

# Wetlands Inventory and Stewardship in the North Columbia

Seed Project - Final Report

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## Executive Summary

The 'Wetlands Inventory and Stewardship in the North Columbia' (WISNC) project was conducted on seven higher elevation wetlands located within the North Columbia in 2020. There is a need to inventory at-risk and ecologically fragile higher elevation wetland ecosystems in this region since little is known about them. Extensive forestry activities occur nearby and, increasingly, there are a number of recreational activities (cross country skiing, mountain biking, hunting, hiking, motorized boating, snowmobiling, ATVing,) that are occurring in or near these wetlands. These increasing activities may be having an impact on ecological features. At-risk species and environmental degradation at a rare ecosystem (partial bog) had been documented in a baseline inventory conducted at Wiseman Lakes, also in the North Columbia, by a 2019 FWCP funded project (COL-F20-W-3093).

The project goals of the WISNC were to a) gain knowledge of the different wetland classes found in the region; b) identify any unique or rare features (e.g., red/blue listed species or rare wetland units); c) identify any disturbances or threats to these wetland ecosystems; d) make recommendations for restoration or conservation initiatives and e) engage Indigenous and community members in wetland conservation and data collection through volunteer opportunities. Due to the Covid-19 pandemic, community Indigenous members were not involved in data collection.

For the WISNC, bird point counts were conducted to show what bird species were present at these wetlands, also 20m x 20m vegetation plots were conducted that led to the determination of the wetland classes using the key from 'Wetlands of British Columbia: A Guide to Identification.' At three of the seven plots inventoried through the WISNC, four at-risk species were located: peregrine falcon (*Falco peregrinus*), pygmy waterlily (*Nympahaea tetragona*), barn swallow (*Hirundo rustica*), and Loesel's liparis (*Liparis loeselii*). Previously, amphibian and reptile inventories completed in 1995, which included seven survey stations on the west benches off Donald Forest Road (where most of the WISNC wetland plots are located), found that one of the two main areas of concentration for the Columbia spotted frog in the entire Columbia Basin was along the Donald Forest Road area near Golden. These findings indicate that the higher elevation wetlands in the North Columbia deserve greater ecological attention and recognition for at-risk species, including amphibians.

Without knowing what ecological values are present near these higher elevation wetlands human activity is difficult to manage. Baseline data collected through the Wiseman Lake inventory work (COL-F20-W-3093) and the WISNC can be used by government, non-profits, and the general public. The data increases the ecological body of knowledge of higher elevation wetland ecosystems that occur on the West Bench to assist with science-based management decisions. The WISNC fits the FWCP Wetlands and Riparian Areas Action Plan, the Priority Action (P1): identify candidate wetlands and riparian areas for ecosystem restoration. As mentioned above, during wetland inventorying species at risk (SAR) were identified and specific habitat-based actions should be explored to conserve those species, such as buffers being established for forestry or recreational activities.

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## 1.0 Introduction

Wetlands have high levels of biodiversity (Gopal & Junk, 2000), including high plant species richness (Polluck et al., 1998), and they provide habitat for numerous species including those imperilled. Many species of birds, fish, insects, amphibians and reptiles depend upon wetland habitats for breeding, feeding and nesting at different stages in their life cycle (Gopal, 2009). Animals may reside solely in a wetland ecosystem, or may migrate periodically or seasonally into wetlands from other environments (Gopal, 2009), or migrate between various wetland patches (e.g., Columbia spotted frog). Fragmentation of these wetlands pose many problems for these species. Many animals periodically use wetlands for activities such as grazing, but those animals do not reside there (Gopal, 2009).

A recent study took place on one of the higher elevation wetlands on the West Bench above Golden. The report from this study states:

*The [Wiseman] wetland provides habitat for a diverse array of plants, including one of the only confirmed provincial locations for pygmy waterlily (*Nymphaea tetragona*). It also supports several amphibian species (including the at-risk Western Toad), at least 85 bird species, bats, and large carnivores (e.g., lynx, cougar, black bear), and has been designated as Caribou recovery habitat. The botanical inventory in July 2019 yielded a total of 152 plant taxa representing 104 different genera, including records for three provincially listed rare plants. The overall species assemblage was unusual and possibly unique in the province. The fen species composition was characteristic of a WF11 (Tufted Clubrush – Star Moss) Fen Site Association. This fen association occurs with only incidental frequency in the Interior Cedar Hemlock (ICH) zone, comprising < 5% of all wetlands.*

*Despite its potential ecological significance to the region, the wetland complex is currently under year-around pressure from commercial and recreational ATV and snowmobile operators, and signs of recent disturbance related to motorized recreational activities were documented during site visits in 2018 and 2019. Adding to these pressures, a local outdoor adventure company has recently applied for a tenure amendment that would allow for an expanded commercial recreational operation in the Wiseman Lakes area. A viable stewardship strategy for the Wiseman Lakes habitat is required to ensure that its ecological integrity is preserved in the face of ongoing threats. (Miller, 2020).*

There are over one million species at risk of extinction on our planet (Fears, 2019). An increase in the number of recreational activities taking place in the Golden region has occurred in the last decade or two, which may be having negative impacts on plants and wildlife. Some local and regional groups such as the Columbia Wetlands Stewardship Partners (CWSP) and Kootenay Connect (KC) are working to enhance, restore, and manage large riparian and wetland complexes to support the recovery of numerous species at risk (SAR) and those that are of conservation concern in the Columbia Basin. In order to curb extirpation in the long-term, ecological protection and stewardship of the areas providing habitat to species at risk and species of concern is required.

### 1.1 Species inventory data from previous projects

Recently, there was a collation of available data done by CWSP/KC, including SAR spatial occurrences for the Columbia Valley (Darvill, 2020). The data was obtained through various sources such as the British Columbia Conservation Data Centre, eBird database, final reports from research projects supported by funding agencies (such as Columbia Basin Trust, Fish & Wildlife Compensation Program), the knowledge of experts, and Conservation Data Centre and other government data. The assessment determined that there are at least 35 bird species, 2 amphibian species, 2 reptile species, 9 mammal species, 7 species of vascular plants, 2 fish species, 6 invertebrate species, 1 fungus and 1 lichen species and 21 ecological communities listed as being at-risk in the Columbia Valley (Darvill, 2020). As part of this assessment, it was found that several species-at-risk such as grizzly bear, wolverine, peregrine falcon, olive-sided flycatcher, western toad, pygmy waterlily and little brown myotis reside on the West Bench and rely upon this area for various parts of their life history.

Recently, Dr. Michael Proctor completed grizzly bear habitat modelling for the north end of the Columbia Valley (Brisco to Donald), which identified three fine-scale grizzly bear linkage corridors north of Golden in the North Columbia (Proctor, 2021). One of these corridors goes through Gorman and Holt Creeks (M. Proctor, personal communication, Dec 2020; Proctor, 2021). Holt drainage was previously identified as high-quality habitat for Mountain Goat and Grizzly Bear (both blue-listed species), and it is closed to motorized use under the Golden Backcountry Recreation Access Plan.

There are also a significant concentration of amphibian occurrences (mainly Columbia spotted frog and blue-listed western toad) in the wetlands located on the West Bench. Ohanjanian & Teske (1996) completed amphibian and reptile inventories in 1995, which included seven survey stations on the west benches off Donald Forest Road. It was stated in their report that one of the two main areas of concentration for Columbia spotted frog in the entire Columbia Basin, was along the Donald Forest Road area near Golden (Ohanjanian & Teske, 1996). Ohanjanian and Teske (1996) reported that amphibian decline was probably happening in the region back then, but that they had no baseline data to make any firm conclusions or recommendations. Greater than 70% of the global amphibian populations are known to be in decline (Hayes et al., 2010), therefore significant populations of amphibians are important to maintain. It is imperative to identify the corridors connecting anuran habitats (Pilliod, Peterson & Ritson, 2002) located on the wetlands on the West Bench that support abundant amphibian populations and to develop a conservation plan with that specific goal in mind. Amphibians have some of the greatest evidence of negative effects stemming from recreational activities (Larson, 2015).

### 1.2. Human recreation leading to negative impacts on plants and wildlife

Human recreation can lead to a variety of immediate and long-term impacts on the activity, reproduction, and survival of wildlife (Knight & Cole, 1991; Knight & Gutzwiller, 1995; Whittaker & Knight, 1998). Outdoor recreation is known as a primary cause of the decline of threatened and endangered species in the United States (Losos et al., 1995; Czech et al., 2000; Taylor & Knight, 2003). Given their low population densities, historical and current persecution, as well as large area requirements, large carnivores such as grizzly bear, wolf, and cougar are especially sensitive to anthropogenic disturbances (Breitenmoser, 1998; Crooks, 2002; Gittleman et al., 2001; Pimm et al.,

1988; Terborgh, 1974; Ray et al., 2005; Woodroffe & Ginsberg, 1998; Woodroffe, 2000). Human recreation can also alter carnivore behavior and distribution (e.g., Aaris-Sorensen, 1987; Nevin and Gilbert, 2005a,b; Olson et al., 1997; White et al., 1999). Human recreation can also disturb ungulates, initiating alert and flush responses and potentially result in decreased foraging or reproduction, increased energetic costs or stress, and avoidance of recreational areas (Eckstein et al., 1979; Freddy et al., 1986; MacArthur et al., 1982; Miller et al., 2001; Papouchis et al., 2001; Taylor & Knight, 2003; Yarmoloy et al., 1988).

Bats have been shown to avoid foraging in noisy settings and near roads (Berthinussen & Altringham, 2012; Schaub et al., 2008). Bats were not inventoried as part of this WISNC research project, but there are undoubtedly at least 8 species of at-risk bat species in this area, and possibly more (C. Lausen, personal communication, 2020). Bat research is currently underway in the Columbia Valley. Motorcycle and ATV noise can affect nocturnal bats by disrupting the sleep of individuals that roost during the day (Kight & Swaddle, 2011; Luo et al., 2014). Other studies have shown that the abundance of some arthropod families (prey species for bats and some birds) is lower at sites with higher noise. Thus, the decline in bat foraging activity could be reflecting altered insect abundance (Bunkley et al., 2017). The increased levels of noise that are produced from increasing levels of motorized activity in this general area would be a major driver of negative effects on animal populations (McClure et al., 2013), including bats.

Extensive presence of humans in a forest disturbs wildlife, which includes negative affects to the forest bird community along trails (Botsch et al., 2018). The overall disturbance level to forest birds has been shown to depend mainly on recreational intensity (Botsch et al., 2018). Humans are often perceived as predators by wildlife (Frid & Dill, 2002), which can lead to important changes in their physiology like the release of stress hormones, reproduction difficulties, and in behaviours such as flight for birds (Beale & Monaghan, 2004; Ikuta & Blumstein, 2003; Tablado & Jenni, 2017), and can lead to negative consequences for individual fitness and the dynamics of animal populations (Botsch et al., 2018).

## 2.0 Methods

GoogleEarth Pro (Version 7.3.3.7786) was used to visualize wetland sites prior to ground-based surveys. Sites that were relatively easy to access were chosen and wetland inventories were completed during June and July of 2020. The data form used for this project (Site Visit Form) was originally obtained from the BC Wildlife Federation in 2016 during a training workshop. The protocol for analyzing the site (e.g., SMR, SNR, Von Post, HDI, etc.) came from methods listed in both the 'Field Manual for Describing Terrestrial Ecosystems 2<sup>nd</sup> Edition' (BC Ministry Forests and Range, 2010) and from a paper handout that was obtained from BC Wildlife Federation staff during the 'Map Our Marshes' workshop held in Golden in 2016.

At all wetland sites, two plots were surveyed except for the one site called 'PEFA Pygmy waterlily 1' where only one plot was analyzed due to the hazardous nature of the site (walking on a bog is dangerous). Each vegetation plot was measured out to be 20mx20m. As for plant identification, all plant species located within each plot were identified to the best of the author's (and accompanying



volunteers) knowledge. An attempt was made to list each plant species in order of abundance. Field guide books used for plant identification included Parish, Coupe & Lloyd's (1996) 'Plants of Southern Interior of British Columbia and the Inland Northwest' and 'Field Guide to the Sedges of the Pacific Northwest' (Wilson, 2008). Unknown sedge species were collected in the field and brought back for closer examination indoors using a hand lens and field guide. All unknown plant species were photographed in the field. Photos were subsequently sent to a local (volunteer) amateur botanist who was able to identify some unknown plants or send photos or specimens of unknown plants to colleagues for positive identification.

Once all wetland site characteristics were described, the wetland class was assigned to each plot using the 'Wetlands of British Columbia: A Guide to Identification' (MacKenzie & Moran, 2004) when possible. To learn more about the biodiversity values at each site, wildlife observations were recorded and bird point counts were done at each site if we arrived on site prior to 10:00 am. To conduct bird surveys, the study used the standardized protocol as described in the Prairie and Parkland Marsh Monitoring Program Manual developed by Bird Studies Canada (BSC) (2010). Using this protocol, a primary observer stood at a central location and used a 5-minute silent/listening period, followed by a 5-minute period during which calls of selected focal species (sora, Virginia rail, American bittern, American coot, pied-billed grebe) were played using broadcast equipment (FoxPro Firestorm). This was followed by another 5-minute silent/listening period. During the 15-minute survey, observations (visual and/or aural) of all bird species detected were recorded.

### 3.0 Project Outcomes

Wetlands are among the most productive ecosystems on Earth and they deliver a number of important benefits for humans and wildlife such as habitat, water filtration and purification services, recreational services and aesthetic views. Despite the recognized importance of wetland ecosystems, globally they are being degraded at an alarming rate. It has been estimated that over half of the world's wetlands have already been lost. Threats to global wetland ecosystems include urban and rural development, invasive species, recreation, intensive forestry, and livestock grazing. There are increasing cumulative pressures on the backcountry of the North Columbia (including the wetlands), and threats of forestry and recreation appear to be intensifying in an area known as the West Bench, which is located beneath the Dogtooth Mountain Range near Golden. Here, negative ecological impacts may be occurring as a result of cumulative pressures. Very little is known about the ecological values found on the West Bench, yet there are increasing pressures for more recreational opportunities and forestry. Wetlands there are thought to represent unique and irreplaceable assets. We do not have enough ecological information on these wetlands. There is a need to inventory at-risk and ecologically fragile wetlands, so that human activities can be directed to occur in a more sustainable manner.

The Wetlands Inventory and Stewardship in the North Columbia (WISNC) project started to gather knowledge of the different wetland classes found in the region, including the identification of any unique or rare features/wetlands and disturbances or threats to these wetlands (Tables 1-4). The WISNC fits within FWCP Wetlands and Riparian Areas Action Plan and the Priority Action (P1): identify

candidate wetlands and riparian areas for ecosystem restoration. Photographs of each site can be found in Appendices 6.1- 6.13. We did not identify any sites through this project that require restoration or rehabilitation at this time. However, threats identified at each site are found in Table 5. At three of the seven sites inventoried through the WISNC, four at-risk species were located: peregrine falcon, pygmy waterlily, barn swallow and Loesel's liparis. The bird point counts completed at four of the wetland sites identified 35 bird species using those higher elevation wetlands. It is likely that those birds are breeding at those higher elevation wetlands (given the season when those point counts were conducted), but nest searches were not performed as it was beyond the scope of this project.

The preliminary outcome of this research indicates that there are high levels of biodiversity (including but not limited to at-risk species, bird species, amphibian species, and plant species) at these higher elevation wetland sites which deserve higher priority action and attention, including more comprehensive inventory work. For instance, this seed research project discovered that one of the inventoried wetlands in 2020 was very similar both ecologically and botanically to Wiseman Lakes (fen association that occurs with only incidental frequency in the ICH zone) (Miller, 2020), which is also in the North Columbia.

There are a number of scattered wetland ecosystems on the West Bench above Golden. The trails and Forest Service Roads (FSRs) in the WISNC study area do not currently receive high levels of use, but in order to maintain the high ecological values of these higher elevation wetlands greater ecological management consideration should be taken. A recommendation echoes what was reported in 2020, “A viable stewardship strategy for the Wiseman Lakes habitat [and all of the wetlands on the West Bench] is required to ensure that its ecological integrity is preserved in the face of ongoing threats” (Miller, 2020).

Before approval occurs for any further motorized recreational tenures on the West Bench, a well thought out, long-term plan needs to be developed that incorporates cumulative effects, what level of use is acceptable, new scientific information, increasing levels of recreational activity and resulting impacts, habitat for species at risk, and the long-term vision of motorised clubs in the area, etc. The development of any area for the purpose of motorized use needs to be very thoroughly investigated to avoid a myriad of negative impacts on wildlife and species at risk. Furthermore, it is highly worth further quantify threats for each site (e.g., estimated level, type and seasonal use). There is value in making a subsequent application to the FWCP to further investigate the high elevation wetlands in the North Columbia. The author recommends that a larger application for a larger project be submitted to FWCP and the proponent has an intention to do so in subsequent years.



Table 1. Site characteristics at each plot within the seven surveyed wetlands in the North Columbia.

Plot No	Date	Plot Name/Site	Easting	Northing	SMR	SNR	Wetland Class	Elevation (m)	Hydrogeo-morphic position	Mesoslope position	Site Disturbance	Structural Stage	Von Post	Water Color	pH	% open water	HDI	Humus/Organic Form	Humus thickness (cm)	R.Z. soil texture	R.Z. Coarse Fragment (%)	Estimated soil depth (cm)	Gleying or Mottling	Restrict Layer (cm)	% by cover layer
1	2020-06-18	Cabin Lk	496032	5688043	8	D	Fen	1075	Palustrine	Level	none	2b	3	tea colored	7.78	0.1 at plot	Sl	n/a	15	n/a	n/a	15	n/a	15	herb (100%)
2	2020-06-18	Cabin Lk	496023	5688091	8	A	Bog	1066	Palustrine	Level	none but logging and rec around		2	tea colored	6.6	0		Fibric	90	n/a	n/a	approx 90	n/a	20	
1	2020-06-18	Deserted 2	495502	5688649	8	B	Bog	1107	Palustrine	Level	none	2b	2	tea colored	7.18	5	St	Fibric	10	n/a	n/a	>125	n/a	7	herb (30%), moss (70%)
2	2020-06-19	Deserted 2	495494	5688682	7(?)	C	?	1092	Palustrine	Level	none	2b	5	deep brown turbid	n/a	0		Mesic	>25	n/a	n/a	>125	n/a	18	shrub (40%), herb (50%), moss (10%)
1	2020-06-19	Deserted Lk	495151	5689217	8	C	Fen?	1188	Palustrine	Level	n/a	2b	5	tea colored	7.56	0	St	Mesic	>125	n/a	n/a	>125	n/a	10	shrub (15%), herb (55%), moss (30%)
2	2020-06-19	Deserted Lk	495368	5688892	8	C	?	1097	Palustrine	Level	n/a	2b	n/a	n/a	6.47		Sl	Mesic	8	Silty clay	11	57	n/a	7	herb (95%), moss (5%)
1	2020-07-11	Bush Arm	474896	5739317	7	D	Marsh	756	Fluvial	Level	Causeway	2b	n/a	n/a	7.4	0	Sl, MO	no organic soil	n/a	clay	20	75	no	63	herb (75%), moss (25%)
2	2020-07-11	Bush Arm	474916	5739376	4	D	?	754	Fluvial	Level	Causeway built/present, Oxeye Daisy	2b	n/a	n/a	7.3		Sl, MO	n/a (no organic, all mineral)	none	clay	50	and below 10 cm	no	17	shrub (10%), herb (40%), moss (50%)
1 of 1	2020-07-13	PEFA Pygmy w	494758	5691848	8	D	Bog	994	Lacustrine	Level	Forestry	2b	6	tea color	6.64	0	St	Mesic	25	n/a	n/a	>130	n/a	0	shrub (2%), herb (30%), moss (68%)
1	2020-07-13	Beaver Dam	495175	5691359	5	E	Marsh	983	Palustrine	Level	Biotic, other	2b	8	tea color	7.85	0	MO	Humic	15	n/a	n/a	65	n/a	0 (water table at surface)	shrub (50%), herb (50%)
2	2020-07-13	Beaver Dam	495162	5691318	7	D	Marsh	976	Palustrine	Level	Forestry	2b	9	yellow-d	7.06	0	MO	Humic	n/a	n/a	n/a	70	n/a	0	herb (100%)
1	2020-07-13	Liparis	495153	5691212	8	E	?		Palustrine	Level	Biotic, other	2b	n/a		7.95	0	St	Humic	n/a	Sandy clay	30	>130	n/a	0 (water table at surface)	herb (95%), moss (15%)
2	2020-07-13	Liparis	495171	5691095	8	E	Look up		Palustrine	Level	Harvest, Biot	2b	n/a		7.25	0	Sl	Not organic	none	Silty clay	5	>130	minimal	5	herb (60%), moss (40%)

Table 2. Plant species lists found at the 20m x 20m plots surveyed.

Plot No	Plot Name/Site	Plant species	Wildlife Obs
1	Cabin Lk	<i>Menyanthes trifoliata</i> – buckbean, <i>Comarum palustre</i> – marsh cinquefoil, <i>Platanthera aquilonis</i> – northern green rein orchid, <i>Equisetum fluviale</i> – swamp horsetail, <i>Carex aquatilis</i> – water sedge, <i>Rubus arcticus</i> – nagoon berry, <i>Salix drummondiana</i> – Drummond's willow	Black bear scat on trail to site. Bird point count conducted.
2	Cabin Lk	<i>Menyanthes trifoliata</i> – buckbean, <i>Comarum palustre</i> – marsh cinquefoil, <i>Platanthera aquilonis</i> – northern green rein orchid, <i>Carex aquatilis</i> – water sedge, <i>Rubus arcticus</i> – nagoon berry, <i>Salix drummondiana</i> – Drummond's willow, <i>Trientalis glutinosa</i> – sticky false asphodel, <i>Drosera anglica</i> – great sundew, <i>Trichophorum cespitosum</i> – tufted clubrush, <i>Eleocharis palustris</i> – common spike-rush, <i>Carex lasiocarpa</i> – slender sedge, <i>Pinus contorta</i> – lodgepole pine	Moose tracks, bear scat, log 'lifted' likely by bear.
1	Deserted 2	<i>Menyanthes trifoliata</i> – buck bean, <i>Trientalis glutinosa</i> – sticky false asphodel, <i>Drosera anglica</i> – great sundew, <i>Trichophorum cespitosum</i> – tufted clubrush, <i>Carex lasiocarpa</i> – slender sedge, <i>Carex capillaris</i> – hairlike sedge, <i>Eleocharis palustris</i> – common spike-rush, mosses	Bird point count conducted.
2	Deserted 2	<i>Menyanthes trifoliata</i> – buckbean, <i>Comarum palustre</i> – marsh cinquefoil, <i>Pyrola asarifolia</i> – pink wintergreen, <i>Lysimachia thyriflora</i> – tufted loosestrife, <i>Viola adunca</i> ? - early blue violet (this could be another sp but as not in flower not sure), <i>Taraxacum officinale</i> – common dandelion, <i>Hieracium piloselloides</i> – tall hawkweed, <i>Carex lasiocarpa</i> – slender sedge, <i>Betula pumila</i> – bog birch, <i>Salix drummondiana</i> – Drummond's willow, <i>Salix bebbiana</i> – Bebb's willow, mosses	
1	Deserted Lk	<i>Menyanthes trifoliata</i> – buckbean, <i>Platanthera aquilonis</i> – northern green rein orchid, <i>Viola renifolia</i> – kidney leaved violet, <i>Carex aquatilis</i> – water sedge, <i>Carex lasiocarpa</i> – slender sedge, <i>Salix drummondiana</i> – Drummond's willow, <i>Salix bebbiana</i> – Bebb's willow, mosses	Bear scat, moose tracks. Bird point count conducted.
2	Deserted Lk	<i>Menyanthes trifoliata</i> – buckbean, <i>Comarum palustre</i> – marsh cinquefoil, <i>Lycopus uniflorus</i> – northern water horehound, <i>Cirsium arvense</i> – canada thistle, <i>Typha latifolia</i> – cattail, <i>Carex lasiocarpa</i> – slender sedge, <i>Salix bebbiana</i> – Bebb's sedge, <i>Mentha arvensa</i> – field mint (within 1 m), grass unknown	Columbia Spotted Frog
1	Bush Arm	grass spp., <i>Equisetum</i> spp. – Horsetail spp., <i>Carex</i> spp. – sedge spp. A few more plant but of each little present.	Barn Swallows* on site - detected with bird point count conducted. Nests on nearby bridge at Bush Causeway.
2	Bush Arm	<i>Equisetum</i> spp. – Horsetail spp., <i>Carex</i> spp. – sedge spp., grass spp., moss sp., 3 additional forbs (very little of each, <i>Carex</i> sp. – sedge spp.	garter snake (2)
1 of 1	PEFA Pygmy waterlily 1	<i>Drosera rotundifolia</i> – round-leaved sundew, <i>Potentilla palustris</i> – marsh cinquefoil, <i>Lysimachia thyriflora</i> – tufted loosestrife, <i>Rubus arcticus</i> – nagoon berry, <i>Aconitum columbianum</i> – columbia monkshood (outside plot), <i>Menyanthes trifoliata</i> – buckbean (outside plot), <i>Nymphahaea tetragona</i> – pygmy water lily (BLUE S3)* (outside plot), <i>Galium trifidum</i> – small bedstraw, <i>Sparganium</i> sp – not determined, <i>Equisetum fluviale</i> – marsh horsetail, <i>Eriophorum chamissonis</i> – Chamisso's cotton grass, <i>Carex aquatilis</i> – water sedge, <i>Carex diandra</i> – lesser panicled sedge (this or <i>lasiocarpa</i> was the predominant sedge at this plot), <i>Carex lasiocarpa</i> – slender sedge, <i>Ledum groenlandicum</i> – labrador tea, <i>Betula pumila</i> – bog birch, <i>Alnus incana</i> – mountain alder, <i>Pinus contorta</i> – lodgepole pine, <i>Thuja plicata</i> – western red cedar, <i>Salix</i> unknown 1 – willow	Long-toed Salamander approx. 100 m from site. 3 beaver lodges, Peregrine Falcon, * <i>Nymphahaea tetragona</i> – pygmy waterlily*. Bird point count conducted.
1	Beaver Dam	<i>Mentha arvensis</i> – field mint, <i>Aconitum columbianum</i> – columbia monk's hood, <i>Lysimachia thyriflora</i> – tufted loosestrife, <i>Galium triflorum</i> – sweet-scented bedstraw, <i>Cicuta douglasii</i> – Douglas's water hemlock, <i>Utricularia macrorhiza</i> – greater bladderwort, <i>Circaea alpina</i> – enchanter's-nightshade, <i>Nymphaea variegata</i> – variegated yellow pond-lily, <i>Viola</i> sp – unknown, <i>Rubus idaeus</i> – red raspberry, <i>Rubus pubescens</i> – trailing raspberry, <i>Cirsium arvense</i> – canada thistle, <i>Typha latifolia</i> – cattail, <i>Equisetum arvense</i> – common horsetail, <i>Carex aquatilis</i> – water sedge (outside plot), <i>Carex</i> unknown – sedge (outside lot), <i>Eleocharis palustris</i> – common spike-rush (outside plot), <i>Cornus stolonifera</i> – red osier dogwood, <i>Salix drummondiana</i> – Drummond's willow, <i>Salix</i> unknown – willow	Moose tracks, Columbia Spotted Frog, Deer tracks, MAKE, SWTH, leeches, BUFF, Magnolia Warbler. No bird point count due to too late in day.
2	Beaver Dam	<i>Comarum palustre</i> – marsh cinquefoil, <i>Epilobium ciliatum</i> – purple leaved willow herb, <i>Utricularia vulgaris</i> – greater bladder wort, <i>Sparganium</i> unknown – bur reed, <i>Carex aquatilis</i> – water sedge, <i>Carex</i> unknown 1 – sedge, <i>Carex</i> unknown 2 – sedge	Many ungulate tracks.
1	Liparis	<i>Zigadenus elegans</i> – mountain death-camas, <i>Parnassia palustris</i> – marsh grass-of-parnassus, <i>Utricularia vulgaris</i> – greater bladderwort, <i>Comarum palustre</i> – marsh cinquefoil, <i>Viola</i> spp. – violet (outside plot), <i>Packera paupercula</i> – canadian butterweed (just outside plot), <i>Hieracium piloselloides</i> – tall hawkweed (exotic) (outside plot), <i>Chara vulgaris</i> – common stonewort, <i>Sparganium</i> spp. – bur reed, <i>Schoenoplectus acutus</i> – hard-stemmed bulrush, <i>Carex aurea</i> – golden sedge (outside plot), <i>Carex buxbaumii</i> – Buxbaum's sedge, <i>Carex lasiocarpa</i> – slender sedge, <i>Carex aquatilis</i> – water sedge, <i>Carex flava</i> – yellow sedge, <i>Carex</i> spp., <i>Juncus articulatus</i> – jointed rush	
2	Liparis	<i>Liparis loeselii</i> – Loesel's liparis*, <i>Gentianopsis macounii</i> – Macouin's fringed gentian (outside plot), <i>Euthamia graminifolia</i> – fragrant goldenrod (infrequent in S BC – E-flora note), <i>Spiranthes romanoffiana</i> – hooded ladies' tresses, <i>Parnassia palustris</i> – marsh grass-of-parnassus, <i>Potentilla anserina</i> – silverweed, <i>Primula mistassinica</i> – Mistassini primrose (bird's-eye primrose), <i>Mentha arvensis</i> – field mint (outside plot), <i>Viola</i> spp. – violet, aster unknown, <i>geranium</i> spp., <i>Schoenoplectus acutus</i> – hard-stemmed bulrush, <i>Triglochin palustris</i> – marsh arrow-grass, <i>Carex buxbaumii</i> – Buxbaum's sedge, <i>Carex rostrata</i> – slender beaked sedge, <i>Carex lasiocarpa</i> – slender sedge, <i>Juncus articulatus</i> – jointed rush, grass spp. 1, grass spp. 2	<i>Liparis loeselii</i> – Loesel's liparis* – blue-listed species.

Table 3. Date and site conditions of the bird point counts.

Site Name	Date	Start Time	Cloud cover	Air temp	precip code	Beaufort wind scale	Wind speed	Wind direction	Background noise code
Cabin Lk	18-Jun-20	1000	0	18	0	2	4	SE	0
Deserted Lk	06-Jun-20	944	2	17	0	1	6	SE	0
PEFA Pygmy waterlily	13-Jul-20	935	7	14	0	1	2	NW	0
Bush Arm	11-Jul-20	908	2	15	0	2	8	N	0

Table 4. Resulting bird species lists for point counts.

	Cabin Lk	Deserted Lk	PEFA Pygmy waterlily	Bush Arm
Common Loon	X	X	X	
Canada Goose				X*
Wilson's Snipe				X
Spotted Sandpiper				X
Solitary Sandpiper		X*		
Pileated Woodpecker		X*		X
Willow Flycatcher				X
Least Flycatcher	X	X		
Red-eyed Vireo		X		
Common Raven	X*			
Canada (Gray Jay)	X*	X		
Barn Swallow				X
Black-capped Chickadee	X*			
Red-breasted Nuthatch	X*	X	X	
Ruby-crowned Kinglet	X		X	
Golden-crowned Kinglet	X	X	X	
Swainson's Thrush	X	X	X	X
Varied Thrush				X
American Robin	X		X	X
Red-winged Blackbird				X*
Orange-crowned Warbler			X*	
Yellow Warbler	X	X		X
Yellow-rumped Warbler			X	
Townsend's Warbler	X*			
Common Yellowthroat		X*	X	X
Wilson's Warbler	X*	X		
Chipping Sparrow		X*		
Savannah Sparrow				X
Song Sparrow		X*	X	X
Lincoln's Sparrow	X*	X*	X	X
Dark-eyed Junco	X	X	X	
Western Tanager	X*	X	X*	
pine siskin	X*	X		X
passerine sp.	X			
peregrine falcon			X	

Note - x\* means the bird was counted after the 15-minute survey period.

Table 5. Potential threats at each site that should be further investigated.

Site Name	Potential threats
Cabin Lk	Expanding motorized recreational disturbance near the lake, but no disturbance observed on the wetland itself. Motorized dirt club wants to expand single track dirt biking in this area. Resulting noise pollution and other effects from this type of human activity is detailed in this report. Nearby forestry activities (logging) may be having negative impacts on the wetland.
Deserted Lk	There is a logging road about 130 m away, this may or may not be having an impact on wetland.
Deserted 2	None observed, but there is an old access, an old logging road that has likely brought some invasive plant species (Canada thistle) to the wetland area.
Bush Arm	Causeway nearby; blocks waterflow which could be leading to other negative ecological impacts. Blowing dust arriving in wetlands, coming from vehicles travelling on causeway. Invasive plant species observed (oxeye daisy) - extensive infestation.
PEFA Pygmy waterlily	Logging occurred within riparian boundary of wetland. About 13 meters away (along eastern wetland edge), forestry activities (logging) may be having a negative impact on the wetland. Only a thin strip of trees separates the wetland from a forestry clearcut.
Beaver Dam	Forestry activity close to wetland. Several invasive plant species noted including: yellow hawkweed, sow thistle, oxeye daisy.
Liparis	Forestry activity close to wetland; thin strip of trees are left to south. Several invasive plant species noted including: yellow hawkweed, sow thistle, oxeye daisy, self heal.

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## 6.0 Appendices

Appendix 6.1 Cabin Lake Plot 1 photograph.





Appendix 6.2 Cabin Lake Plot 2 photograph.





Appendix 6.3 Deserted 2 plot 1 photograph.





Appendix 6.4 Deserted 2 plot 2 photograph.





Appendix 6.5 Deserted Lk Plot 1 photograph.





Appendix 6.6 Deserted Lk Plot 2 photograph.





Appendix 6.7 Bush Arm Plot 1 photograph.





Appendix 6.8 Bush Arm Plot 2 photograph.





Appendix 6.9 PEFA Pygmy waterlily Plot 1 photograph





Appendix 6.10 Beaver Dam Plot 1 photograph.





Appendix 6.11 Beaver Dam Plot 2 photograph.





Appendix 6.12 Liparis Plot 1 photograph.





Appendix 6.13 Liparis Plot 2 photograph.

