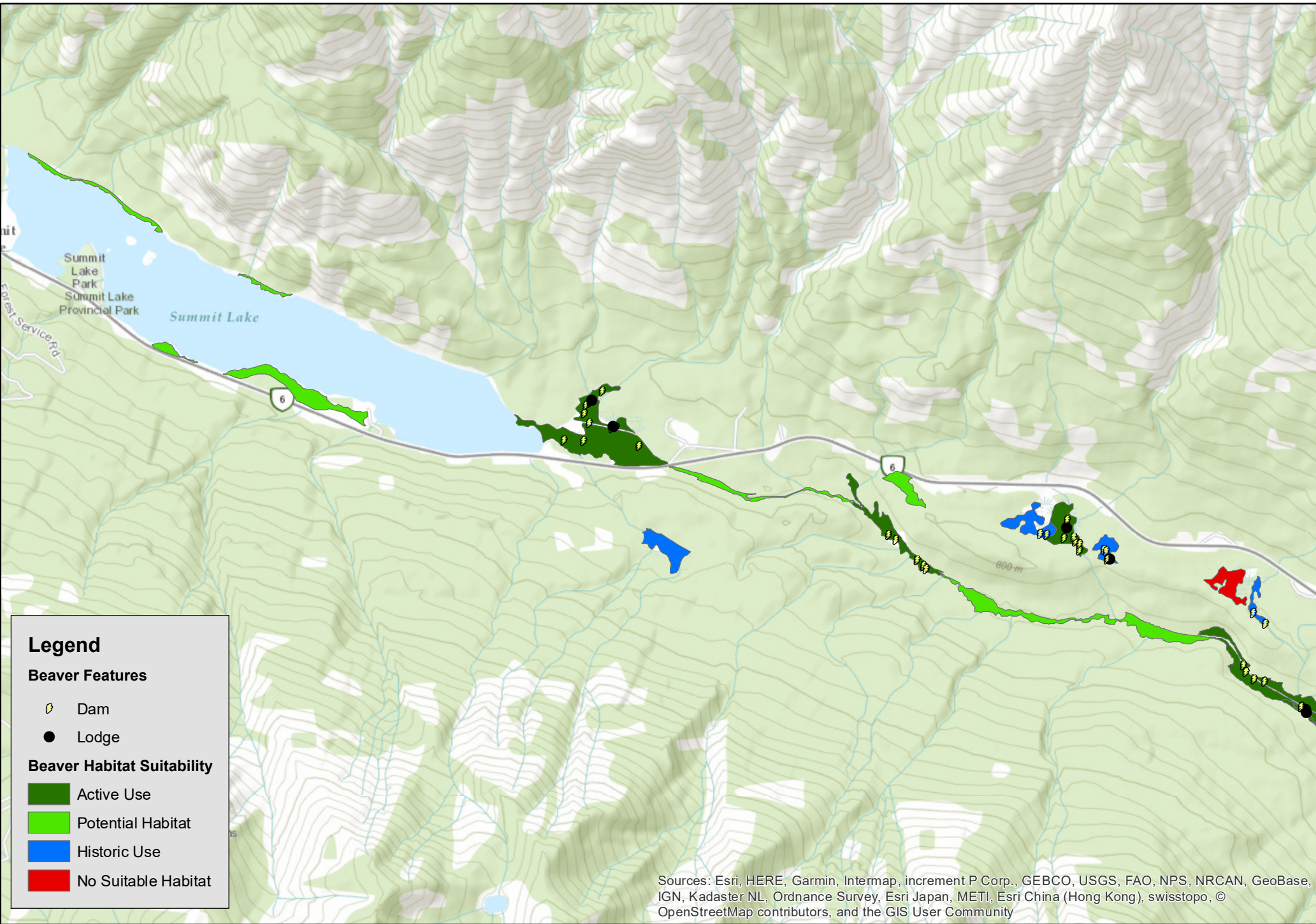


Figure 3.2-2 Beaver Habitat Suitability in the Northern Portion of the Bonanza Biodiversity Corridor



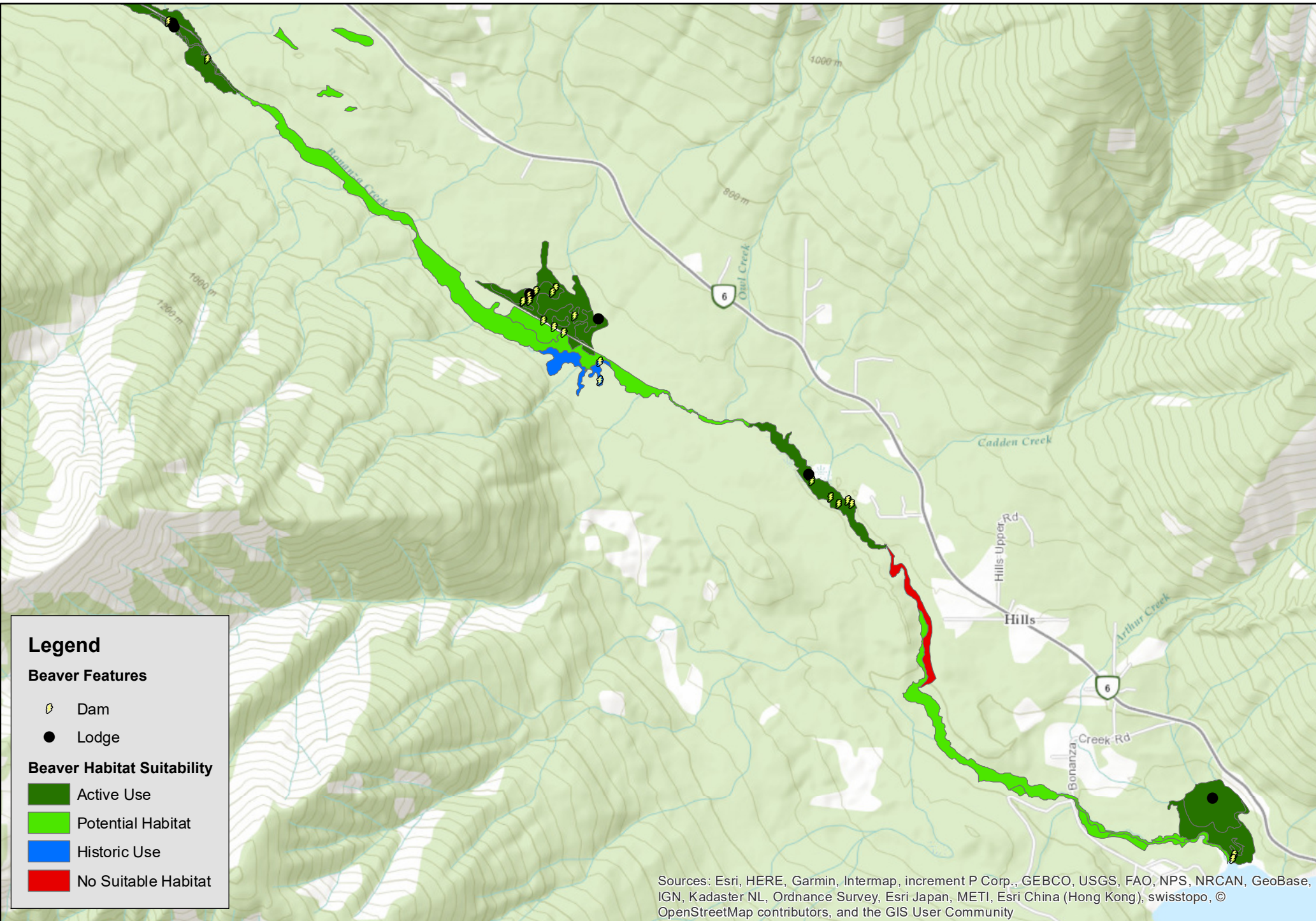


Figure 3.2-3 Beaver Habitat Suitability in the Southern Portion of the Bonanza Biodiversity Corridor

Coordinate System: NAD 1983 UTM Zone 11N
 Projection: Transverse Mercator
 Datum: North American 1983
 Map Number: BBC-BH01
 Date: 2021-03-02



3.3 POPULATION ESTIMATES

A rough population estimate was calculated for the BBC, based on the generally accepted average number of beavers per lodge of five (Hatler and Beal 2017). The population estimate for active lodges is 25 beavers (Table 3.3-1). A population estimate that includes potential lodges is not included in this process, as it is hard to determine where a lodge may be placed.

Table 3.3-1. Beaver population estimate based on lodges

	Number of Lodges	Population Estimate
Active	5	25
Historic	4	20
Potential	?	0
Total	9	45

To better capture the total potential habitat of the BBC, active, historic, and potential colonies were mapped (Figure 3.3-1). Using the colony approach, the current population is estimated to be 40 beavers, with the potential for an additional 45 beavers if all historic (assuming historic habitat is still viable) and potential habitat is occupied in the future (Table 3.3-2). This habitat-based analysis results in the potential carrying capacity of the BBC at a population of 85 beavers inhabiting 17 distinct colonies.

Table 3.3-2. Beaver population estimate based on colonies

	Number of Colonies	Population Estimate
Active	8	40
Historic	3	15
Potential	6	30
Total	17	85

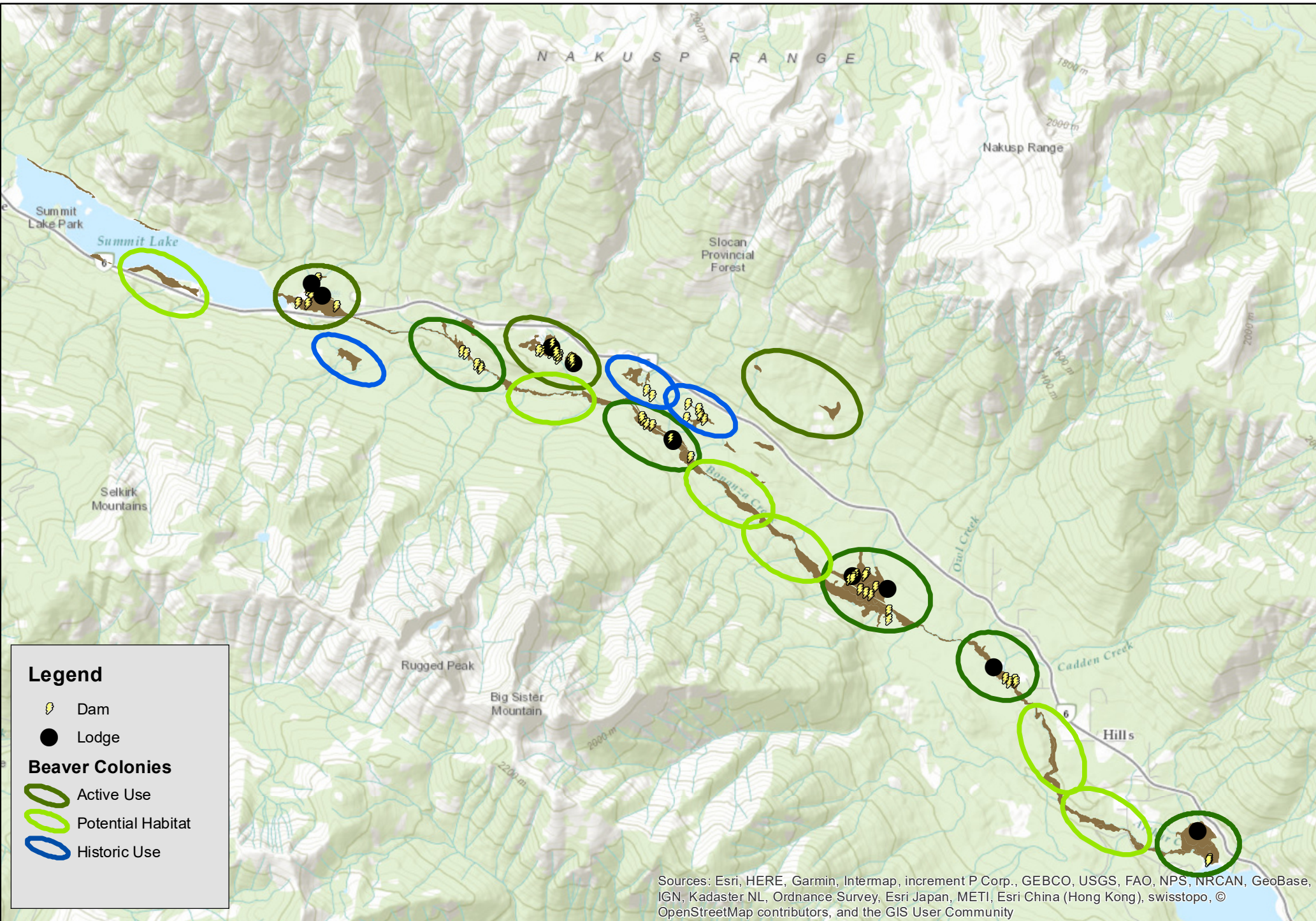


Figure 3.3-1 Beaver Colonies and Dams in the Bonanza Biodiversity Corridor

4. SUMMARY

Based on the first two years of this project, the extent of current, historic, and potential beaver habitat in the BBC has been identified. The habitat assessment suggests that active beaver populations occupy 47.2% (65.3 ha) of the suitable habitat in the BBC. Based on the number of lodges found in the BBC, the current population of beavers is approximately 25. The colony-based population estimate indicates that 40 beavers may inhabit the BBC. Using the colony-based approach, the carrying capacity of the BBC, if all current, historic and potential habitat is fully used, is 85 beavers inhabiting 17 distinct colonies.

Year three of the project will include:

- ◆ incorporation of the habitat assessment data into the restoration plans for the Upper Bonanza and Summit Lake sites;
- ◆ site visits to some potential habitat areas that have not been field-surveyed to ensure the mapping is accurate;
- ◆ continued monitoring of beaver activity, mainly along Bonanza Creek;
- ◆ deployment of the wildlife camera network; and
- ◆ final updates to the habitat assessment mapping and population estimates using the 2021 field data.

5. REFERENCES

- Beaver Solutions. 2020. Retrieved on March 3, 2020 from: <https://web.archive.org/web/20090803170950/http://beaversolutions.com/index.asp>
- Boyce, M.S. 1980. Habitat ecology of an unexploited population of beaver in interior Alaska. Pages 155-186 *In*: Chapman, J.A., and D. Pursley, eds. Proceedings, worldwide furbearer conference; 1980 August 8-11; Frostburg, MD.
- Durand, R. and T. Ehlers. 2021. *Bonanza Biodiversity Corridor Ecosystem Enhancement Projects; Species-at-Risk Surveys*. Prepared for the Slokan Lake Stewardship Society.
- Durand, R. and T. Ehlers. 2018. *Rosebery to Summit Lake Rail Trail and Moto-Bypass Environmental Impact Assessment*. Prepared for Recreation Sites and Trails British Columbia.
- Fitch, L. 2016. Caring for the Green Zone: Beaver—Our Watershed Partner. Lethbridge, Alberta: Cows and Fish - Alberta Riparian Habitat Management Society. Retrieved on March 3, 2020 from: <http://cowsandfish.org/whatsnew/documents/BeaverOurWatershedPartnerforWEB.pdf>
- Haemig, P.D. 2012. Ecology of the Beaver. *ECOLOGY.INFO* 13. Retrieved on March 3, 2020 from: <http://www.ecology.info/beaver-ecology.htm>
- Hatler, D.F., and A.M. Beal. 2017. Furbearer Management Guidelines for Beaver. Province of British Columbia. 10 p. Retrieved on March 15, 2020 from: <https://www2.gov.bc.ca/gov/content/sports-culture/recreation/fishing-hunting/hunting/trapping-in-bc/furbearer-management-guidelines>
- Hall, J.G. 1960. Willow and Aspen in the Ecology of Beaver on Sagehen Creek, California. *Ecology*. 41(3). 484-494 p.
- Kinas, H., Duke, D., and N. Panesar. 2017. Alberta Beaver Survey Comprehensive Data Report. Miistakis Institute Rm U271, Mount Royal University 4825 Mount Royal Gate SW Calgary, Alberta T3E 6K6. 78 p. Retrieved on March 15, 2020 from: www.rockies.ca/files/reports/Alberta_Beaver_Survey_Comprehensive_Data_Report.pdf
- MacKillop, D. and A. Ehman. 2016. *A Field Guide to Site Identification and Interpretation for Southeast British Columbia; the south-central Columbia Mountains*. Victoria, BC. Land Management Handbook 70. BC Ministry of Forests, Lands and Natural Resource Operations.
- Mahr, M. 2018. *High-level overview of the Bonanza Biodiversity Corridor*. Prepared for the Kootenay Conservation Program.

- Ministry of Environment, Lands and Parks Vancouver Island Region. 2001. Vancouver Island Region Beaver Management Guidelines, pp. 23. Retrieved on March 3, 2020 from: http://wlapwww.gov.bc.ca/vir/pa/beaver_guide1.htm
- National Trappers Association. 2012. Retrieved on March 3, 2020 from: www.nationaltrappers.com/beaver.html
- Novak, M. 1987. *Beaver-Wild Furbearer Management and Conservation in North America*; M. Novak, J.A. Baker, et al. (eds). Ontario Ministry of Natural Resources, Toronto, Ontario, pp. 283-312.
- Peyton, C. 2020. Background Report on Beavers to Support Planning for the Bonanza Biodiversity Corridor Wetland Restoration Project. Upstream Environmental Consulting. Prepared for the Slokan Lake Stewardship Society.
- Pollock, M.M., G.M. Lewallen, K. Woodruff, C.E. Jordan, and J.M. Castro (Editors). 2017. The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains. Version 2.0. United States Fish and Wildlife Service, Portland, Oregon, pp. 219. Retrieved on March 13, 2020 from: <https://www.fws.gov/oregonfwo/promo.cfm?id=177175812>
- Province of British Columbia Ministry of Environment Wildlife Branch. 1988. Beaver Management Guidelines in British Columbia, pp. 6. Retrieved on March 20, 2020 from: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/beaver_mgt.pdf
- Slough, B.G., and R.M.F.S. Sadleir. 1977. A Land Capability Classification System for Beaver (*Castor canadensis* Kuhl). *Canadian Journal of Zoology*. 55, pp. 1324-1335. Retrieved on March 3, 2020 from: https://www.researchgate.net/publication/237978939_A_Land_Capability_Classification_System_for_Beaver_Castor_Canadensis_Kuhl
- Smith, D.W., Consolo Murphy, S., and M.K. Phillips. 1996. Yellowstone National Park and Robert Crabtree Yellowstone Ecosystem Studies. Beaver Survey Yellowstone National Park, pp. 8.
- Taylor, J.D., Yarrow, G.K., and J.E. Miller. 2017. Beavers. Wildlife Damage Management Technical Series. USDA, APHIS, WS National Wildlife Research Center. Ft. Collins, Colorado, pp. 21. Retrieved on May 15, 2020 from: https://www.aphis.usda.gov/wildlife_damage/reports/Wildlife%20Damage%20Management%20Technical%20Series/Beaver-WDM-Technical-Series.pdf.
- Wright, J.P., Jones, C.G., and A.S. Flecker. 2002. An Ecosystem Engineer, the Beaver, Increases Species Richness at the Landscape Scale. *Oecologia*. 132 (1). pp. 96–101. Retrieved on March 14, 2020 from: https://www.researchgate.net/publication/202001807_An_ecosystem_engineer_the_bever_increases_species_richness_at_the_landscape_scale