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Regional District of Central Kootenay

Kootenay Lake Local Conservation Fund Guidance Document



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EXECUTIVE SUMMARY

In November 2015, the electorate from Regional District of Central Kootenay (RDCK) Electoral Areas A, D and E voted to establish the Kootenay Lake Local Conservation Fund (KLLCF). The purpose of the fund is to provide local financial support for relevant projects that will contribute to the conservation values of Kootenay Lake's natural areas, and to the restoration and preservation of a healthy environment. Specifically, the intent is to provide funding for local conservation projects that are not the existing priority of Federal, Provincial or Local governments, but that address known threats to priority terrestrial and aquatic habitats and dependent species. This KLLCF Guidance Document outlines a range of threats to key biodiversity habitat targets identified by the KLLCF as being of specific relevance to the Kootenay Lake region, with a focus on RDCK Electoral Areas A, D and E. In response to the identified threats, priorities and appropriate actions were developed for conservation in Areas A, D and E within the Kootenay Lake region. These will inform the KLLCF Terms of Reference and ensure that funded projects are strategically aligned with identified priorities and actions.

Ten habitat targets were listed as key components of local ecosystem/habitat diversity in the study area and included in order of importance: hydro-riparian systems; fish habitat; at-risk aquatic and terrestrial vertebrates; wetlands; dry forest; connectivity habitats; old forest; cottonwood-dominated floodplain; brushlands/grasslands; shrub and herb-dominated floodplain; and karst (distinctive landforms that result from the dissolving action of water on soluble bedrock). The area of each habitat target on private versus crown land was quantified as was the area protected.

A standard set of global International Union for Conservation of Nature (IUCN) threats and sub-threats were evaluated within a local context for both terrestrial and aquatic habitat targets in the study area. A total of eight threat categories and 55 threat activities were identified. Threats were coarsely ranked to help inform on required conservation actions. The top ranked threats at a local scale included habitat loss, degradation/conversion (due to dams, residential development and other factors), roads (construction, use and maintenance in multiple contexts), overall impact of changing climate, increased fire risk (frequency and severity), resource use (in particular roads on crown land), water management regimes (river flows, flood patterns, and reservoir levels) and were similar to those reported for the region.

In total, 39 broad-based conservation actions were developed that were applicable to aquatic and terrestrial habitat targets on private land identified within the study area. Conservation actions were ranked and summarized by habitat target, relative to the number/severity of threats acting on a target, and the availability and degree of protection for that target in order to obtain an overall ranking for each action: Very High; High; Moderate; or Low. Rankings were designated as follows:

- Very High corresponded to actions that result directly in critical or high value target habitat protection, either via acquisition, covenant establishment, or landowner agreement as well as actions that directly implement recommendations in recovery plans focused on a target listed species/habitat, or where mortality to a listed, rare or regionally sensitive species (or access to its critical habitat) is reduced directly by the action being implemented;
- High ranked conservation actions included: implementation of management plans, regulations, bylaws or guidelines that enhance listed species and/or target habitat protection on private land; implementation of stewardship actions that benefit listed, rare,

or regionally sensitive species and/or target habitats; and, actions involving implementation of assessments, inventories, research and/or monitoring initiatives to identify critical and/or priority habitat and/or threats to listed species or to ecosystems (e.g., climate change);

- Moderate ranked conservation actions included: planning or inventory; research and monitoring actions; stewardship planning; development of assistance programs; associated financial incentives; and, development of management plans, regulations/bylaws, guidelines, or land use planning initiatives on private land; and
- Low ranked conservation actions applied to more indirect measures (which may potentially lead to future conservation actions) that are focused on problem wildlife management, citizen science, public education and awareness, and participation in other planning and management initiatives underway.

In addition, nine other key conservation actions deemed important in a local context, but that are typically addressed on crown land and/or under the responsibility of government were listed for reference.

It is recommended that the broad-based conservation actions matrix developed during this study be used to further evaluate the relative merit of proposed conservation actions. For simplicity, ranking was based on a 10-point system that could be combined with scoring for other criteria (e.g., proposal quality, team experience, project cost) to evaluate proposals for prioritized funding under the KLLCF. Specific examples were also included for each broad-based conservation action, where applicable. The specific examples do not provide an inclusive or exhaustive list of all the possible conservation actions that are applicable to this program as this was beyond the scope of this review.

The following is a list of information gaps and needs identified during this review:

- Consideration of listed invertebrate and plant species and listed ecological communities occurring in the study area;
- Lack of local information on the degree and/or rate of climate change occurring and the need for monitoring habitat change for the identified conservation targets;
- Information gaps related to “climate refugia” for providing habitat diversity and stability needed to enable climate change adaptation and improved resilience at multiple spatial scales;
- Karst abundance and distribution and susceptibility to threats requires further evaluation within the study area;
- Broadening the geographic scope of inventory, management, monitoring and threat evaluations for sensitive habitats and species at risk within the study area that includes greater collaboration and information sharing with larger landowners and managers as well as participation of private landowners;
- Clarification of fish-bearing status and areas of native/non-native fish overlaps for streams, wetlands and small lakes within the study area, which may include fish inventory and spawning surveys in collaboration with provincial agencies;

- Clarification of aquatic connectivity issues associated with water quantity, such as low stream or sub-surface flows; and
- Collaboration with First Nations to ensure that the proposed protection, enhancement, and restoration of ecosystem, habitat, and species targets will align well with the goal of improved protection of cultural and archeological values in the study area.

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1.0 INTRODUCTION

Kootenay Lake is located within an idyllic setting, between the Purcell and Selkirk Mountain ranges in southeastern British Columbia. The lake is characterized by high species diversity, well-known for its exciting freshwater fishery, and provides habitat to several indigenous and rare fish species (e.g., Bull Trout, Gerrard Rainbow Trout, Kootenay River White Sturgeon¹; Porto 2008; Wilson et al. 2004). This uniqueness is also reflected in the diversity of lake, river, stream and wetland habitats found within this system.

Kootenay Lake straddles the Southern and Central Columbia Mountains ecosections and is dominated by a moist to wet interior climate. The surrounding mountains are relatively steep and dissected, with varied geology, and topography and terrain typical of glacial source areas. The mountainous slopes adjacent to the lake are predominately forested, but include areas of parkland and alpine tundra at highest elevations. Vegetation communities consist of wetter to dryer subzones of the Interior Cedar-Hemlock (ICH) and Engelmann Spruce-Subalpine Fir (ESSF) zones (MacKillop and Ehman 2016). Natural disturbance regimes range from relatively infrequent stand-replacing fire regimes at upper elevations, to mixed-severity and frequent, low intensity fire regimes at lower elevations on southern aspects. Terrestrial faunal diversity is also very high (with as many as 370 animal species; review in Wilson et al. 2004; MacKillop and Ehman 2016), and includes species found mainly in forested ecosystems (e.g., Mountain Caribou, Grizzly Bear, Wolverine, Fisher, Northern Goshawk, Western-Screech-Owl, Great Blue Heron), as well as those species associated with more open ecosystems. The latter include many listed species (e.g., Lewis Woodpecker, Yellow-breasted Chat, Peregrine Falcon, American Badger, Townsend's Big-Eared Bat, Northern Leopard Frog, Coeur d'Alene Salamander, Northern Rubber Boa, Western Skink) associated with riparian, wetland, shrubland, grassland, and/or open forest habitats.

The Kootenay Lake area has a rich archaeological record with First Nations occupation sites dating back 10,000-12,000 years. The area is considered to have relatively low to modest levels of human development and a high degree of functional riparian and landscape connectivity (Nature Conservancy of Canada 2004; Machmer and Steeger 2008; MacKillop and Ehman 2016). Populations of iconic wide-ranging species are still found here, and linkage zones have been identified as critical to maintain their seasonal movements, gene flow, and long-term viability (Nature Conservancy of Canada 2004; Proctor et al. 2015; Utzig and Holt 2015). The area continues to support an important freshwater fishery, and it offers outstanding recreational opportunities and a high quality of life for local residents. However, a variety of human-caused threats (e.g., dams, flow management regimes, climate change, forestry, transportation and service corridors, recreation, mining, aquatic and terrestrial invasive species, human settlement) are undeniably influencing local ecosystem processes and biodiversity (reviews in Utzig et al. 2003, AMEC et al. 2011, Shaw et al. 2013; Utzig and Holt 2015; Martin et al. 2017 Draft).

At a finer scale, the foreshore and upland areas of Kootenay Lake have been experiencing increased development pressure over the last decade, as more people are drawn to this attractive area to live, recreate and work. A study conducted in the West Arm of Kootenay Lake in 2008 observed a 15% increase in urban residential land use, an overall net loss of riparian vegetation, and an increase in the number of foreshore modifications since 2004 (AMEC 2009). A scoping

¹ Scientific names of all vertebrate fish and wildlife species can be found in Appendix A, Tables A1 and A4, respectively.

study conducted for Kootenay Lake identified that the main developments and/or issues of concern for the area included: i) foreshore developments; ii) water quality and quantity; iii) protection of culturally important areas; iv) sensitive habitats for fish and wildlife; v) fish and wildlife population protection; and, vi) access, recreation and navigation (AMEC et al. 2011). The increase in urbanization and higher levels of impact observed was thought to negatively impact the foreshore and cause potential impacts to fish and fish habitat, archaeology and traditional use. In 2012, it was estimated that approximately 56% of Kootenay Lake's shoreline had a moderate to high level of development impacts including lakebed substrate modification, riparian vegetation removal and construction of shoreline habitat modifications (i.e., groynes, docks, retaining walls, marinas, boat launches, boat basins) (Ecoscape 2016).

In upland areas, threat assessments (Utzig et al. 2003; Utzig and Scott-May 2003; Shaw et al. 2013; Martin et al. 2017 Draft) have highlighted the following issues of concern, among others: i) changes to seral stage distributions with resulting reductions in old and mature forest habitats; ii) fire suppression and the loss of fire-maintained and mixed fire severity regime habitats; iii) fragmentation of habitat due to density and patterns of rural/urban development, forest harvesting and road establishment (with major impacts on Mountain Caribou and Grizzly Bear); iv) loss of stand-level habitat elements, including large snags, live wildlife trees, veteran trees and large coarse woody debris; v) invasive species and impacts on plant community structure and resulting degradation of habitat values (e.g., ungulate winter range, wetlands), and vi) climate change impacts leading to reduced ecosystem resilience and ecological integrity (Utzig and Holt 2012; Utzig et al. 2016).

In November 2015, the electorate from Regional District of Central Kootenay (RDCK) Electoral Areas A, D and E (Figure 1) voted to establish the Kootenay Lake Local Conservation Fund (KLLCF). The purpose of the fund is to provide local financial support for relevant projects that will contribute to the conservation values of Kootenay Lake's natural areas, and to restoration and preservation of a healthy environment. Specifically, the intent is to provide funding for local conservation projects that are not the existing priority of federal, provincial or local governments (KLLCF 2015), but which address known threats to priority habitats and dependent species.

This Guidance Document outlines a range of threats to key biodiversity habitat targets identified by the KLLCF as being of specific relevance to the Kootenay Lake region, with a focus on RDCK Electoral Areas A, D and E. In response to the identified threats, priorities and appropriate actions were developed for conservation within Areas A, D and E of the Kootenay Lake region. These will inform the KLLCF Terms of Reference and ensure that funded projects are strategically aligned with identified priorities and actions.

1.1 Project Objectives

This project was designed to address the following key questions regarding the Kootenay Lake area:

1. What is the current status of conservation in the Kootenay Lake area (e.g., information, research, literature review)?
2. What are the key target habitats in the Kootenay Lake area and what percent of these occur on private land?

3. What are the current threats to conservation in the Kootenay Lake area based on the categories within the IUCN Classification Scheme?
4. What are the high priority actions/projects to address these threats?
5. What information gaps exist?

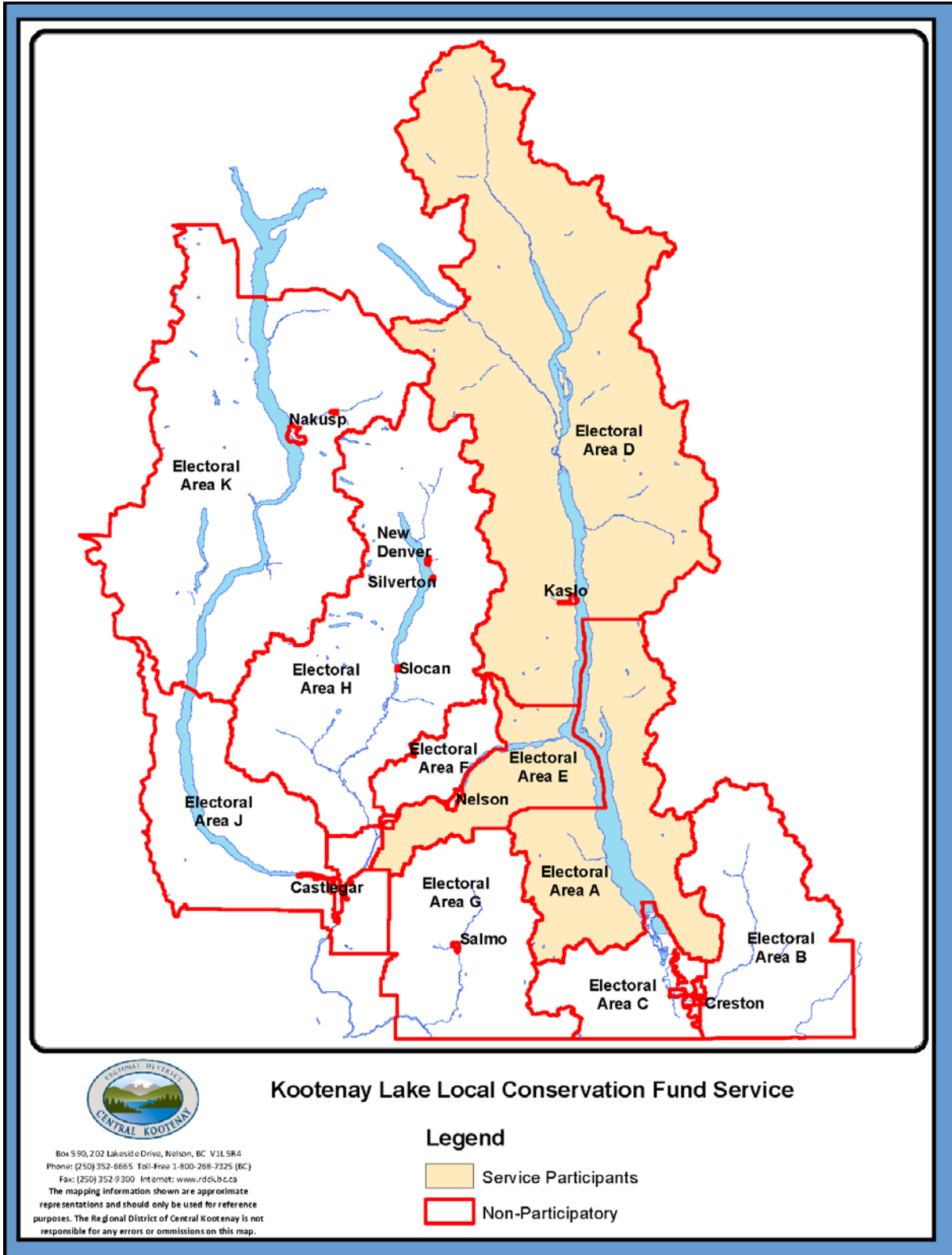


Figure 1: Overview of the Kootenay Lake Local Conservation Guidance Study Area, BC

2.0 STUDY AREA DESCRIPTION

2.1 Overview

The study area includes the following electoral areas and key geographic features (see Figure 1):

Electoral Area A

- Includes the west side of the southern portion of Kootenay Lake and the watersheds of Kutetl Creek (main tributary only), Midge Creek (from the confluence of Kutetl south), Seeman Creek, Laib and Cultus Creeks, Elmo and Next Creeks, and Shaw Creek;
- Includes the east side of Kootenay Lake from Bernard Creek, following the centerline of the lake west to Boswell, south to approximately halfway between Wynndel and Arrow Siding, and eastward to the height of land; and
- Includes all of Lockhart Creek Provincial Park, most of Nature Conservancy Canada (NCC) Darkwoods Conservation Area, and a small portion of both the West Arm and Kianuko Provincial Parks.

Electoral Area D

- Extends eastward to the height of land and north up the east side of Kootenay Lake from the Bernard Creek to the height of land at the top end of the upper Duncan River;
- The western boundary follows the height of land, southward to Outlook Mountain within Kokanee Glacier Provincial Park and then southeast to include the Coffee Creek drainage, joining the lakeshore just south of Coffee Creek Provincial Park; and
- Includes the eastern portion of Goat Range Park, the western portion of Purcell Wilderness Conservancy Park, and the eastern portion of Kokanee Glacier Park.

Electoral Area E

- Includes the west side of Kootenay Lake, from Outlook Mountain, following Kokanee Creek to the West Arm at Longbeach;
- The boundary follows the West Arm, skirting the city limits of Nelson to the south, all the way to Thrums;
- Between South Slocan and Thrums, the boundary follows the western edge of crown land, rather than the West Arm centerline;
- From Thrums, the boundary follows the height of land in a northeasterly direction, generally skirting crown land, until it connects with the Electoral Area A boundary at the top end of Kutetl Creek; and
- Includes most of West Arm Provincial Park as well as a small portion of Kokanee Glacier Park.

2.2 Hydroelectric Developments

The study area has a long history of hydroelectric developments that have shaped the environment and dictated conservation activities. Thus, a brief overview of the hydro-system as it relates to the

study area was included herein. The first dam built (by Cominco/Teck Metals Ltd.) on the Kootenay River system to create water storage was Corra Linn Dam in 1932 and it is located at the outlet of the West Arm of Kootenay Lake. This dam, now owned/operated by FortisBC, is approximately 17 km downstream of the study area, but directly affects water levels in Kootenay Lake. Duncan Dam, located on the lower Duncan River, which flows into the north end of Kootenay Lake, was completed in 1967 and built by BC Hydro as a storage facility under the Columbia River Treaty (1964). There are no power generation facilities at Duncan Dam and the Duncan Lake Reservoir is used to provide storage and downstream flood control as dictated by the Columbia River Treaty (BC Hydro 2007). The reservoir behind Libby Dam (1973, US Corps of Engineers, Montana, US) is Lake Koocanusa that extends approximately 140 km upstream from the dam, 62 km of which is located in BC, but does not fall within the study area. Libby Dam is a major upriver storage dam for the Columbia-Kootenay River hydroelectric system and its reservoir water level fluctuations directly influence conditions in Kootenay Lake. Water levels in Kootenay Lake are regulated by the Boundary Water Treaty (1909) governed by the International Joint Commission (IJC). The rules for regulating Kootenay Lake were set out in an Order of Approval (dated November 11, 1938), which was intended to “provide levels and outflows that would result in generally beneficial conditions without unacceptable adverse effects on any one interest” (Thompson 1981). The IJC Order for storage in Kootenay Lake dictates upper operating limits for the elevations of Kootenay Lake as measured at a gauge installed at Queens Bay on Kootenay Lake.

3.0 CONSERVATION STATUS

Key aquatic and terrestrial locations within the study area as they relate to conservation status and associated activities are further described below.

Kootenay Lake is a significant regional area that supports and provides habitat for regionally important fish species such as Rainbow Trout (*Oncorhynchus mykiss*), Bull Trout (*Salvelinus confluentus*), Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*), Kokanee (*Oncorhynchus nerka*), Burbot (*Lota lota*) and White Sturgeon (*Acipenser transmontanus*). However, the lake has undergone major ecological impacts over the past half century including eutrophication, introduction of non-native fish and invertebrate (i.e., *Mysis relicta*) species, hydro-electric impoundments and subsequent changes to the hydrograph and water quality (i.e., Libby and Duncan dams; Section 2.2). There has also been increased development pressure, especially along the foreshore, which has impacted fish populations and their habitats. Historically, recreation and commercial fisheries have existed in Kootenay Lake for Rainbow Trout, Bull Trout (previously identified as Dolly Varden), Mountain Whitefish (*Prosopium williamsoni*), Burbot, and Kokanee (Andrusak 1986). A recreational fishery for Mountain Whitefish experienced very high catch rates in the late 1960's, but the fishery was soon abandoned, although abundance remained high (Andrusak 1986). A fishery for Burbot also existed, but dramatic declines were observed in the 1970's and the fishery collapsed (see Section 3.1.13 for further details). The Kootenay River White Sturgeon population was also once abundant and represented an important food source for First Nations, but it has also been in decline (see Section 3.1.13 for further details). Recreational fishing effort has been primarily directed at Rainbow Trout (specifically a large piscivorous form known as Gerrards) and Bull Trout (Redfish 2016). Recent estimates indicate that these fisheries support 20,000-40,000 angler days per year and are worth approximately \$5-10 million annually to the local economy (Redfish 2016). Rainbow and Bull Trout are reliant on Kokanee (a keystone species) as their main food source, which also has its own fishery. Dramatic declines in Kokanee abundance (which impact trout species) were observed in the 1970's and more recently in 2012

(Andrusak 1986; Redfish 2016). Efforts to rebuild Kokanee stocks in Kootenay Lake were initiated in 1992 through a lake fertilization program presently being conducted by FWCP/MFLNRORD (e.g., FWCP 2012a; Bassett et al. 2016). Kokanee abundance in the North Arm² improved in the late 1990's through to the early 2000's, based on escapement returns to the Meadow Creek spawning channel (AMEC 2012, 2013), until the 2012 decline was observed (Redfish 2016). More recent efforts to rebuild Kokanee stocks through management of predators and increased Kokanee survival are underway, but it is estimated that full recovery may take up to 12 years (Redfish 2016). Additional information on the status of these species in Kootenay Lake has also been summarized in AMEC et al. (2011) and Redfish (2016).

Duncan-Lardeau River and Meadow Creek Watershed, is located between the Purcell and Selkirk Mountain ranges, and drains into Kootenay Lake. The headwaters of the Duncan River system originate at Mount Dawson, near Glacier National Park where it flows south easterly for 55 km to Duncan Lake Reservoir (herein called Duncan Reservoir) (BC Hydro 2007). Prior to the construction of Duncan Dam in 1967, Duncan Lake divided the upper and lower Duncan Rivers. Duncan Dam was built on the Lower Duncan River by BC Hydro for storage under the Columbia River Treaty, approximately 5 km downstream from the original Duncan Lake outlet and 11 km upstream of Kootenay Lake (BC Hydro 2007). Duncan Dam created an impoundment that flooded Duncan Lake and a portion of the upper Duncan River. The reservoir formed by the dam is approximately 45 km long, 1 to 2.5 km wide with a mean depth of 52 m and maximum depth of 117 m (BC Hydro 2007). There are four main tributaries to the lower Duncan River (the section below Duncan Dam), the largest being the Lardeau River, followed by Hamill Creek, Cooper Creek, and Meadow Creek. The Lardeau River is located approximately 1.3 km downstream of Duncan Dam and is unregulated. The river is headed by Trout Lake and contains several higher gradient tributaries that are prone to debris flows during the freshet (Vonk 2001). Trout Lake is not within the study area. Meadow Creek has the smallest drainage area compared to other lower Duncan River tributaries and its confluence is approximately 6 km downstream of Duncan Dam. Meadow Creek spawning channel is located in the middle reach of the creek. This 3 km spawning channel was funded by BC Hydro and built in 1967 as partial compensation for the loss of Kokanee spawning habitat due to Duncan Dam construction (Redfish Consulting Ltd. 1999). The Duncan-Lardeau River floodplain has the largest low elevation wetland features within the study area and has been identified as a key focal area for the securement, creation and restoration of wetlands and riparian areas. Most of the area is owned privately and floodplain impacts include settlement, small-scale agriculture, mill site development, mining, and transportation corridors (FWCP 2014). In recent decades, the area has experienced a decline in logging with subsequent closure of mills, a decrease in human population, and there are no longer active mines (FWCP 2014). The Nature Trust (TNT) of BC and the Ministry of Environment co-own and manage a complex of ten properties totaling approximately 700 ha, of which approximately 568 ha are in the study area. These properties are managed for the purpose of biodiversity conservation and enhancement (Krebs et al. 2013). Wetland, riparian and forest habitats found on these properties support a number of listed species and have been the focus of various large-scale wetland creation and enhancement efforts over the last decade. Other activities include invasive weed control, vegetation planting, understory brushing to enhance browse, wildlife tree creation using fungal inoculation techniques, nest and bat box installation, turtle artificial nest site construction, amphibian crossing

² Note that three genetically distinct Kokanee stocks were present in Kootenay Lake: North, South and West arms. The South Arm stock is thought to be functionally extinct (e.g., Eriksen et al. 2009).

establishment, as well as various other wildlife and habitat inventory and enhancement efforts (I. Manley, pers. comm., 2018).

Nature Conservancy Canada (NCC) Darkwoods property (referenced herein as Darkwoods) is an approximately 55,000 ha (of which 43,636 ha are in the study area) private land holding that covers an estimated 52.5% and 5.2% of the private and total land comprising the study area. It supports a variety of species and habitats (review in Ennis et al. 2009; Wilson and Field 2011; Page 2013; Irvine 2014 and references therein) across the full elevational gradient of the study area, from valley bottom riparian to alpine ridge tops. It provides critical habitat and vital connectivity for many wide-ranging ungulate and carnivore species, such as Mountain Caribou, Grizzly Bear, Wolverine, Canada Lynx, Mountain Goat, Rocky Mountain Bighorn Sheep, and potentially also American Badger. The area also includes high elevation streams and small to medium sized lakes that provide habitat for native Rainbow Trout and Bull Trout (Irvine 2014; Amec Foster Wheeler 2016a; 2016b). Darkwoods is linked to a number of adjacent protected areas, including **West Arm Provincial Park** (26,199 ha), **Midge Creek Wildlife Management Area** (14,757 ha), **Creston Valley Wildlife Management Area** (6,900 ha just outside the study area), **NCC Frog-Bear – Sirdar Conservation Property** (69 ha). This network of properties creates a protected landscape of approximately 180,000 ha that captures significant portions of a diverse cross-section of ecosystem types found in the South Selkirks Natural Area (Page 2013).

It should be kept in mind that by virtue of its large size, Darkwoods represents 97.7% of private land conservation in the study area, and therefore skews the proportions of total area protected and specific habitat target representation in favour of higher elevation habitats. This is an important caveat to bear in mind when considering the most appropriate conservation actions to address threats acting at different elevations within the overall study area. Another consideration of note regarding Darkwoods is that only primary areas (mapped as zone 1 in the property management plan) are currently exempt from potential harvesting activity (Adrian Leslie, pers. comm., 2018).

Over the years, a variety of conservation activities and actions have been undertaken on the Darkwoods property to improve habitat suitability and condition, including planning and implementation for improved connectivity and fire management; access restrictions; Whitebark pine research, inventory and enhancement; various inventories for sensitive ecosystems and key wildlife habitats, listed plant, fish and wildlife species at risk (SAR), as well as invasive plants. Specific habitat enhancement using mainly silvicultural techniques (e.g., brushing, pruning, spacing) have also been undertaken. In addition, fish passage culvert inspections (Amec Foster Wheeler 2016a) and an evaluation of the feasibility of eradication of non-native fish species (Amec Foster Wheeler 2016b) have also been conducted.

West Arm Conservation Properties, co-owned and managed by TNT of BC and the Ministry of Environment include a complex of seven properties totaling approximately 129 ha along the West Arm of Kootenay Lake between Longbeach Road and Redfish Creek. These lands encompass the Kokanee Creek spawning channel, which receives annual maintenance and invasive weed control efforts (I. Manley, pers. comm., 2018).

Riondel Conservation Property, owned and managed by the Ministry of Environment, includes two properties totaling approximately 103 ha at Riondel.

Six Mile Slough (Conservation Land Agreement) is the only section (179 ha) of the larger Creston Valley Wildlife Management Area (CVWMA) within the study area. It is managed by Ducks

Unlimited mainly for the purpose of migratory waterfowl, shorebird, other waterbird, and upland game bird enhancement. A system of dikes, water control structures, and pumps was constructed in the CVWMA in the early 1970's and the resulting wetland compartments were managed to enhance wildlife during flood and drought cycles, and to prevent habitat losses associated with management of the Kootenay River system for hydro-electric power generation and flood control (Wilson et al. 2004). Water level management maintains a rich diversity of habitat types supporting an estimated 370 vertebrate species (286 bird, 56 mammal, 6 reptile, 6 amphibian and 16 fish) as well as thousands of plant species, invertebrates and other biota, many of which are considered rare or endangered (review in Wilson et al. 2004). Conservation actions undertaken to maintain this biological diversity include: management of water levels and encroaching woody vegetation; control of invasive plant and animal species; vegetation planting/ baiting; nest structure establishment; access management in sensitive areas; and ongoing wildlife research, inventories, monitoring and follow-up targeting a range of listed, sensitive and regionally significant species.

Marsden Face Conservation Properties include six properties (98 ha), co-managed by TNT and FWCP, that are located just outside of the study area boundary. These properties are comprised of riparian, dry open forests, shrublands and rocky habitats (Machmer and Korol 1998). These properties provide important ungulate winter range, as well as dryer riparian and upland habitat for a diversity of SAR. Additional dry mature forested parcels under covenant to Teck Metals Ltd. comprising 25 ha on adjacent private lands, owned by Teck Metals Ltd., (Machmer and Steeger 2006; Machmer 2015) and crown lands (in Grohman Narrows Provincial Park) enhance the size, function, connectivity and species richness of these parcels. Grohman Narrows Provincial Park supports relatively high species richness (Dulisse and Wood 2000; Dulisse 2001) and is an important wildlife corridor for animals to cross over to and from the Bonnington and Kokanee Ranges. Over the last 20 years, various habitat enhancement actions, such as invasive weed control, nest and bat box establishment, wildlife tree creation, nest platform creation, prescribed burning, brushing for browse enhancement, have been conducted to improve habitat condition (I. Manley, pers. comm., 2018).

Rover Creek Covenant Properties are located just outside of the study area boundary and include approximately 133 ha of high value private riparian and upland forested land (including Gold Island) that Teck Metals Ltd. has internal covenants on within the Rover Creek watershed (Machmer et al. 2009; Machmer 2015).

BC Provincial Parks include a number of small sites within the South Arm, main lake and West Arm of Kootenay Lake (i.e., Midge Creek, Drewry Point, Lockhart Beach, Pilot Bay, Coffee Creek, Campbell Bay, Lost Ledge, Davis Creek, Lardeau, Kokanee Creek, and Grohman Narrows) that comprise a portion of Kootenay Lake Provincial Park. These sites generally include camp sites and visitor facilities (e.g., trails, boat launches, picnic grounds) accessed by car and/or boat. Intensive use of these facilities creates potential for conflict between recreational activities (e.g., boating, watersports, dog walking, outdoor recreational vehicle use and mountain biking that contribute to wildlife disturbance and invasive weed spread) and biodiversity protection, particularly for sensitive species and habitats (Holt et al. 1998). Medium to large provincial parks within the study area include Lockhart Creek (3,734 ha), West Arm (26,199 ha), Cody Caves (63 ha), Kokanee Glacier (32,035 ha), and portions of Kianuko (11,638 ha), Goat Range (79,124 ha) and Purcell Wilderness Conservancy (198,116 ha). These parks support a rich diversity of riparian, wetland and upland habitats, but higher elevation forests and subalpine to alpine habitats are

proportionately over-represented, an important point to bear in mind when looking at amounts of land and habitat target protection in sections to follow.

Provincial Wildlife Management Areas (WMA) only include Midge Creek (14,757 ha) within the study area that provides additional valley bottom to high elevation habitat and landscape scale connectivity linking Darkwoods with the West Arm Provincial Park.

Regional Parks

Smaller Regional Parks managed by the RDCK in the plan area include the following:

- Bonnington Regional Park;
- Morning Mountain Regional Park;
- Riondel Regional Park;
- Balfour Beach Regional Park;
- Cottonwood Lake Regional Park;
- Glacier Creek Regional Park;
- James Johnston Regional Park;
- McDonald's Landing Regional Park;
- Taghum Beach Regional Park; and
- Sunshine Bay (Harrop Wetlands) Regional Park.

Wetland enhancement actions and interpretive signage installation have been conducted by the Kootenay Lake Stewardship Society over the last several years, and there is potential for additional wetland creation and enhancement to be undertaken around the Kootenay Lake area (I. Manley, pers. comm., 2018). All of the above parks are generally “multiple use” sites with a variety of infrastructure, trails, parking areas, picnic grounds, and waterfront access. Some are intensively used by the public and there is potential for conflict between human recreational activities and biodiversity conservation, particularly for sensitive species and habitats (e.g., disturbance and mortality by unleashed dogs at Balfour Beach and Harrop Wetlands Regional Parks; Machmer 2018).

In addition to the conservation properties (and associated conservation actions) described above, a number of broader conservation-related initiatives have been undertaken in the Columbia Basin (including the study area), mainly as compensation to address dam impacts, but also more recently to address development impacts and resource use. Some examples are provided below.

- Fish & Wildlife Compensation Program (FWCP) in the Columbia Basin was created in 1995 to coordinate efforts to compensate for fish and wildlife losses associated with BC Hydro projects in the region. An Administrative Agreement was signed in 1999 between the BC Ministry of Environment and BC Hydro to formalize the management of the program, which was developed to satisfy the obligations regarding fish and wildlife attached to the Arrow, Duncan, Mica, Seven Mile and Revelstoke project water licences. The program is delivered as a partnership between BC Hydro, the BC Provincial

Government, Fisheries and Oceans Canada, First Nations and public stakeholders. Programs covered by the FWCP in the study area include:

- Meadow Creek spawning channel is located on a tributary to the lower Duncan River near Meadow Creek, BC and was built in 1967 as compensation for the construction of BC Hydro's Duncan Dam and the corresponding losses from Kootenay Lake's North Arm Kokanee population (FWCP 2012a; AMEC 2012). The Meadow Creek spawning channel is managed by the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (MFLNRORD);
- Kootenay Lake fertilization project (1992 to present) addresses lake productivity losses (and associated Kokanee population impacts) related to hydroelectric developments and conducts water quality monitoring in the main portion of Kootenay Lake;
- A comprehensive program to understand the impact of BC Hydro dams was undertaken in 2005 (see summary by Utzig and Schmidt 2011);
- Action planning for large lakes, small lakes, streams, uplands and drylands, and species of interest (FWCP 2012a; 2017b; 2017c; 2017d; 2017e; and FWCP 2014, respectively) have been developed and help to address hydroelectric impacts associated with Duncan Dam in the study area. The FWCP funds conservation actions related to these action plans;
- Redfish and Kokanee spawning channels are located in the West Arm of Kootenay Lake near Balfour, BC and were built in the early 1980's in response to habitat deterioration and declining numbers of West Arm Kokanee (Redfish 1999). Both spawning channels are managed by the MFLNRORD;
- BC Hydro Water Licensing Requirements (WLR) studies were initiated in 2008 include studies conducted to address fish and wildlife impacts associated with Duncan Dam: https://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/duncan_dam.html (Accessed 13 April 2018);
- Columbia Basin Trust (CBT) Environment Grants Program funds a variety of conservation, enhancement and restoration actions focused on ecosystems and/or species of conservation concern, climate change adaptation, water resources and environmental education and awareness; and
- Kootenay Lake Shoreline Management Guidelines were developed in 2017 to clarify and streamline land use decision-making processes between different agencies, proponents and stakeholders as they relate to riparian, fish and fish habitat and include archaeological and Ktunaxa cultural values (KNC et al. 2017).

3.1 KCLLF Habitat Targets

Ten terrestrial and aquatic habitat targets, including those listed in the KLLCF Terms of Reference (2015) are key components of local ecosystem/habitat diversity within the study area. A high level overview for each of these habitat targets is provided below. Further details can also be obtained from the key literature cited within each habitat target, as well as additional references identified in Appendix A, Table A1. Whitebark pine ecosystems were not included in the list of priority habitat targets, given the over-representation of high elevation habitats in Darkwoods and other high elevation protected areas within the study area. Greater emphasis was placed on low to mid-elevation ecosystems that are at highest risk based on varied threats acting in the Interior Cedar

Hemlock (ICH) forest. Whitebark pine ecosystems would nevertheless emerge as a higher priority if our recommendation to explicitly include listed plants and ecological communities (in addition to vertebrates) in the evaluation of rare entities in the study area; however it was beyond the scope of this project to include this ecosystem.

3.1.1 Connectivity Habitat

Habitat connectivity is considered to be one of the most important factors required to preserve biological diversity, by maintaining dispersal, gene flow, and local adaptation to environmental changes (Hodgson et al. 2009). Connectivity can be loosely defined as “the degree to which the landscape facilitates or impedes movement between resource patches” and it must be assessed at the appropriate scale of interaction between an organism and its habitat (Taylor et al. 1993; D’Eon et al. 2002). Wide-ranging species with dispersed resource and/or reproductive needs (e.g., Mountain Caribou, Grizzly Bear, Wolverine, and Bull Trout) must shift habitats seasonally, and require landscape scale connectivity and linkage corridors between core use areas. Other species may maintain relatively large, contiguous home ranges year-round that satisfy their needs (e.g., Northern Goshawk using large tracts of old and mature forest). Populations of less mobile species (e.g., some reptiles, amphibians, small mammals and small-bodied fish) occupy small home ranges and are especially sensitive to habitat loss, if individuals cannot move to suitable replacement habitat nearby. Increasing development (e.g., urbanization, forestry, roads, linear corridors) is progressively fragmenting suitable habitats and maintaining connectivity at appropriate scales to permit dispersal is key, especially for populations already at risk. The importance of connectivity habitat and linkage zones is magnified as species abundances, spatial distributions, and ecological networks (e.g., food webs, predator-prey relations, host-parasite webs) shift in response to climate change (Thompson and Gonzalez 2017).

Aquatic connectivity habitat allows for unimpeded seasonal or annual aquatic movements and migrations between lake, river and tributary stream habitats to meet spawning, feeding, overwintering and thermal requirements. Topographical or physical barriers to fish movement/migration typically comprise either natural barriers (e.g., waterfalls, chutes, cascades, canyons, beaver and debris dams), reaches with gradients >20% (BC Ministry of Forests 1998) or unnatural barriers (including culverts, dams and other human-made structures). Aquatic connectivity can also be impacted by water quantity, such that low stream flows (or flows that go subsurface) can inhibit movements and migrations (e.g., low summer stream flows preventing access to Kootenay Lake tributary spawning areas in fall for Kokanee and Bull Trout). Climate change may further reduce snowpack and exacerbate low stream flows (CBT 2017).

3.1.2 Hydro-Riparian Systems (Large, Medium, Small)

The critical importance of riparian habitat for the conservation of ecosystem structure, function and biodiversity is well-acknowledged and has been extensively reviewed in a general context (e.g., Gregory et al. 1991), and with respect to the Columbia River Basin in particular (review in Johnson and O’ Neil 2001). The riparian zone is the area immediately adjacent to the foreshore and is critical to the maintenance of a healthy aquatic environment. Riparian zones have a direct influence on aquatic habitat values and are considered fish habitat. The productivity of aquatic and riparian habitat is intertwined by reciprocal exchanges of material and therefore is directly important for healthy fish stocks (e.g., Naiman and Latterell 2005). Riparian areas also protect shoreline areas from erosion, provide nutrient inputs, provide high value habitat used by a disproportionate number of wildlife species, and can provide cover for nearshore and stream-

dwelling fish species. The balance of life in these hydro-riparian areas is very sensitive, as the relationship between different environments develops slowly and any modifications can negatively impact this area. When these areas are developed, it changes the capacity of the land to transport water and nutrients to the waterway. Changing the hydro-riparian and nearshore environment from a pervious and absorptive substrate to a more impervious landscape (i.e., roads, buildings, and pastures) removes the natural water filtering mechanism of the soil column, reducing water storage ability and water quality in drainage bodies (Booth et al. 2002 as cited in AMEC 2009). Land development within hydro-riparian areas including the foreshore may include dredging the foreshore for docks and boat ramps, addition of large angular boulders to build groynes and/or boat basins, the removal of important riparian vegetation for land clearing to build homes, removal of natural shoreline substrates so landowners can have sandy beaches, deposition of deleterious substances into the lake via direct sewage releases, and the hardening of the shoreline where retaining walls protect homes that are built too close to the natural high water mark. Additionally, private land owners are developing accretions (where soil is gradually deposited on the shore of a body of water, the land so formed belongs to the riparian owner on whose property the deposit is formed), that are usually in sensitive areas such as near the confluence of rivers and are within the allowable hydroelectric operational zone for Kootenay Lake. These development changes, in turn, potentially impact fish and wildlife. Development issues within the hydro-riparian/foreshore areas of Kootenay Lake are further discussed in AMEC et al. (2011) and Ecoscape (2016).

3.1.3 Wetlands

Wetland habitats are known to be highly productive, perform essential hydrological and biogeochemical functions, and support a disproportionate number of listed species (reviews in Mitch and Gosselink 1993; Nolan and Jeffries 1996). Wetlands represent critical breeding, rearing, feeding and staging habitats for many species of fish, wildlife and other biota (reviews in Johnson and O'Neil 2001; Steeger et al. 2001; Machmer et al. 2004) and the progressive loss and conversion of wetlands has become a key conservation issue.

3.1.4 Fish Habitat

Fish habitat can be defined as spawning grounds, nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly in order to carry out their life processes. In other words, the habitats include not only the water in rivers, lakes, streams and wetlands, but also the quality of that water and the total surroundings in which plants and other life forms interact to make fish life possible. Thirty native fish species and seven non-native fish species (Section 4.2.4) that rely on fish habitats within Kootenay Lake and its tributaries, as well as in wetlands and small to medium-sized (up to 1000 ha) lakes located within the study area. These areas provide fish and other aquatic organisms areas to carry out their life processes, including spawning (e.g., gravel substrates for Kokanee and Bull Trout), larval rearing (e.g., shallow, low flow areas), and feeding (e.g., access to food sources including plankton, aquatic invertebrates and small forage fish). Large tributaries (≥ 20 m in width; Section 4.2.2) in the study area (e.g., Duncan and Lardeau rivers) also contribute to water quality and quantity in Kootenay Lake (see also AMEC et al. 2011). Water quality and quantity in medium and small streams varies by system, but many are experiencing an increased demand for water resources due to increased development pressure in the study area (AMEC et al. 2011) and from climate change (CBT 2017). Many of these systems rely on sustained snowpack and experience reduced late summer stream flows. Reduced stream flows can impact fish and fish habitat by reducing habitat availability and suitability (i.e., width, depth, velocity) thus impacting critical life stage processes and food resources.

3.1.5 Old Growth Moist Interior Cedar-Hemlock Forests

Old growth forests and their associated stand characteristics and structures (e.g., multi-layered canopies with canopy gaps; large veteran trees, snags, woody debris, upturned root wads with pits and mounds providing varied topography; abundant lichens, mosses, epiphytes, fungi) are known to support high levels of biodiversity. They provide interior forest habitat conditions for a variety of plants and animals requiring a stable microclimate (with respect to temperature, relative humidity, wind, etc.) including a number of listed species (Johnson and O'Neil 2001; Steeger et al. 2001). Old growth forests are also important for water and nutrient cycling, they store vast amounts of carbon and are therefore critical for mitigating the effects of climate change (McGarvey et al. 2015).

Moist warm ICH ecosystems found adjacent to Kootenay Lake include the ICHmw2 and ICHmw4 biogeoclimatic subzones/variants, both characterized by stand-replacing fires, but with mixed-severity fire regimes common on warmer aspects at lower elevations. Warm, moist summers and cool to mild moist winters with persistent moderate snowpacks (which prevent soils from freezing to significant depth) prevail in these ecosystems. The moist ICH is highly productive and supports an abundance and diversity of wildlife species, most notably species associated with older forests (MacKillop and Ehman 2016).

3.1.6 Dry Interior Cedar-Hemlock Forests

Dry Interior Cedar Hemlock ecosystems found adjacent to Kootenay Lake in the study area include the very dry ICHxw and the dry ICHdw1 biogeoclimatic subzones/variants. Both are considered fire-maintained, but the ICHxw is typically characterised by frequent, low severity fires whereas most aspects of the ICHdw1 have a mixed-severity fire regime. Hot, dry summers and mild, dry winters with shallow snowpacks prevail in the ICHdw1; conditions in the ICHxw are slightly hotter and dryer, with less snowfall (MacKillop and Ehman 2016). Dry ICH ecosystems support a mosaic of riparian, wetland, forest and brushland plant communities with very high levels of biodiversity and disproportionate numbers of listed species (MacKillop and Ehman 2016).

3.1.7 Karst (Hot and Cold Springs)

Karst is defined as “a distinctive group of landforms that results from the dissolving action of water on soluble bedrock (usually limestone, dolomite, marble or gypsum) which produces a landscape characterised by features such as epikarst, vertical shafts, sinkholes, sinking streams, springs, complex subsurface drainage systems, and caves.” (BC Ministry of Forests 2003). Karst ecosystems often support endemic, unusual, or rare plant and animal species, both on the surface and underground (BC Ministry of Forests 1997, 2003). Certain species of ferns and mosses prefer or, in some cases, require a limestone substrate on which to grow, and many wildlife species use karst habitat. Caves can be karst and their stable environments can be critically important habitat for bat species that depend on them for roosting and hibernation as well as snakes and other reptiles that use them for hibernaculum. Caves are used intermittently by large carnivores for shelter or resting, and birds and small mammals often nest in caves and other cavities. Ungulates commonly bed down in the vicinity of cave entrances during summer when the air from caves is cooler, and during the winter when cave air is generally warmer than surrounding temperatures (BC Ministry of Forests 1997).

Groundwater in karst aquifers can represent a significant source of drinking water, and karst systems act as natural sinks for carbon dioxide, thus helping to mitigate impacts of climate change (Forti 2015). Karst and caves were used for shelter, and as sacred places for burial and ceremonial purposes by some First Nations in BC (BC Ministry of Forests 1997). First Nations in the study area continue to value karst for ancestral, heritage, and cultural reasons (C. Conroy, pers. comm., 2018). The extent and significance of karst in the Interior of BC is not well understood (BC Ministry of Forests 1997). Isolated locations, limited ground access, and extreme winter climates have made the exploration and documentation of interior karst lands more difficult than those on the coast. The only karst features our team was aware of include (a) the caves and sinkholes present around Cody Caves Provincial Park, (b) the various caves near Heart Lake and Mt. Bulmer, and (3) tufa deposits in various locations along the north end of Kootenay Lake³. There is a reluctance to discuss specific karst locations due to concerns regarding degradation of pristine sites (J. Pollack, pers. comm., 2018).

3.1.8 Brushlands and Grasslands

Brushlands are shrub-dominated ecosystems which typically occur in dry to moist climates on warm, dry insulated sites which have rubbly, coarse-textured soils (generally rockier and shallower than those of grassland sites; MacKillop and Ehman 2016). They are often found in a mosaic with other ecosystems, including dry, open forests, rock outcrops, and potentially also grasslands. Brushlands provide important structural diversity, as well as cover, feeding, nesting, and roosting habitat for ungulates, herptiles, birds, small mammals and invertebrates. Brushlands are important habitats for a diversity of listed wildlife species in the study area that are most commonly found in the ICHxw and warm aspects of the ICHdw1. Fire suppression has reduced brushland abundance and distribution, since fire is an important process for maintaining these sites. Many brushland sites are degraded, because of their susceptibility to weed invasion.

True grassland sites are extremely uncommon in the study area and based on mapping, none were confirmed in the ICH subzones/variants of focal interest for this project (although alpine grasslands are present in the Engelmann Spruce – Subalpine Fir zone; MacKillop and Ehman 2016). Partially treed grasslands were more abundant on steep south aspects at lower elevations, but they have been lost due to fire suppression.

3.1.9 Cottonwood-dominated Floodplain

The cottonwood-dominated floodplain was added as a habitat target, because of its documented importance for browsers, wildlife tree-dependent birds and mammals (e.g., cavity and open nesters, as well as roosting, denning and perching species; Egan et al. 1997; Jamieson and Braatne 2001; Naimon et al. 2005; Fenger et al. 2006), as well as amphibians and reptiles seeking cover, moisture, and food. It also provides important riparian vegetation cover for fish habitat (e.g., shade, large woody debris and food resource inputs). Cottonwood floodplains support a diverse assemblage of invertebrates (e.g., shade-loving flies, moths, wood-boring beetles) that attract consumers, and they provide ideal travel corridors through lowland areas (Egan et al. 1997). Their distribution and regeneration potential has been heavily impacted by dams and water level regulation (Utzig and Schmidt 2011). Cottonwood dominated riparian communities are rare in areas where they were previously common, such as river confluences and outlets. This is likely

³ A tufa deposit (meteocone travertine) is material that results where highly calcareous springs emerge and the water evaporates, leaving tufa behind. They are not displayed on the Karst map.

due to a reduction in flooding following river regulation and removal associated with development. Cottonwood dominated floodplain areas that still remain (along foreshore areas of West Arm Provincial Park and the Kootenay River delta near Creston) are limited and are likely under duress, due to lack of seasonal flooding (Holt and Machmer 2005).”

The cottonwood-dominated floodplain corresponds roughly to the middle bench [Fm] flood ecosystem class, as described in MacKillop and Ehman (2016). Middle bench ecosystems occur along lakes, streams and rivers on sites that are briefly (10-25 days) flooded during freshet, which allows for tree growth, but forests are dominated by flood-tolerant broadleaf species (i.e., mainly black cottonwood, with some trembling aspen and conifers mixed in). Soils on cottonwood-dominated floodplains have some horizon development.

3.1.10 Shrub and Herb-dominated Floodplain

Shrub and herb-dominated floodplain ecosystems are important to a range of aquatic and terrestrial species, including fish, amphibians, furbearers, small mammals, bats, waterfowl, shorebirds, and other water bird species. They have been profoundly impacted by dams and continue to be affected by flow regulation, so a decision was made to include them, even in the absence of current mapping.

Shrub and herb-dominated floodplain ecosystems include both the low bench [Fl] and active channel [Fa] flood ecosystem classes described in MacKillop and Ehman (2016). Low bench sites are adjacent to permanent streams and rivers and are flooded for moderate periods, with shrub-dominated cover (willows and alders), and limited soil horizon development. Active channel sites have sparse shrub or herb-dominated cover with limited soil horizon development. These sites have only recently been described (Mackillop and Ehman 2016) and there is currently no reliable source of mapping available for the study area (D. MacKillop. pers. comm., 2018).

3.1.11 Vertebrate Species At Risk

The Conservation Data Centre (CDC) assesses the level that BC species or ecological communities are at risk of being lost and assigns Conservation Status Rankings⁴ accordingly, to help set out conservation priorities. Based on these rankings, the CDC also assigns species and ecosystems to red, blue or yellow lists to provide a simplified view of the status of BC's species and ecosystems. These lists also help to identify species and ecosystems that can be considered for federal designation as "Endangered" or "Threatened." by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

3.1.12 Terrestrial Species At Risk

A total of 48 terrestrial vertebrate SAR (3 amphibians, 3 reptiles, 31 birds, and 11 mammals) occur in the Kootenay Lake “region”, but only 42 of these species (2 amphibians, 3 reptiles, 28 birds, and 9 mammals) are confirmed within the study area, as currently defined by electoral areas A, D and E (see Appendix A, Table A4). Information summarising the biogeoclimatic zones and habitat

⁴ Conservation Status Rankings are described in detail at:
<https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/status-ranks>.

subtypes they are found in, habitat target use, diet, and other relevant comments regarding applicable recovery and management plans are summarised in Appendix A, A4.

3.1.13 Aquatic Species At Risk

Four fish species at risk have been identified within the study area including Bull Trout, Westslope Cutthroat Trout, Burbot and White Sturgeon (Appendix A, Table A4). Additional information is provided below for each of these species as related to this program because they are fewer in number compared to terrestrial SAR (Section 3.1.12). Kokanee is a regionally important species (not SAR-listed) and population status has been described in Section 3.0 and important spawning habitats for this species were included under Hydro-Riparian Systems (Section 3.1.2) and Fish Habitat targets (Section 3.1.4).

Adfluvial Bull Trout are provincially blue-listed and within the study area they reside primarily in Kootenay Lake and Duncan Reservoir. However, they migrate into steeper tributaries to spawn and it is these migratory and spawning stream habitats on private lands that may be vulnerable to certain activities (Andrusak and Andrusak 2012). Westslope Cutthroat Trout are also provincially blue-listed. They are present primarily in streams and small lakes throughout the study area where they are primarily year-round residents likely making only small spawning migrations into lake inlet/outlet streams to spawn. There are a few (<5) observations in the West Arm of Kootenay Lake, although no recorded observations exist for the main body of Kootenay Lake or Duncan Reservoir (COSEWIC 2016). Stocking records suggest the majority of streams (90%) in the West Kootenay contain native Westslope Cutthroat Trout populations while half of the small lakes have naturally occurring populations and the other half are introduced/stocked populations (COSEWIC 2016). Additional details for Bull Trout and Westslope Cutthroat Trout were also provided in Section 3.1.4).

Burbot are provincially red-listed, reside primarily in Kootenay Lake and Duncan Reservoir in deeper habitats, but also use the Lardeau and lower Duncan Rivers (see AMEC 2015). Burbot once provided an important sport and commercial fishery in Kootenay Lake with an estimated annual harvest of up to 26,000 fish from the West Arm (Martin 1976). Some angling also occurred at the north end of Kootenay Lake in the vicinity of the Duncan River delta (Redfish Consulting 1998). In the 1970's, dramatic declines in the Kootenay Lake/Kootenai⁵ River Burbot population occurred. This eventually led to a collapse of the fishery and listing of the population in BC (Red-listed by the CDC) and in Idaho, (Endangered in USA). Although some Burbot spawning is still occasionally observed in the Goat River near Creston, BC, and in the Kootenai River at Bonners Ferry, Idaho, spawning masses of Burbot once observed at Balfour are no longer present (Paragamian et al. 2005). The collapse of the Kootenay Lake/Kootenai River Burbot population most likely resulted from unsustainable harvest rates, spawning stream habitat degradation, a reduction in juvenile Burbot food due to introduction of mysids (*Mysis relicta*), and impoundment of the Duncan and Kootenay rivers by Duncan and Libby dams (Spence 1999; Ahrens and Korman 2002). Currently MFLNRORD are working with US government agencies for the recovery of the Kootenay Lake Burbot population (e.g., Neufeld 2006).

The Kootenay River White Sturgeon population is provincially red-listed and listed under the federal Species-At-Risk-Act (SARA) as Endangered (Schedule 1 - 2006). This population was once abundant and Ktunaxa Nation elders have historically observed juveniles in seasonally

⁵ Kootenay River is referenced in Canada, whereas Kootenai River is used in the US portion of the river.

flooded wetland areas in Indian Creek near its confluence with the Goat and Kootenay rivers (Ptolemy and Vennesland 2003). The Kootenay River White Sturgeon population was in decline prior to the construction of Libby Dam (1972) presumably due to habitat alterations such as dyking, but more consistent recruitment failures occurred after completion of the dam (Paragamian et al. 2005; Apperson and Anders 1991). Changes in the hydrograph (flow and sediment transfer) from the construction and operation of Libby Dam have been postulated as a main factor for the decline. Historical observations and angler reports from BC indicated that areas with abundant White Sturgeon included the the confluence of the Kootenay River with Duck Lake and Summit Creek, near Creston, BC; sturgeon were numerous and weighed up to 350 lbs (Prince 2001). Also, the delta near Kuskonook Creek was the single most productive area for anglers when there was an active fishery (AMEC et al. 2011). Federally protected critical habitat areas for White Sturgeon in Kootenay Lake have been designated under SARA within delta areas of Kootenay Lake, Duncan River and Crawford Creek (Fisheries & Oceans 2014). White Sturgeon may also occasionally use the West Arm of Kootenay Lake, but critical habitat areas have not been designated because use is low/sporadic (R.L. & L. Environmental Services 1999; Stevenson and Evans 2016).

4.0 METHODS AND INFORMATION SOURCES

The following sections provide a description of the methods used to meet the project objectives.

4.1 Literature Review and Gap Analysis

A literature review was conducted to help inform the evaluation of current conservation status and actions underway in the study area as well as existing and future threats relevant to the main conservation targets and data gaps (Section 2.0). Additional habitat targets that were not identified in the KLLCF Terms of Reference (2015) were added, if applicable based on this review. Information was compiled from online searches of government, public and research-related sites. References reviewed for this program were compiled and those not cited within the main document are summarized in Appendix A, Table A1. Interviews were also conducted with researchers, government agents, and technical experts where required. Individuals interviewed during this review are presented in the Acknowledgements section of this document and their personal communications are listed throughout the document where applicable. Baseline GIS layers that were reviewed for this program are listed in Appendix A, Table A2.

The literature review also compiled relevant information on traditional knowledge available in previous reports for Kootenay Lake, where applicable. Team members have also worked with the Ktunaxa Nation Council (KNC) and familiarity with KNC priorities and perspectives on stewardship of “All Living Things” was helpful for this task. Representatives of the KNC Lands and Resources Agency were also contacted to discuss their conservation priorities.

4.2 Summary and Mapping of Habitat Targets

Terrestrial and aquatic habitat targets as listed in the KLLCF Terms of Reference (2015) were reviewed and additional targets were added as appropriate, based on our literature review and gap analysis. The following ten targets were found to be key components of local ecosystem/habitat diversity in the study area, and were therefore included for further evaluation.

4.2.1 Connectivity Habitat

For this project, landscape-level regional connectivity and linkage zones in the Central and Southern Columbia Mountains were mapped at a broad regional scale for the study area, based on the outputs from Conservation Planning Reports for several regional landscapes (Appendix B, Figure B1; Utzig and Holt 2014, 2015). This involved a synthesis of existing protected land (parks, protected areas, conservation properties and Mountain Caribou reserves), which was coupled with proposed Grizzly Bear core and linkage zones and reserves (Proctor et al. 2015), as well as other conservation and linkage areas (Appendix B, Figure B1). More localized finer scale connectivity was not considered, other than trying to incorporate known biodiversity hotspots and/or key linkage zones (based on information from local biologists and studies) into larger regional corridors and conservation areas, to the extent possible. The Fish/Bear Lakes and the Argenta wetlands adjacent to Highway 31A and 31, respectively, Grohman wetlands adjacent to Highway 3A, and Creston Valley wetlands adjacent to Highway 3A are all examples of localized hotspots where animal migration has resulted in high roadkill mortality (e.g., Western Toads, Painted Turtles; McCrory and Mahr 2016; J. Dulisse, pers. comm., 2018; Machmer, pers. obs.).

Mapping of both natural fish movement/migration barriers (e.g., waterfalls, chutes, cascades, canyons, beaver and debris dams, reaches with gradients >20% (BC Ministry of Forests 1998) and obstacles (including culverts, dams and other human-made structures) was completed for the study area (Appendix B, Figure B2), based on the DataBC Warehouse (Fish.PSCIS_Assessment_SVW). It was not possible to evaluate aquatic connectivity issues associated with water quantity, such as low stream flows (or flows that go subsurface) that can also inhibit fish movements and migrations (Section 3.1.1).

4.2.2 Hydro-Riparian Systems (Large, Medium, Small)

For this project, hydro-riparian systems were defined as large, medium or small, according to the BC Riparian Management Guidebook (1995) that provides stream classification rules. Table 1 provides a comparison of the BC Riparian Stream Classification system and how these were defined for this program.

Table 1: Definition of large, medium and small hydro-riparian system

BC Riparian Stream Classification System	KLLCF TOR Definition
S1 streams - ≥ 20 m width	Large
S2 streams - $\geq 5 - 20$ m	Medium
S3 streams - 1.5 – 5 m	Small
S4 streams - < 1.5 m and fish bearing	Small
S5 streams - > 3 m but non-fish-bearing	Small
S6 streams - ≤ 3 m but non-fish-bearing	Small

Consistent with the Hydro-riparian Planning Guide (2004), a 200 m buffer was added to each side of mapped stream features (for a total width of 400 m considering both sides of a stream (see Appendix B, Figure B3); this was conducted for all classes of streams. BC Riparian Management Guidebook (1995) rules were also used to define lakes into the following three classes for mapping purposes (Appendix B, Figure B3): large lakes/reservoirs - $> 1,000$ ha (e.g., Kootenay/Duncan); medium lakes - > 5 ha; and, small lakes - ≤ 5 ha.

4.2.3 Wetlands

Wetlands identified within Predictive Ecosystem Mapping (PEM) available for the Kootenay Lake Forest District are defined according to the five wetland classes (i.e., marsh, shallow open water, fen, bog, swamp) identified in McKenzie and Moran (2004). Some portions of the study area did not have PEM data available, so TRIM wetlands (which are not classified) were substituted for these areas. All classes were pooled together for mapping purposes (Appendix B, Figure B4).

4.2.4 Fish Habitat

The spatial distribution of native and non-native fish species was evaluated for stream, lake and wetland habitats. A list of native and non-native fish species was compiled for the study area and is provided in Appendix A, Table A3. Known fish observation data points were added to fish habitat base maps. Due to the limitations of the GIS data available, fish bearing status had to be inferred along the entire length of a stream based on fish observation data points. This may bias the results because some streams may not be fish bearing along their entire length. Fish-bearing streams were added to Hydro-Riparian maps (Appendix B, Figure B3). Fish habitats were also assumed to be included within the hydro-riparian systems habitat target (Section 4.2.2).

4.2.5 Old Growth Moist Interior Cedar-Hemlock Forests

Only old forest (structural stage 7) polygons in the ICHmw2 and ICHmw4 were used to define and map old growth moist ICH forests. Their identification was based on the latest 2015 Kootenay Lake Forest District Predictive Ecosystem (PEM) coverage. Given the apparent lack of old forest left in the moist ICH, a decision was made to also map mature forest (structural stage 6). This was done in order to comment on potential future recruitment of old forest (assuming that some of these polygons would not be lost to wildfire, insects, diseases, harvesting, development, or other threats before attaining old age). For ease of viewing and interpretation, first a map of all ICH biogeoclimatic subzone/variants in the study area was produced (Appendix B, Figure B5). Secondly, a map of old and mature forests was overlaid on these ICH units (Appendix B, Figure B6). This permitted evaluation of the amount of old forest in the moist ICH, as well as in the dry ICH (see below), which was felt to also be important.

4.2.6 Dry Interior Cedar-Hemlock Forests

Dry ICH forest includes all structural stages (1-7) of the ICHdw1 and ICHxw biogeoclimatic subzones/variants located adjacent to Kootenay Lake in the study area. Identification of these habitats was based on 2015 Kootenay Lake Forest District Predictive Ecosystem (PEM) coverage. A map of all ICH units in the study area clearly identifies the dry ICHdw1 and ICHxw (Appendix B, Figure B5). A map of old and mature forests was overlaid (Appendix B, Figure B6), which permitted evaluation of the amount of old (and recruitment mature) forest in the dry ICH units. The latter was deemed important based on an analysis of old forest (and associated structure) use by vertebrate SAR in the dry ICH.

4.2.7 Karst (Hot and Cold Springs)

There is no verified source of karst mapping available for the study area. To identify potential karst values, the BC government “Karst-Likelihood” mapping layer (WHSE_LAND_USE_PLANNING.RKPM_KARST_POTENTIAL_AREA_SP 2011) was used (Appendix B, Figure B6). This layer

rates karst potential based on the following three classes of % soluble bedrock (Appendix B, Figure B7): Primary = >50%; Secondary = 20-49%; and, Tertiary = 5-19%.

4.2.8 Brushlands and Grasslands

Mapping included all “brushland” polygons in ICH biogeoclimatic subzones/variants of the study area, based on 2015 Kootenay Lake Forest District Predictive Ecosystem (PEM) coverage (Appendix B, Figure B8).

4.2.9 Cottonwood-dominated Floodplain

Two approaches were used to map cottonwood-dominated floodplains: (1) a “cottonwood floodplain” layer was used, based on 2015 Kootenay Lake Forest District Predictive Ecosystem (PEM) coverage, and (2) a deciduous mapping product developed by Jamieson (2010) for a FWCP study focusing on deciduous stands in the Columbia Basin was used (only polygons with >40% black cottonwood were used for mapping) (Appendix B, Figure B9). These coverages were compared for extent and accuracy, and based on differences observed, a decision was made to consider both coverage sources for the purpose of calculating the amount of cottonwood-dominated floodplain.

4.2.10 Shrub and Herb-dominated Floodplain

As outlined in Section 3.1.10, shrub and herb-dominated floodplain sites have only recently been described in Mackillop and Ehman (2016). There is currently no reliable source of mapping available for the study area (D. MacKillop. pers. comm., 2018) and thus shrub and herb-dominated floodplains could not be included in further quantitative analyses.

4.2.11 Vertebrate Species At-Risk

Mapping the distributions of all individual terrestrial and aquatic SAR occurrences and evaluating threats and actions site-specifically was beyond the scope of this report. However, impacts of particular threats on vertebrate SAR were inferred, based on an analysis of SAR associations with the mapped habitat targets (Appendix A; Table A4). This analysis considered federally or provincially listed terrestrial and aquatic vertebrates that have some potential to occur in the study area (52 species total; 48 terrestrial and 4 fish species). Likelihood of occurrence was determined as broadly as possible (by including resident species, breeders, seasonal migrants, non-breeders, and periodic transients), although only 46 species (42 terrestrial and 4 fish species) are confirmed in the study area, as defined by electoral areas A, D and E (see Appendix A, A4). This information was compiled based on available information from the BC Conservation Data Centre (CDC), the Species Inventory Database (SPI), the BC Breeding Bird Atlas (BBA), the Columbia Basin Database for Wildlife Habitat Relationships (Steeger et al. 2001), information recently compiled by a team member (Marlene Machmer) for the 2016 Land Management Handbook #70 (MacKillop and Ehman 2016), site-specific knowledge of fish and wildlife use in the study area, and a summary of data from various field guides and studies.

For all potentially occurring vertebrate species, use of each habitat target was evaluated (based on interpretation of habitat use information compiled from the sources above) and qualified, where information was available. For the purpose of evaluating potential SAR use of old moist ICH habitat, species use of moist ICH was determined first, and then the subset of species using old

forest habitat and associated old structure (i.e., large veteran trees, snags, coarse woody debris, etc.) was considered. It became obvious during the information compilation that old forest structure was an important habitat component in the dry ICH as well, so the very same approach was used to address SAR use of the dry ICH, and old forest structures nested within. There was limited information available on the occurrence of karst or the use and dependency of SAR on karst habitat *per se*. Therefore, documented use of a broader range of rock-dominated features (e.g., caves, cliffs, rock outcrops, waterfalls, springs, seeps, sinkholes, talus) was compiled and used to infer likely use of karst features.

A list of other provincially and/or federally listed species (invertebrates, plants) and plant communities with potential to occur in the Kootenay Lake Forest District was compiled, based only on information from the CDC database (Appendix A, Tables A5 and A6, respectively). These species were not analysed with respect to the ten habitat targets (although their use of “habitat subtypes” is indicated in the tables), but they were included for reference in relation to the section on information gaps and needs.

Additional analysis was also completed for two provincially blue-listed fish species in the study area: Bull Trout spawning habitats; and, Westslope Cutthroat Trout resident habitats. The spatial distribution was estimated for stream habitats where both these species have been identified. Other fish SAR in the study area include White Sturgeon and Burbot. Further analysis was not included for these species because they are found mainly in Kootenay Lake and larger rivers within the study area and these habitats were included under the Fish Habitat target review (Section 4.2.4).

4.2.12 GIS Mapping

Nine of ten priority habitat targets identified to be of conservation concern were mapped, as detailed in the previous section. Data layers were gathered from various sources, including Regional Forest Ecologist databases, Data BC data catalogue, Fish and Wildlife Conservation Program data warehouse, and from individual research projects completed by members of our team (for connectivity and cottonwood floodplain). The cadastral data used was provided by the RDCK (Tom Dool). The ownership values of the feature class called “Cadastre Master” were grouped in order to create area reports based on “Crown” versus “Private” land. There are five broad types of ownership in this data:

- Fee simple – includes strata and land share as well as fee simple;
- Crown – includes federal parks/reserves as well as “not surveyed” crown;
- RDCK – includes ball parks, vacant residential land, community halls, etc.;
- Municipal – airports, graveyards, etc.; and
- No ownership code.

Much of the land base has no ownership codes (i.e., it is not surveyed), so it was given the value of Crown land. Two groupings were created based on:

- CROWN – Crown and no ownership code; and
- FEE SIMPLE – fee simple, RDCK, and Municipal.

Lumping the RDCK and Municipal lands together with fee simple was deemed appropriate because the majority of land is not raw; it has been developed and utilized in some way⁶.

The large waterbodies (Kootenay Lake and the Duncan Reservoir) were removed from all analyses in order to create a standard approach for area analysis, as several of the layers used were either mapped without including these boundaries at all (i.e., biogeoclimatic zones) or the boundaries extended out beyond the shoreline (i.e., cadastral data). The large waterbody boundaries were also used in the creation of the buffer for large hydro-riparian areas.

RDCK cadastral information and land ownership information was overlaid on each type of target data, and a GIS analysis was completed to calculate and summarize the area (ha) and percentage of priority habitat targets found on private versus crown land. The same GIS approach was used to calculate protected area (ha), defined as parks on crown land and conservation properties on private/local government land, and summarize proportion of the land base of each habitat target that is protected on private versus crown land. This information was summarized into tables, appendices, and maps, and discussed with respect to conservation implications and appropriate actions in the study area, with emphasis on private land. In some cases, the existing information cannot be mapped (e.g., shrub and herb-dominated floodplain), the mapped layers only indicate potential and have not been verified (e.g., karst), or the available mapping resolution may not be adequate to identify all features (e.g., small wetlands under a hectare in size). In addition, it is likely that many of the values are not accurately mapped on private lands (i.e., forest cover is not sampled on private land, only photo-interpreted superficially).

4.3 Identification of Global and Local Conservation Threats

For this project, a detailed quantitative threat ranking was not requested. However, it was deemed necessary to assess and rank the threats in relation to habitat targets, in order to provide a credible basis for the prioritisation and ranking of conservation actions in Section 4.4.

Threat assessment focuses on understanding the conservation need (or risk) in relation to the habitat targets. Risk to habitat targets can be determined using a wide range of criteria, and prioritising risk can be complex. Consistent with an analysis to determine provincial and regional threats and risk to biodiversity values (Holt et al. 2003), the broad level of threat for the Kootenay Lake study area was analysed by considering the following elements:

- the conservation status of the habitat target (i.e., rare, irreplaceable, critical for life-history of listed species and wildlife guilds, etc.);
- the severity of the pressure on the habitat target (rate of decline: very rapid, rapid, slow, negligible);
- the spatial scope of impact (proportion of habitat target impacted: whole, majority, minority, negligible); and
- the probability of impact (frequency and duration: current, continuing, short-term, long-term, future).

⁶ This idea was discussed on January 9, 2018, with Juliet Craig before proceeding with analysis.

All of the above factors influence the overall magnitude (consequence) of impact to a habitat target and were considered as part of the threats assessment. The probability that an impact occurs, multiplied by the consequence (determined above), results in an overall assessment of threat. To determine the residual threat, after protection mechanisms are in place, the following was also considered:

- the extent to which the habitat target has strong, representative protection within protected areas (from mapping outputs);
- whether there is effective policy protection for the habitat target;
- whether there is effective non-legislative protection for the habitat target; and
- the reversibility of the impact, once it has occurred.

All of the criteria outlined above were considered in ranking the level of threat for aquatic and terrestrial habitat targets. Team knowledge and information from the literature review, mapping products, data summaries, and habitat use by vertebrate SAR informed the assessment. An overall impact ranking of High (3), Medium (2), Low (1) or Negligible (0) was applied to each habitat target.

The IUCN Threat Classification Scheme (2017a; Version 3.2) was used to provide an initial hierarchical listing of threats and sub-categories to terrestrial and aquatic habitats, which was customised to reflect localised threats. This involved reviewing threats and sub-categories identified in previous relevant studies (e.g., Holt et al. 2003; Shaw et al. 2013; Utzig et al. 2016; Martin et al. 2017 Draft) as they apply specifically to the Kootenay Lake study area.

The following nine broad-scale global IUCN threats and sub-categories were found to be most applicable to the study area (IUCN 2017):

1. Residential and Commercial Development;
 - Habitat loss, conversion and degradation
 - Residential water demand
 - Septic demand and sewage leaching
 - Invasive weed species establishment and spread
 - Human related disturbance
2. Climate Change;
 - Overall terrestrial impacts
 - Overall aquatic impacts
 - Increased fire risk
 - Increased incidence of insects and diseases
 - Increased moisture stress

3. Invasive Species and Problematic Species, Genes and Diseases;
 - Non-native plants
 - Non-native animals
 - Problematic species, genes and diseases
4. Natural System Modifications (dams and water management/use, fire suppression);
 - Habitat loss, conversion and degradation
 - River/flood patterns in remaining system
 - Lake/reservoir levels behind dams
 - Physical obstructions (flooded areas)
 - Physical obstructions (reservoir drawdown areas)
 - Fire suppression and changing wildfire patterns
5. Transportation and Service Corridors;
 - Road construction, use and maintenance
 - Railways construction, use and maintenance
 - Other linear corridor construction, use and maintenance (powerline, gas, other)
6. Human Intrusions and Disturbance (recreation on land and water);
 - Non-motorised recreation on land
 - Motorised recreation on land
 - Non-motorised recreation on water
 - Motorised recreation on water
 - Resort development and use
7. Resource Use (forestry, livestock grazing, harvest, agriculture, mining and quarrying, alternative energy production);
 - Landscape-level modification
 - Riparian and wetland systems impacts and degradation
 - Forestry roads
 - Silviculture practices
 - Stand structure modification
 - Seral stage conversion
 - Vegetation modification
 - Recreational harvest (hunting, trapping, angling, gathering)
 - First Nations use
 - Illegal activities (poaching and persecution)
 - Habitat loss, conversion and degradation

- Pesticides and fertilisers
 - Non-native or GMO crops
 - Fish and wildlife mortality, disturbance and displacement
8. Pollution (domestic, commercial, and industrial); and
- Sewage and wastewater
 - Garbage and solid waste
 - Air-borne pollutants
 - Chemicals
9. Geological Events
- Landslides, debris floods/torrents, avalanches.

Current threats to local conservation targets were reviewed in the context of the above identified threats and sub-categories. The relative impact of each of these threats and or sub-categories on 12 conservation targets (10 habitat targets as well as terrestrial and aquatic SAR) was qualified and ranked in a summary table.

4.4 Identification of Conservation Actions and Priority Ranking

Each threat/sub-threat in Section 4.3 was further considered to determine a potential suite of appropriate conservation actions to address the risks. This iterative process was repeated for all threats/sub-threats, and it resulted in a long list of possible conservation actions (some of which were common to multiple threats). Conservation actions were subsequently grouped under more general conservation categories. The general categories adopted were those developed for “conservation neighbourhood actions” in the Slocan and Columbia Valleys (Mahr 2017a; 2017b). The “other” category was intended to reflect actions that may improve ecosystem process or function, but are not necessarily covered under other categories (e.g., restoring a more natural hydrograph and flood/flow management regimes in wetland areas).

To be consistent with Kootenay Conservation Program’s neighbourhood conservation planning approach, eight “conservation bins” were ordered to reflect their perceived effectiveness in addressing the ranked threats/sub-threats:

1. Protect critical, valuable and/or under-represented habitats;
2. Monitor and protect species at risk/of concern;
3. Enhance or restore landscape connectivity;
4. Restore or create habitats or sites;
5. Prevent/address invasive species;
6. Reduce recreational pressure;
7. Advance climate resilience; and
8. Other (e.g., restore ecosystem processes and function).

Given limited resources to fund conservation activities, actions need to be prioritised, and in doing so, a number of factors should be considered. Broad conservation need (based on the level of threat to priority habitat targets), feasibility and likelihood of success are key components to consider. The potential of actions to result in “on the ground” conservation in the short term is also an important consideration for the KLLCF (J. Craig, pers. comm., 2017), and clearly only a subset of potential conservation actions reviewed are relevant in a private land context.

Conservation actions were therefore ranked based on the following four criteria:

1. Feasibility and likelihood of success (ranked from 1-3, with 1 = Low; 2 = Moderate; 3 = High; and 4 = Very High);
2. Potential to result in on-the-ground conservation (ranked 1-3, with 1 = Direct conservation action; 2 = Required step to guide future conservation action; and 3 = Potential step to guide future conservation action);
3. Demonstrated need or threat (ranked from 1-3, with 1 = Low; 2 = Moderate; and 3 = High); and
4. Relevance in a private land context (rated subjectivity).

A summary list of general conservation actions was developed to address all of the potential threats and sub-threats from the threat analysis. Conservation actions were first ranked in declining order of feasibility and effectiveness (criterion #1). Then the ranked conservation actions were grouped based on their potential to result in “on the ground” conservation (criterion #2):

1. Direct conservation actions (High = 3);
2. Necessary steps required to guide future conservation actions (Moderate = 2);
3. Potential steps to guide future conservation actions (Moderate = 1); and
4. Steps to guide conservation actions by government or other jurisdictions (N/A).

Finally, the ranked/grouped conservation actions were ranked for relevance against the 12 habitat targets. The latter were ordered and assigned scores (criterion #3) from most to least important (based on threat analysis output coupled with the mapping and quantification of total and protected target availability and distribution). Actions listed under criterion #4 are generally considered government responsibilities and for this reason, they were not ranked against habitat targets, although they were retained to help demonstrate how the team allocated responsibilities on crown versus private lands.

Based on the above rating system, each ranked/grouped conservation action was scored against each habitat target to generate an overall score (total maximum number of points = 10) based on the sum of the scores for the criteria #1-3. A summary table was generated that integrates all of the criteria considered and provides a ranking framework for assessing the relative merit of proposed conservation projects. It is envisioned that this scoring system could be combined with scoring for other criteria (e.g., proposal quality, team experience, project cost) to devise an overall system to evaluate proposals for funding under the KLLCF.

Specific examples were also included for each broad-based conservation action, where applicable. The specific examples do not provide an inclusive or exhaustive list of all the possible

conservation actions that are applicable to this program as this was beyond the scope of this review.

5.0 SUMMARY OF HABITAT TARGETS

Overall, the study area encompasses 834,163 ha (the 47,552 ha area of Kootenay Lake and Duncan Reservoir have been removed from this total). Of this total, approximately 245,228 ha (29.4%) are protected as parks (federal or provincial) or as conservation properties (including both private lands and regional parks). Crown land encompasses approximately 750,660 ha, of which approximately 27% is protected, while private land covers approximately 83,504 ha of which approximately double (53%) is protected (Table 2). An overview map of the amount of crown versus private land within the study area is presented in Figure 2.

Notably, the NCC Darkwoods Conservation Area represents 5.2% of the study area, 17.8% of all protected land, 52.3% of private land, and 97.7% of private conservation land in the study area. It therefore skews the proportions of the total and private land protected in the study area in favour of higher elevation habitats. This is an important caveat to bear in mind when considering the most appropriate conservation actions to address threats acting at different elevations within the overall study area.

An overview of the ten habitat targets reviewed is provided in Table 2. Each target is briefly highlighted below. Further details for each habitat target are provided in Appendix B (Tables B1-B11), along with overview maps (Appendix B, Figures B1 to B9).

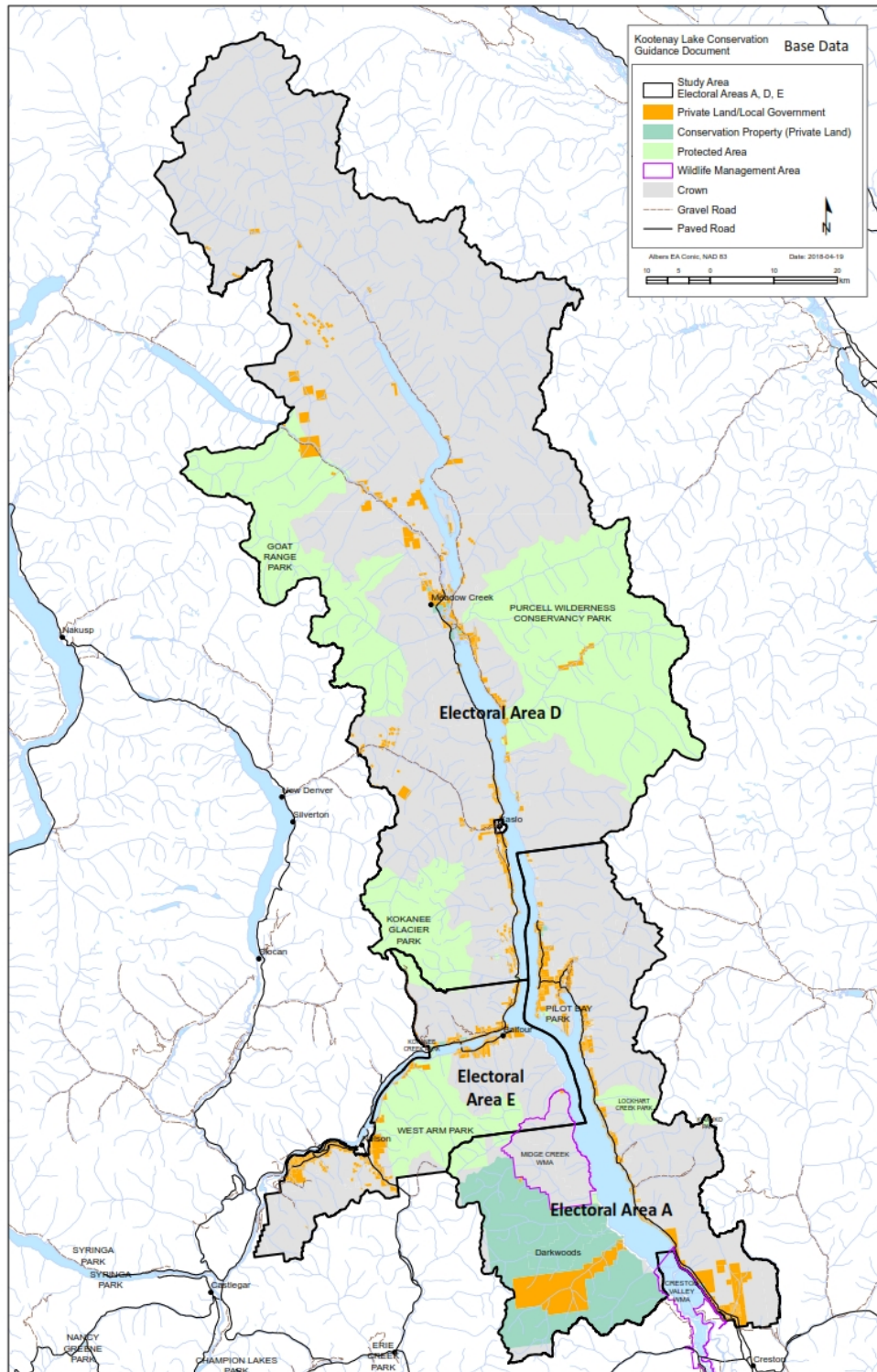


Figure 2: Overview map of Crown versus private land within Areas A, D and E of the Kootenay Lake Conservation Guidance Study Area, BC.

Table 2: Overview of Habitat Targets Quantified in the Kootenay Lake Study Area

Habitat Target Type	Crown Land Amount	%	Private Land/Local Government Amount	%	Total Amount	%
Total Study Area (ha)	750,660	90	83,504	10	834,163	100
Total Area Protected (ha)	200,795	24	44,433	5	245,228	29
Total Area Protected (ha) (excluding NCC Darkwoods from area calculations)	200,795	25	797	0.1	201,592	25.1
Connectivity Habitat and Barriers						
Terrestrial Connectivity Feature Area (ha)	623,965	75	68,668	8	704,370	84
Fish Connectivity Dataset - Total Stream Length (km)	6,390	91	657	9	7,047	100
Fish Connectivity Dataset - Stream Length Below 20% Gradient Threshold (km)	2,152	31	370	5	2,522	36
Hydro-Riparian Systems						
Large Hydro-Riparian Areas (ha)	16,305	2	4,853	1	21,158	3
Small/Medium Hydro-Riparian Areas (ha)	237,697	28	24,376	3	262,073	31
Total Hydro-Riparian Areas (ha)	254,001	30	29,229	4	283,231	34
Wetlands						
Total Wetland Area (ha)	1,290	0.15	338	0.04	1,628	0.20
Fish Habitat						
Total Stream Length (km)	15,205	92	1,333	8	16,538	100
Total Small Lake Area (ha)	1,173	0.14	198	0.02	1,371	0.16
Moist Interior Cedar-Hemlock (ICHmw) Forests						
Total Moist ICH (ICHmw2, mw4) Forest BGC Area (ha)	114,204	13.7	13,918	1.7	128,121	15.4
Total Moist ICH (ICHmw2, mw4) Old Forest BGC Area (ha)	4,518	0.5	1,478	0.2	5,996	0.7

Habitat Target Type	Crown Land Amount	%	Private Land/Local Government Amount	%	Total Amount	%
Dry Interior Cedar-Hemlock (ICHxw, dw1) forests						
Total Dry ICH (ICHdw1, xw) BGC Area (ha)	45,200	5	23,835	3	69,036	8
Total Dry ICH (ICHdw1, xw) Old Forest BGC Area (ha)	2,243	0.3	605	0.1	2,847	0.3
KARST (Cold and Hot Springs)						
Total Primary, Secondary or Tertiary Likelihood of KARST Area (ha)	168,611	20.2	13,986	1.7	182,598	21.9
Primary = >50% soluble bedrock (ha)	20,990	2.5	2,044	0.2	23,034	2.8
Secondary = 20% to 49% soluble bedrock (ha)	11,117	1.3	4,386	0.5	15,503	1.9
T = tertiary = 5% to 19% soluble bedrock (ha)	136,504	16.4	7,557	0.9	144,060	17.3
Brushlands and Grasslands						
Total Brushland Area (ha)	31	0.0037	1	0.0001	32	0.0039
Cottonwood Stands						
Rank 1 (>80%) Cottonwood Stand	81	0.01	124	0.01	205	0.02
Rank 2 (41-80%) Cottonwood Stand	581	0.07	497	0.06	1,078	0.13
Deciduous Floodplain (mid-bench)	2,343	0.28	934	0.11	3,278	0.39
Listed Vertebrate Species by Habitat Target						
Aquatics - Adfluvial Bull Trout Spawning Streams (km)	257	1.6	52	0.3	310	1.9
Aquatics - Westslope Cutthroat Trout Total Stream Length (km)	741	4.5	113	0.7	855	5.2
Aquatics - Westslope Cutthroat Trout Total Small Lake Area (ha)	203	0.024	20	0.002	223	0.027

Notes:

- All habitat target summaries include protected and unprotected areas (i.e., total areas of each target); the proportion protected is described in Appendix B, Tables B1-B11
- Area (ha) of Kootenay Lake and Duncan Reservoir is not included in this total
- Percentages are determined by comparing all habitat areas (ha) to the Total Study Area (ha)
- Habitat targets related to stream length (km) compared to total stream length for that particular dataset

5.1 Connectivity Habitat

5.1.1 Terrestrial

A landscape scale connectivity mapping evaluation by Utzig and Holt (2015) identified important connectivity areas within the study area, based on their value as Mountain Caribou reserves, existing conservation lands and protected areas (Appendix B, Figure B1). This same evaluation delineated proposed conservation lands, Grizzly Bear core areas and linkage zones, as well as other proposed linkage areas and reserves based on the best available information (Appendix B, Table B1-1, Figure B1). The analysis indicated that there are a total of 704,370 ha of important connectivity habitat (representing 84% of the total study area; Table 2), of which 623,965 ha (90%) are on crown land, and 68,668 ha (10%) are on private land. However, of the total connectivity habitat identified, only 244,935 ha (or 34.8%) are currently protected. Of this total currently protected, 200,530 ha (82%) are on crown land and the remaining 44,406 ha (18.1%) are on private land (Appendix B, Table B1-2). Therefore, there are clearly a number of opportunities to improve protection on private lands in areas identified as important for connectivity, but not yet secured.

5.1.2 Aquatic

The stream gradient dataset was smaller than the total stream length dataset (7,047 km and 16,538 km, respectively; Table 2). Of the data available, the majority of stream length potentially accessible to fish (<20% gradient threshold) occurs on crown land (2,152 km) and nearly one third of this area is located within parks (Appendix B, Table B2-1, Figure B2). Nearly half of the stream length potentially accessible to fish on private land is located within protected areas (Appendix B, Table B2-1).

The majority of fish passage obstacles identified within the study area (n=222) are located on crown land (n=160) and include natural and unnatural obstacles (Appendix B, Table B2-2, Figure B2). On private land, the majority of obstacles were natural (n=47) and included cascades/chutes, falls, large woody debris dams and rocks. Unnatural obstacles on private land included culverts (n=8), dams (n=4), hydroelectric dams (n=1) and potentially other unspecified obstacles (n=2; Appendix B, Table B2-2). Fish passage assessments (n=174) have primarily been completed on crown land (n=162) and the majority of locations assessed were passable (n=104), although there were barriers (n=49), potential barriers (n=6) and unknown passage (n=3) points identified (Appendix B, Table B2-3). The majority of fish passage assessments on private land (n=12) assessed locations that were passable (n=9), although three barriers were identified using this evaluation (Appendix B, Table B2-3). The data suggest that there are opportunities to improve fish passage by removal of unnatural obstacles on both crown and private land.

5.2 Hydro-Riparian Systems (Large, Medium, Small)

Hydro-riparian habitat is located on 283,231 ha (34%) of the study area with the majority of this located on crown land (30%) and the remainder on private (4%; Table 2). The majority of hydro-riparian areas are classified as small/medium (31%) and the remaining are large (3%). Similar proportions of large hydro-riparian areas are observed on crown and private land (2% and 1%, respectively; Appendix B, Table B3-1, Figure B3).

Of all hydro-riparian areas occurring on crown land, approximately 9.3% are protected. This represents nearly half the 17.5% protection found on private land. Small/medium hydro-riparian areas make up the majority of the protected areas, while <0.5% of both the crown and private land base consists of protected large hydro-riparian areas (Appendix B, Table B3-2). Hydro-riparian systems are one of the most sensitive systems and provide habitats for fish (Section 3.1.4) and wildlife; there are opportunities to protect, restore and enhance this habitat target.

5.3 Wetlands

Wetlands occur on only 1,628 ha (or 0.2% of the study area), and approximately 79% and 21% of these wetlands are on crown and private lands, respectively (Table 2; Appendix B, Figure B4). This skew confirms the potential for additional wetland protection on private land, as well as restoration or construction of wetlands wherever opportunities to do so most effectively are identified.

The wetland type has not been differentiated for the majority of wetlands (966 ha total: 789 ha crown and 177 ha private), while the remaining wetlands have been differentiated as shallow water (457 ha total: 413 ha crown and 44 ha private), marsh (136 ha total: 67 ha crown and 69 ha private), swamp (67 ha total: 13 ha crown and 47 ha private) and fen (2.9 ha total: 2.5 ha crown and 0.4 ha private; Appendix B, Figure B4). The majority of undifferentiated, shallow water and fen wetlands occur on crown land while the majority of swamp and marsh wetlands occur on private (Appendix B, Table B4-1). Given the small amount of wetland habitat in the study area (<1%), protection, restoration or creation of additional wetlands on private and crown land should be a high priority.

Native fish species have been identified in 119 ha (68 ha crown and 52 ha private) of wetland areas while non-native species have been identified in 70 ha (32 ha crown and 38 ha private). Nearly all non-native fish species are located in undifferentiated wetland types with the exception of 1.5 ha of marsh wetland on crown land that contained non-native species (Appendix B, Table B4-2). Wetlands on private land containing native fish species are primarily the undifferentiated wetland type (42 ha), though some are also identified in shallow water wetland (9.94 ha) and swamp wetland (0.02 ha; Appendix B, Table B4-2). On private property, 0.8 ha of wetlands with native fish species are protected within conservation properties (2% of the total wetland area with native fish present on private property), while 14 ha of wetlands with non-native fish species are protected on crown park land areas (21% of the total wetland area with native fish present on crown land; Appendix B, Table B4-2). There are opportunities for non-native fish species removal in wetlands on crown and private lands and the potential for protection of wetlands with native fish species.

5.4 Fish Habitat

The majority (92%) of all stream length in the study area is on crown land (16,538 km; Table 2). Of the total length of streams occurring on crown land, approximately two thirds is within protected park areas. Of the total stream length occurring on private land (8%), over half is located on conservation properties (Appendix B, Table B5-1).

Fish presence has been identified in 15% of the total stream length occurring on crown land and 25% of the total stream length occurring on private land (Appendix B, Table B5-1, Figure B3). On crown land, native fish species have been identified in 2,344 km of stream length; approximately one quarter of this length is within protected park areas, and non-native fish species have been

identified in 357 km of stream length (approximately 15% of this length is within parks; Appendix B, Table B5-1, Figure B3). On private land, native fish species have been identified in 328 km of stream length and nearly half of this length is within conservation properties, while non-native fish species have been identified in 99 km of stream length and approximately half of this length is within conservation properties.

Not including the two large water bodies in the study area (Kootenay Lake and Duncan Reservoir), small/medium sized lakes occur on only 1,371 ha, representing a very small proportion of the study area (0.16%). The majority of medium/small lakes occur on crown land (Table 2). Native fish species have been identified in 359 ha (312 ha crown and 47 ha private), non-native fish species have been identified in 23 ha (15 ha crown and 8 ha private), and unidentified fish species have been observed in 24 ha (24 ha crown and 0.05 ha private) of medium/small lakes in the study area (Appendix B, Table B5-2). Medium/small lakes in the study area are mostly higher elevation, low productivity (oligotrophic) systems. There is the opportunity for non-native fish species removal in medium/small sized lakes on crown and private land. In addition, trends in fish abundance, distribution and productivity are lacking for medium/small lake systems within the study area.

Two large waterbodies in the study area include Kootenay Lake and Duncan Reservoir and provide habitat for regionally important (Appendix A3) and SAR aquatic species (Appendix A4). In addition, the large hydro-riparian areas of these two lakes (Section 3.1.2) provide shoal spawning areas for native fish species (e.g., shoal spawning Kokanee in the West Arm), rearing areas for larval fish, as well as provide feeding opportunities for many aquatic species. As discussed (Section 4.2.2), there are opportunities for protection, restoration and enhancement of these hydro-riparian areas on both crown and private lands.

5.5 Old Growth Moist Interior Cedar Hemlock Forests

Moist ICH forest comprises 15.4% of the total study area (13.7% and 1.7% of crown and private land, respectively; Figure B5). Only 5,996 ha of old moist ICH forest (0.7%) remain in the study area (Table 2). Of this total, 4,518 ha (75%) are on crown land and 1,478 ha (25%) are on private land (Appendix B, Tables B6-1 and B6-2, Figure B6). This negligible amount of old moist ICH forest is concerning, when compared to the natural range of variability estimated in moist ICH landscapes (i.e., >14-21% old forest as a proportion of the total crown forest land base; Province of British Columbia 1995). Furthermore, residual old forests in the study area are highly dispersed and fragmented into tiny patches with limited interior forest habitat conditions (Appendix B, Figure B6). This substantially reduces their value for species that require old interior forest habitat conditions in addition to old stand structure. Given that biological edge effects extend a minimum of 200 m and up to 1,000 m into forest edges (depending on the type of forest and edge, respectively; Province of BC 1995), old forest patches smaller than 200 m radius (12.6 ha in size) have no interior habitat whatsoever. Clearly there is a need to protect greater old moist ICH forest, coupled with recruitment of adjacent mature forest (for future old forest) in large contiguous reserves. This is necessary to achieve greater protection of sufficiently large forest patches that can provide at least some interior forest habitat.

5.6 Dry Interior Cedar-Hemlock Forests

There are 69,036 ha of dry ICH habitat, representing about 5% of the total study area (Appendix B, Table B7-1, Figure B5). Of this total amount, 45,200 ha (65%) and 23,835 ha (35%) are found on crown and private land, respectively (Table 2). For dry ICH as a whole, 8,773 ha (12.7 %) are

protected. This includes 4,643 ha (6.7%) on crown and 4,130 ha (6%) private lands, respectively (Appendix B, Table B7-1, Figure B5).

Considering only the old dry ICH, an estimated 2,847 ha remain (of which 70% is on crown land and the remainder on private; Appendix B, Table B7-2, Figure B6). Only 500 ha are protected, which represents 0.06% of the total study area (Appendix B, Table B7-3). Of these protected old dry ICH forests, 372 ha are on crown land and 136 ha are on private conservation properties; these areas represent 0.05% and 0.16% of the total crown and private land in the study area, respectively (Appendix B, Table B7-3). This negligible amount of old, dry forest is of concern in relation to the natural range of variability estimated in dry ICH landscapes (i.e., >13-19% old forest as a proportion of the total crown forest land base; Province of British Columbia 1995). As with the moist ICH, residual old dry forests in the study area are highly dispersed and fragmented into small patches (Appendix B, Figure B6), which limits their value for a subset of species that require old interior forest habitat conditions, in addition to old stand structure. There is an obvious need to protect and restore greater old dry forest coupled with recruitment of adjacent mature dry forest in large contiguous reserves. This would provide stand structure and interior forest habitat for the listed species requiring these values (see Appendix A; Tables A4).

5.7 Karst (Cold and Hot Springs)

An estimated 23,034 ha (2.8%) with primary karst potential (>50% soluble rock) are mapped in the study area, and this area increases substantially when secondary and/or tertiary karst potential is considered (Table 2; Appendix B, Figure B7). Crown lands support about ten times as much primary karst potential as private lands (i.e., 20,990 versus 2,044 ha, respectively; Appendix B, Table B8-1). Of the primary karst, 6,743 ha or 32% are protected on crown land, while another 185 ha (9%) are protected on private land (Appendix B, Table B8-2). Given that this mapping has not been verified, ground-truthing and characterisation of the areas with primary karst potential should be a priority.

5.8 Brushlands and Grasslands

Only 32 ha of brushland are mapped in the study area (i.e., 0.004% of the total study area; Table 2), yet a number of listed species depend on brushland/grassland habitat for their life requisites. Less than one hectare of brushland is protected on private land, and none is protected on crown land (Appendix B, Table B9-1, Figure B8).

The latest Ecosystem Classification Field Guide for southeast BC (MacKillop and Ehman 2016) is the first to describe climax brushland and grassland ecosystems, however, quantitative data on target amounts of these habitats is scant and not provided. This question requires further research and evaluation to estimate quantitatively, based on natural disturbance regimes. However, it is anticipated that brushland/grassland abundance in the study area will increase as climate change progresses. When forested sites are regenerating after fire or harvesting, they would be expected to go through a brief brushland successional stage naturally, which could help to supplement current climax brushland habitat abundance and distribution. However, current fire suppression and silvicultural practices (e.g., conifer planting, brushing, herbicide application to control deciduous species, etc.) truncate and/or eliminate the brushland phase of natural succession. Therefore, prescribed fire, reduced fire suppression, and modified silviculture (i.e., to allow for a more protracted brushland phase; and/or do not treat some brushy areas on crown land mechanically or with glyphosate) would all be helpful in promoting increased brushland habitat

availability and distribution. In agricultural areas, encouraging farmers/ranchers to leave some natural shrublands and/or meadows fallow for some periods would also be helpful.

5.9 Cottonwood-Dominated Floodplain

Several options were available to evaluate the availability of cottonwood floodplain habitat. Using the most generous estimate (i.e., mid-bench deciduous floodplain from PEM), an estimated 3,278 ha (0.39%) are found in the study area, but only a portion of this total is expected to be cottonwood-dominated (Table 2; Appendix B, Figure B9). Based on more specific cottonwood evaluations, 205 ha of Rank 1 and 1,078 ha of Rank 2 cottonwood, for a total of 1,283 ha are remaining (0.15% of the total study area; Table 2; Jamieson and Braatne 2001, Jamieson et al. 2001).

Estimates for protected cottonwood floodplain also vary depending on the mapping source. A total of 815 ha of mid-bench deciduous floodplain from PEM are protected (643 ha on crown land and 171 ha on private; Appendix B, Table B10-1). Only 295 ha of cottonwood are protected, including 8.4 ha of crown and 35 ha for Rank 1, as well as 61 ha on crown and 190 ha for Rank 2 (Jamieson and Braatne 2001; Jamieson et al. 2001; Appendix B, Table B10-2). Regardless of which source is used, close to 3,000 ha of cottonwood-dominated floodplain (i.e., 1,397 ha of floodplains and an additional 1,426 ha of riparian forests with cottonwoods, wet and very wet forests) were lost as a result of dam impacts on the Duncan system alone (Utzig and Schmidt 2011). Additional habitats were and continue to be degraded due to operations of the Duncan Dam, and to a lesser extent by the operation of Corra Linn and Libby Dams. It is assumed that only a small portion of the residual cottonwood-dominated floodplain habitat remains, relative to natural pre-dam levels; Utzig and Schmidt 2011). Furthermore, only a negligible portion of that residual amount is protected, indicating a need for greater cottonwood securement and restoration.

5.10 Shrub and Herb-dominated Floodplain

There is no mapping information currently available for low-bench ecosystems that most closely correspond to shrub- and herb-dominated floodplains, which have only recently been described (MacKillop and Ehman 2016). Findings are expected to be somewhat comparable to the mid-bench findings from cottonwood floodplain habitats (Appendix B, Table B10-1), given that low-bench sites are located below mid-bench sites; however, this assumption requires future verification. Securing more cottonwood-dominated floodplain habitat on private land, as recommended above would be expected to also achieve greater protection of low-bench floodplain habitat.

5.11 Vertebrate Species At Risk

5.11.1 Terrestrial

Previous records were confirmed for a total of 48 terrestrial vertebrates that are provincially or federally listed within or reasonably nearby the study area (Appendix A, Table A4). These include 3 amphibians, 3 reptiles, 31 birds, and 11 mammals. All of the herptiles are year-round residents, but the Northern Leopard Frog is only known from the CVWMA. At least nine of the mammals are year-round residents (Fisher once occurred locally, but may be extirpated, and little is known about the status of the Red-Tailed Chipmunk in the study area), Of the 31 birds, 23 species are confirmed local breeders, while the remainder are seasonal migrants that have some local records available (Forster's Tern, Flammulated Owl and White-headed Woodpecker are only known from the

CVWMA). Information on use of the ten habitat targets by the 48 terrestrial vertebrates, along with additional comments regarding confirmed study area records, nature of use of the Kootenay Lake Area, and diet, and is compiled in Appendix A, Table A4. The Table also indicates whether recovery plans or provincial management plans are available for each species.

Dry ICH has the highest level of confirmed use by listed species (46 species total). At least 19 of these species use old forest structure (i.e., large veteran trees and snags, large coarse woody debris, etc.) for breeding, feeding, roosting, or cover. This emphasizes the importance of protecting old forest structure that remains, as well as targeted retention during ecosystem restoration treatments.

Approximately 33 listed terrestrial vertebrate species use wetlands as follows (minimum number of species in parentheses): shallow open water (n=28); marshes (n=25); swamps (n=11); fens (n=9); and bogs (n=8). For hydro-riparian and lake habitat, approximately 31 terrestrial listed vertebrates use this habitat type as follows: small (n=27); medium (n=31); large (n=22); and lakes (n=22). Use of islands was important for at least two listed species (both in hydro-riparian and/or wetland contexts). To accommodate the needs of listed species, additional protection, enhancement and, potentially, the creation of wetlands are important conservation actions.

Moist ICH is used by at least 26 listed terrestrial vertebrate species. Of these, approximately 12 species use old forest habitat and/or structures (e.g., large veteran trees and snags, large hollows logs and woody debris, high lichen loads), while four species require interior forest habitat conditions. These findings again emphasize the value of old forest, associated structures and the need to protect large, contiguous tracts of old forest, which accommodate the needs of species requiring interior forest habitat conditions.

Shrub- and herb-dominated floodplain habitat (including mudflats, gravel and sand bars), are used by a minimum of 26 listed terrestrial vertebrate species, including a number of seasonal migrant birds, and resident amphibians and reptiles. A greater focus on mapping, characterising, protecting and restoring low-bench floodplain habitat is needed, given its relative importance to a diversity of vulnerable species.

Cottonwood-dominated floodplain habitat is used by a minimum of 24 listed terrestrial vertebrate species, either as pure stands or in combination with other riparian deciduous and coniferous species. All seral stages are important for wildlife, but in particular, mature cottonwood-dominated stands (with an abundance of snags and live wildlife trees with hollows, cavities, broken tops, and strong horizontal limbs, as well as large woody debris and hollow logs) are of high value for breeding, roosting, denning and perching species.

Information on the specific use of karst by wildlife was inferred from their use of a broader range of rock-dominated features (e.g., caves, cliffs, rock outcrops, waterfalls, springs, seeps, sinkholes, talus). At least 16 listed terrestrial vertebrate species in the study area use rock-dominated habitats for breeding, roosting, denning, shelter and thermoregulation. Verification of the locations of high value karst, investigation of use by wildlife, and protection of key sites is recommended.

At least seven listed terrestrial vertebrate species (i.e., Northern Goshawk, American Badger, Mountain Caribou, Fisher, Grizzly Bear, Mountain Goat, and Wolverine) in the study area require connectivity at the landscape scale. Other species (such as Western Toad and Painted Turtle) are known to require connectivity between breeding ponds and/or terrestrial nesting sites and other

core use areas (i.e., forested habitat or wetland habitat in the case of toads and turtles, respectively). Selected species in the study area have limited movement capability and are currently thought to occupy small, defined core areas with relatively limited opportunities for dispersal and gene flow (e.g., Northern Leopard Frog, Northern Pocket Gopher, Red-Tailed Chipmunk, Coeur d'Alene Salamander, and possibly others). At a very minimum, all of the above species are thought to be sensitive, with respect to habitat connectivity, and require further study to evaluate existing connectivity, linkages and dispersal capability. Connectivity of other vulnerable species may merit additional study and documentation with respect to conservation planning and implementation. For example, some species may be more sensitive to connectivity seasonally (e.g., listed bat species at a maternity colony, Great Blue Herons at a rookery, swallow species at a breeding colony), when they are confined to a breeding site and reliant on accessible and abundant food resources close by.

In addition to listed vertebrates, there are as many as 33 listed invertebrates and 55 plant species potentially occurring in the study area (Appendix A, Tables A5 and A6). Further investigation regarding the occurrence and habitat associations of these species in the study area is warranted, so that they can be fully integrated into conservation planning, implementation, monitoring actions, as well as habitat restoration and enhancement.

5.11.2 Aquatic

Adfluvial Bull Trout from Kootenay Lake and Duncan Reservoir utilize 310 km, approximately 2% of stream length within the study area, during spawning migrations and the majority of this is located on crown land (Table 2). Approximately one quarter of adfluvial Bull Trout spawning habitat on crown land is protected, while approximately half of that on private land is protected (Appendix B, Table B11-1). There is an opportunity for protection and/or enhancement for streams on private land used by Bull Trout (27 km of 52 km is currently not protected).

Westslope Cutthroat Trout (WCT) utilize 855 km, approximately 5%, of stream length in the study area and 223 ha in small lakes, <0.05% of the total study area (Table 2). In both streams and lakes, the vast majority of occurrences of WCT are on crown land (Table 2). On crown land, one third of the stream length and half of the small/medium lake area containing WCT is protected while on private land, nearly half of the stream length and more than three quarters of the small/medium lake areas containing the fish species is protected; only 48 km of stream and 2.6 ha of small/medium lakes where WCT have been recorded on private land remain unprotected (Appendix B, Tables B11-1 and B11-2). WCT have also been documented in 36 ha of wetlands within the study area, the majority of which occur on crown land (23 ha, 8 ha of which are protected). Of the 13.7 ha of wetlands containing WCT on private land, 13 ha are protected (Appendix B, Table B11-3). There is an opportunity for protection and/or enhancement for streams, wetlands and small lakes on private land used by WCT.

Additional fish species of regional interest are covered under hydro-riparian systems (Section 4.2.2) and fish habitat (Section 4.2.4).

6.0 SUMMARY OF CONSERVATION THREATS

A standard set of global IUCN threats and sub-threats were evaluated within a local context for both terrestrial and aquatic habitat targets in the study area. The final list is summarized in Table 3 and includes eight threat categories and 55 threat activities.

Threats and sub-threats were further ranked with respect to the severity of their impact on each habitat target. Habitat targets having the highest number and severity of applicable threats (i.e., highest summed threat scores) were identified (Table 4). The most to least threatened targets were ranked as follows: hydro-riparian; fish habitat; at risk aquatic vertebrates; at risk terrestrial vertebrates; wetlands; dry forest; old moist forest; connectivity; brushlands; cottonwood floodplain; shrub and herb-dominated floodplain; and, karst. Note that these results reflect very coarse scale differences in the level of overall threat to targets and differences of a few points should not be used to definitively quantify threat level by target. For example, habitat targets for fish habitat, at risk aquatic vertebrates, at risk terrestrial vertebrates, wetlands and dry forests were ranged from 76 to 71 points, which should be treated as a relatively similar ranking when compared to karst having a score of 6 (Table 4). The top ranked threats at a local scale included habitat loss, degradation/conversion (due to dams, residential development and other factors), roads (construction, use and maintenance in multiple contexts), overall impact of changing climate, increased fire risk (frequency and severity), resource use (in particular roads on crown land), and water management regimes (river flows, flood patterns, and reservoir levels; Table 4). These threat results are similar to those previously reported for the Kootenay Region, Columbia Basin, and Selkirk Forest District (e.g., Holt et al. 2003; Martin et al. 2017; and Shaw et al. 2013).

Table 3: Conservation Threats Summary

Global Threats (IUCN)	Threat Sub-categories	Activity	Comments on the Local Threats
Residential and Commercial Development	Low elevation development	Habitat loss, conversion and degradation	Conversion results in lower suitability and creates barriers to movement. High severity and frequent to continuous in occurrence, with low reversibility in many low elevation valleys. Affects all elements of the system from processes through to single species directly.
		Residential water demand	Localized impact, mainly in low elevation more densely populated areas. Contributes to drying of creeks and wetlands.
		Septic demand and sewage leaching	Sewage release reduces water quality and oxygen content, increases water temperature, and potentially could lead to localized eutrophication, and growth of tolerant plants and algae.
		Invasive weed species establishment and spread	Development promotes invasive species establishment and spread, especially in more open less shaded terrestrial sites. Aquatic weeds are spread by human-related disturbances and recreation (e.g., boats) and are also more prominent in populated areas. Affects processes through to individual species level, but less pervasive than other threats such as climate change or habitat conversion.
		Human-related disturbance (e.g., by people, pets, machinery and equipment)	Affects processes (movement) and species level. Impacts generally focused at low elevation in settlement zones.
Climate Change	Overall Impact	Terrestrial	Very high risk, due to changes predicted for processes, ecosystems, habitats, down to individual species. Impacts pervasive, of high severity, and probability of occurrence very high. High impacts for all forested, alpine and sub-alpine ecosystems (glacier recession). Potentially lower impact for drier ecosystems as their range will increase, but likely with reduced resilience. Leads to cascading impacts, such as drying of wetlands, and greater encroachment by invasive species etc.
		Aquatic	Moderate to high risk due to changes related to critically lower water levels, especially during the summer months; increased frequency and intensity of flood events and debris torrents; increased water temperatures; potential loss of groundwater reserves; and increased pressure from water users where supply is lower.
		Increased fire risk (frequency and severity)	Impacts of high severity on processes, ecosystems, habitats and forest values (forest stands and connectivity, veteran trees, wildlife trees, CWD, soils, and dependent species). May lead to loss of structure, function, soil erosion, sedimentation, debris flows, landslides, glacial recession, etc. May be less impacting for non-treed systems and species, but likely reduces

Global Threats (IUCN)	Threat Sub-categories	Activity	Comments on the Local Threats
			resilience and invasive weed spread in these systems with reduced habitat suitability.
		Increased incidence of insects and diseases and associated mortality of key tree species	Impacts of high severity to forest values in some ecosystems. Local impacts known to be significant (e.g., loss of very high value trees due to birch decline, white pine blister rust, mountain pine beetle, spruce beetle, etc.) and will increase with climate change. Loss of tree species in riparian areas will have impacts on fish and fish habitats, but severity of risk is unknown.
		Increased moisture stress and mortality of key vegetation species	Impacts of high severity to some forest stands in some ecosystems, impacting dependent animal species. Local impacts known to be significant (e.g., loss of cedar on drier sites in WK systems). Loss of tree species in riparian areas will have impacts on fish and fish habitats, but severity of risk is unknown.
		Extreme weather events (storms, flooding)	Impacts may be of high severity, but localized and infrequent. Impacts are predicted to increase with climate change and may be more extreme in riparian/dry areas.
Invasive and Problematic Species, Genes and Diseases	Invasive Species	Non-native plants	High severity of threat in drier terrestrial ecosystems, and high probability of increased establishment and spread due to climate change impacts. Spread in riparian zones (e.g., knotweeds, reed canary grass) will impact some guilds more heavily (waterfowl, amphibians). Increased risk of non-native aquatic plant (e.g., milfoil, yellow flag iris) spread, potentially impacting fish habitat and wetlands.
		Non-native animals	Introduction and spread may have cascading impacts to aquatic and riparian food chains and native species diversity and abundance (e.g., American bullfrog, Northern Pike, Zebra and Quagga Mussels). Impacts may be on a guild (e.g., cavity nesters due to European Starling) or on a resource, such as plants (e.g., Africanized honeybees).
		Problematic species, genes and diseases	Can impact species and populations with cascading trophic impacts on other values (e.g., white nose syndrome impacting Myotis bats and insect populations; chytrid fungus impacting amphibians and predators; honeybee diseases and pests impacting pollination and plant communities; parasites from invasive fish species).
Natural System Modifications	Dams and Water Management	Habitat loss, conversion and degradation	Significant flooding impacts of high severity and scope (25 km long Duncan Lake converted to 45 km long reservoir), from processes to habitats to individual species level changes. The modification is relatively localized, but the magnitude is severe overall.

Global Threats (IUCN)	Threat Sub-categories	Activity	Comments on the Local Threats
		River / flood patterns (in remaining system)	Significant influences of Duncan, Libby and Kootenay Dams on lower Duncan and Kootenay River flows, habitat and productivity. Detrimental for cottonwood and shrub-herb-dominated floodplain ecosystems.
		Reservoir levels (behind dams)	Significant reservoir fluctuations daily and seasonally (30 m range) with high severity impacts on productivity and cascading impacts on all values (from processes to ecosystems, habitat and species).
		Physical obstructions (flooded areas)	Depending on water levels, significant area flooded and impassable for terrestrial species and direct mortality hazards at ice/water interface in winter, especially for wide-ranging species.
		Physical obstructions - reservoir drawdown areas (lake-tributary mouth interface)	Low lake levels can prohibit fish access to tributary habitats during critical spawning periods (e.g., during spring for Rainbow Trout).
	Fire Suppression	Fire suppression and changing wildfire patterns	Impacts on processes, ecosystems, habitats and species level. Drier fire-maintained ecosystems (open and mixed severity forests, climax shrublands) most impacted by fire suppression, but overall broad extent and high severity in those drier locations. Risks given relatively low rating, because except for potential higher severity fires, these targets are not unduly directly affected.
Fuel management	Fuel reduction fire hazard treatments	Potential for poorly implemented fuel treatments to have negative impacts on biodiversity in the short-term.	
Transportation and Service Corridors	Corridors	Roads - construction, use and maintenance	Impacts affect all levels from processes, connectivity, habitats, down through individual species level mortality. Magnitude and severity of impact very large, particularly at low elevations, but also throughout all ecosystems. Often associated with other impacts (e.g., increased hunting/angling, disturbance, displacement, avoidance, invasive species, erosion, sedimentation); difficult to tease apart impacts.
		Railways - construction, use and maintenance	Impacts affect all levels, but magnitude and severity of impact less than roads overall, due to more periodic nature of use which is focused at low elevations. Often associated with other impacts (increased disturbance, displacement, avoidance, invasive species), so difficult to tease apart impacts.
		Other linear corridors - construction and maintenance (powerline, gas, other)	Impacts at all levels from processes, habitats, down through individual species level. Magnitude and severity of impact large (less than roads, but greater than railroads) because of spatial extent, but use and associated disturbance less consistent and seasonal in nature, with some cover/vegetation present. Often associated with other impacts (increased

Global Threats (IUCN)	Threat Sub-categories	Activity	Comments on the Local Threats
			hunting/angling, disturbance, displacement, invasive species); difficult to separate out.
	Recreation on land	Non-motorized on land (e.g., biking, hiking, caving, rock-climbing, skiing)	Higher than expected impacts here due to extensive bike trail systems. Impacts targeted in accessible areas and some targeted impacts on good examples of old forest habitat.
	Recreation on land	Motorized recreation on land (e.g., ATVS, dirt bikes, snowmobiles)	Affects processes, habitats and individual species via disturbance, displacement, mortality, and habitat degradation (linked to invasive species, hunting, angling). Pervasive impact, but magnitude and severity relatively limited by areas of use, which are expanding, due to lack of access management.
	Recreation on water	Non-motorized recreation on water (e.g., sailing, kayaking, canoeing, paddle-boarding, skating)	Affects mainly selected riparian/wetland habitats and individual species, causing periodic and temporary disturbance, displacement on a more seasonal basis.
		Motorized recreation on water (e.g., boating, jet ski, house boats, ferries)	Affects mainly selected riparian/wetland habitats and individual species, causing degradation, disturbance (e.g., boat launch development), displacement, avoidance, fuel leaks, deposition of sewage, garbage, wake).
	Intense recreation	Resort development and use	Very localized impacts, but often on very high value sites. Waterfront resort development and use are associated with non-native aquatic species introductions and increased recreational pressure.
Resource Use	Forestry on crown land	Landscape-level modification - crown	Combination of seral stage conversion and fragmentation impacts processes, habitats, and species. Severity, extent and probability of occurrence high (with some potential for reversibility over the long term), but leading to high risk overall; impacts focused on the crown forested land base.
		Riparian system impacts - crown	Forest practices intend to maintain riparian values, but can fail to do so, leading to reduced riparian/wetland habitat suitability and function, erosion, sedimentation, reduced water quality, etc.
		Forestry roads - crown	Impacts affect all levels from processes, habitats, down through individual species level mortality. Magnitude and severity of impact large, especially if not rehabilitated or closed after use. Often associated with other impacts (e.g., increased hunting/angling, disturbance, displacement, avoidance, invasive species, erosion, sedimentation) so difficult to tease apart impacts.
		Silviculture practices - crown	Loss of deciduous component through silviculture impacts processes, habitats and individual species.

Global Threats (IUCN)	Threat Sub-categories	Activity	Comments on the Local Threats
	Forestry on private land	Stand structure modification - crown	Loss of stand structural elements (e.g., veteran trees, wildlife trees, hollow logs) throughout crown land has significant magnitude of effect, and is pervasive.
		Seral stage conversion - private	Same types of potential impacts as above, but extent much more localized, and compounds effects identified for crown land. Requirements for management are less stringent on private land, hence increased impact ratings for some elements.
		Riparian system impacts - private	Forest practices intend to maintain riparian values, but may often fail to do so; regulations less stringent on private, but spatial extent smaller.
		Silviculture practices - private	Loss of deciduous component through silviculture impacts processes, habitats and individual species.
	Livestock grazing (crown and private)	Stand structure modification - private	Loss of stand structural elements (e.g., veteran trees, wildlife trees, hollow logs) has significant magnitude of effect, but spatial extent smaller.
		Riparian / wetland degradation - grazing	Process and direct impacts on riparian/wetland habitats from grazing is a significant issue; however, local impacts are limited in spatial extent; this could change as climate dries and warms.
	Harvest	Vegetation modification	Process and direct impacts from grazing is a pervasive issue; however, local impacts are more limited than in most other areas of the southern interior, but this could change as climate dries and warms. Rated high for magnitude and risk in dry /warm valleys overall, but given lower rating here due to small area affected.
		Recreational (e.g., hunting, trapping, angling, gathering)	Activity mainly seasonal, focused on certain habitats and species, but low to moderate overall. Primarily on game and fish species, rather than SAR species. Overall effects largely unknown.
		First Nation harvest	Low magnitude and extent in these particular areas.
		Illegal (poaching & persecution)	Low magnitude and extent in these particular areas.
	Agriculture	Commercial wild-crafting	Unstudied, unregulated and unknown impacts with potential for increase in the future. Recent examples of apparent overharvesting: Pine mushrooms, Area D, huckleberries in other areas.
		Habitat conversion and degradation (e.g., cultivated fields, orchards, hobby farms, market gardens)	Magnitude of potential impacts are high, where they occur, but spatial extent assumed to be quite limited. Impacts mainly in low elevation hydro-riparian forest in the lower Duncan/Lardeau Valley and the south end of Kootenay Lake, on fans and along lakeshore. Low elevation forests and riparian systems have thus been disproportionately impacted.

Global Threats (IUCN)	Threat Sub-categories	Activity	Comments on the Local Threats
		Pesticides / fertilizers	Use assumed relatively minimal in an agricultural context, but unknown effect on many species and the significant impact of mosquito control included here.
		Non-native / GMO crops	Local use assumed very minimal so magnitude and extent of impact likely negligible. Future potential unknown.
	Mining and quarrying (historical, current)	Habitat loss, degradation, disturbance, roads	Significant mining legacy with large footprint of disturbance and roads; current operations smaller and focused on placer and aggregate.
		Tailings and pollution	Significant historical legacy with leaching potential into waterbodies, but localized in current extent and impact severity.
	Alternative energy production	Solar, geothermal, wind, etc.	Activities currently very limited in extent, but potential to grow. Impacts expected to be very localized and of negligible severity and magnitude.
Pollution	Domestic, Commercial and Industrial	Sewage and waste water	Sewage release can reduce water quality and O ₂ content, increase water temperature, and lead to localized eutrophication, growth of plants and algae.
		Garbage and solid waste (landfill disposal, incineration, transport)	Generally, the impacts are very localized (confined to specific sites) and of low magnitude unless leaching and toxicity issues
		Air-borne pollutants (from wood, gas and other burning, fires, etc.)	Generally, impacts are localized in settlement areas/centers, more pronounced in winter and of low severity.
		Chemicals (e.g., release and/or spills of detergents, herbicides, fertilizers, pesticides, lubricants, oils)	Contributes to localized eutrophication, habitat degradation and contamination; potential for localized impacts to selected low elevation habitat targets and dependent species.
Geological Events		Landslides, debris floods/torrents, avalanches and associated hazards	Impacts to selected habitats (e.g., avalanche run-out zones, steep terrain and streams disturbed by road-building) and localized impacts can be high, however, extent confined to isolated sites, though potential to increase with climate change.

Table 4: Conservation Threats Ranking (High (3), Medium (2), Low (1) or Negligible (0) impact) Sorted from Highest to Lowest.

Global Threats (IUCN)	Threat Sub-categories	Local Threats	Hydro-Riparian Systems	Fish Habitat	At Risk Aquatic Vertebrates	At Risk Terrestrial Vertebrates	Wetlands	Dry ICH (dw1, xw)	Connectivity	Old ICHmw	Cottonwood-Dominated Floodplain	Brushlands/Grasslands	Shrub and Herb-dominated Floodplain	Karst (Hot & Cold Springs)	Total
Natural System Modifications	Dams and Water Management	Habitat loss, conversion and degradation	3	3	3	3	3	3	3	3	3	3	3	0	33
Residential and Commercial Development	Low elevation development	Habitat loss, conversion and degradation	3	2	3	3	2	3	3	2	3	3	2	1	30
Transportation and Service Corridors	Corridors	Roads - construction, use and maintenance	3	2	2	3	3	3	3	3	2	3	2	1	30
Climate Change	Climate Change	Increased fire risk (frequency and severity)	3	2	2	2	2	3	3	3	2	2	2	0	26
Climate Change	Climate Change	Overall impact of changing climate (terrestrial)	3	0	0	3	3	3	3	3	3	2	3	0	26
Resource Use	Forestry on crown land	Forestry roads - crown	2	2	2	3	2	2	3	2	1	2	1	1	23
Natural System Modifications	Dams and Water Management	River / flood patterns (in remaining system)	3	3	3	2	3	1	1	1	3	0	2	0	22
Natural System Modifications	Dams and Water Management	Reservoir levels (behind dams)	3	2	2	2	2	1	1	2	3	1	3	0	22
Transportation and Service Corridors	Recreation on land	Motorised recreation on land (e.g., ATVS, dirt bikes, snowmobiles)	2	2	2	2	3	2	2	2	1	2	2	0	22
Invasive and Problematic Species, Genes and Diseases	Invasives	Non-native plants	2	2	2	2	3	2	1	1	2	2	2	0	21
Transportation and Service Corridors	Corridors	Other linear corridors - construction and maintenance (powerline, gas, other)	2	1	1	2	2	2	2	2	2	2	2	1	21
Climate Change	Climate Change	Increased moisture stress and mortality of key vegetation species	2	0	2	2	2	3	1	3	2	2	1	0	20
Residential and Commercial Development	Low elevation development	Human-related disturbance (e.g., by people, pets, machinery & equipment)	2	2	2	2	1	2	3	1	2	2	1	0	20
Resource Use	Forestry on crown land	Landscape-level modification - crown	2	2	2	2	1	3	3	3	1	0	1	0	20
Resource Use	Forestry on private land	Riparian system impacts - private	3	2	2	1	2	2	2	1	2	2	1	0	20
Resource Use	Forestry on crown land	Stand structure modification - crown	2	2	2	2	1	3	1	3	1	1	0	0	18
Climate Change	Climate Change	Increased incidence of insects and diseases and associated mortality of key tree species	2	0	0	2	1	3	2	3	2	1	1	0	17

Global Threats (IUCN)	Threat Sub-categories	Local Threats	Hydro-Riparian Systems	Fish Habitat	At Risk Aquatic Vertebrates	At Risk Terrestrial Vertebrates	Wetlands	Dry ICH (dw1, xw)	Connectivity	Old ICHmw	Cottonwood-Dominated Floodplain	Brushlands/Grasslands	Shrub and Herb-dominated Floodplain	Karst (Hot & Cold Springs)	Total
Invasive and Problematic Species, Genes and Diseases	Invasives	Non-native animals	2	3	2	2	3	1	0	1	1	1	1	0	17
Natural System Modifications	Fire Suppression	Fire Suppression and changing wildfire patterns	1	1	1	2	1	3	2	1	1	3	1	0	17
Resource Use	Forestry on crown land	Silviculture practices - crown	2	2	2	1	2	2	0	2	1	3	0	0	17
Resource Use	Forestry on private land	Silviculture practices - private	2	2	2	1	2	2	0	2	1	3	0	0	17
Resource Use	Forestry on private land	Stand structure modification - private	2	2	2	2	2	2	1	2	1	1	0	0	17
Residential and Commercial Development	Low elevation development	Invasive weed species establishment and spread	1	2	1	2	2	2	0	1	1	3	1	0	16
Resource Use	Forestry on crown land	Riparian system impacts - crown	2	2	2	1	2	1	2	1	1	1	1	0	16
Resource Use	Forestry on private land	Seral stage conversion - private	1	1	1	1	1	3	2	2	3	0	1	0	16
Climate Change	Climate Change	Extreme weather events (storms, flooding)	2	3	0	1	1	1	1	1	2	1	1	1	15
Climate Change	Climate Change	Overall impact of changing climate (aquatic)	3	3	3	0	3	0	3	0	0	0	0	0	15
Resource Use	Agriculture	Habitat conversion and degradation (cultivated fields, orchards, hobby farms, market gardens, etc.)	2	1	1	1	2	2	2	1	2	1	0	0	15
Transportation and Service Corridors	Recreation on water	Motorised recreation on water (e.g., boating, seedoos, ferries)	2	2	2	2	1	1	1	1	1	0	1	0	14
Transportation and Service Corridors	Corridors	Railways - construction, use and maintenance	1	1	1	1	1	2	1	1	2	1	1	0	13
Transportation and Service Corridors	Intense recreation	Resort development and use	1	2	2	1	1	1	1	1	1	1	1	0	13
Resource Use	Livestock grazing (crown and private)	Vegetation modification	1	1	1	1	1	1	1	1	1	2	1	0	12
Resource Use	Livestock grazing (crown and private)	Riparian / wetland degradation - grazing	1	1	1	1	1	1	1	1	1	2	1	0	12
Resource Use	Mining and quarrying (historical, current)	Habitat loss, degradation, disturbance, roads	1	1	1	1	1	1	1	1	1	1	1	1	12
Invasive and Problematic Species, Genes and Diseases	Invasives	Problematic species, genes and diseases	1	0	2	2	1	1	0	1	1	1	1	0	11

Global Threats (IUCN)	Threat Sub-categories	Local Threats	Hydro-Riparian Systems	Fish Habitat	At Risk Aquatic Vertebrates	At Risk Terrestrial Vertebrates	Wetlands	Dry ICH (dw1, xw)	Connectivity	Old ICHmw	Cottonwood-Dominated Floodplain	Brushlands/Grasslands	Shrub and Herb-dominated Floodplain	Karst (Hot & Cold Springs)	Total
Residential and Commercial Development	Low elevation development	Residential water demand	1	2	2	1	1	0	1	0	1	0	1	0	10
Natural System Modifications	Dams and Water Management	Physical obstructions - Reservoir Drawdown areas (lake-tributary mouth interface)	1	3	2	0	0	0	3	0	0	0	0	0	9
Transportation and Service Corridors	Recreation on land	Non-motorised on land (e.g., biking, hiking, caving, rock-climbing, skiing)	1	1	1	1	1	1	1	1	0	1	0	0	9
Natural System Modifications	Fuel management	Fuel reduction fire hazard treatments	1	0	0	1	0	2	0	2	0	0	0	0	6
Residential and Commercial Development	Low elevation development	Septic demand and sewage leaching	1	2	2	0	1	0	0	0	0	0	0	0	6
Resource Use	Agriculture	Pesticides / fertilisers	1	1	1	1	2	0	0	0	0	0	0	0	6
Pollution	Pollution	Chemicals (e.g., release and/or spills of detergents, herbicides, fertilizers, pesticides, lubricants, oils)	1	1	1	1	0	0	0	0	0	1	0	0	5
Resource Use	Mining and quarrying (historical, current)	Tailings and pollution	1	1	1	1	1	0	0	0	0	0	0	0	5
Transportation and Service Corridors	Recreation on water	Non-motorised recreation on water (e.g., sailing, kayaking, canoeing, paddle-boarding, skating)	1	1	1	1	1	0	0	0	0	0	0	0	5
Geological Events	Geological events	Landslides, debris floods/torrents, avalanches and associated hazards	1	1	1	0	0	0	1	0	0	0	0	0	4
Natural System Modifications	Dams and Water Management	Physical obstructions (flooded areas)	0	0	0	1	0	0	3	0	0	0	0	0	4
Pollution	Domestic, Commercial and Industrial	Sewage and waste water	1	1	1	0	1	0	0	0	0	0	0	0	4
Resource Use	Harvest	Illegal (poaching & persecution)	0	1	1	1	0	0	0	0	0	0	0	0	3
Pollution	Pollution	Garbage and solid waste (landfill disposal, incineration, transport)	0	1	1	0	0	0	0	0	0	0	0	0	2
Resource Use	Harvest	Recreational (e.g., hunting, trapping, angling, gathering)	0	1	0	1	0	0	0	0	0	0	0	0	2
Resource Use	Agriculture	Non-native / GMO crops	0	0	0	1	0	0	0	0	0	0	0	0	1

Global Threats (IUCN)	Threat Sub-categories	Local Threats	Hydro-Riparian Systems	Fish Habitat	At Risk Aquatic Vertebrates	At Risk Terrestrial Vertebrates	Wetlands	Dry ICH (dw1, xw)	Connectivity	Old ICHmw	Cottonwood-Dominated Floodplain	Brushlands/Grasslands	Shrub and Herb-dominated Floodplain	Karst (Hot & Cold Springs)	Total
Resource Use	Harvest	First Nation harvest	0	0	0	1	0	0	0	0	0	0	0	0	1
Pollution	Pollution	Air-borne pollutants (from wood, gas and other burning, fires, etc.)	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource Use	Alternative energy production	Solar, geothermal, wind, etc.	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource Use	Harvest	Commercial wildcrafting	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total			81	76	74	73	72	71	65	62	58	57	43	6	

7.0 SUMMARY OF CONSERVATION ACTIONS

In total, 39 broad-based conservation actions were developed that are applicable to aquatic and terrestrial habitat targets and relevant for private land within the study area (Table 5). These actions were arranged in descending order of perceived feasibility and effectiveness and they were nested within three main action groups: i) direct conservation actions (Rank 3); ii) required steps to guide future conservation actions (Rank 2); and iii) potential steps to guide future conservation actions (Rank 1). Each action was also ranked against each of the habitat targets (also arranged in descending order of threat from 3 to 1). Cells in the main body of Table 5 provide the overall scores, based on summing the scores for feasibility/effectiveness (scored from 1-4), action group (scored from 1-3), and threat (scored from 1-3) for each target habitat type. For most actions, at least one relevant example is provided to better illustrate the action, but these are only examples, and there may be a multitude of possible options, depending on the action. Conservation actions listed in Table 5 were also grouped by conservation bins (Section 4.4) to be consistent with other regional assessments and that table is provided in Appendix C, Table C1.

Conservation actions were ranked by habitat target, relative to the number/severity of threats acting on a target, and the availability and degree of protection for that target. Threat scores for many of the habitat targets were relatively comparable, so there was limited resolution to differentiate among them. Furthermore, some targets subject to a moderate level of threat had very low habitat availability or protection in the study area (e.g., brushland and cottonwood floodplain). For this reason, all targets were ranked high with respect to threats, with the exception of shrub and herb-dominated floodplain and karst, for which additional information (i.e., mapping and data on abundance and distribution) is required.

Very High feasibility/effectiveness scores correspond to actions that result directly in **critical** or **high value target habitat protection**, either via acquisition, covenant establishment, or landowner agreement. Very High scores were also assigned where the actions directly implement recommendations in recovery plans focused on a target listed species/habitat, or where mortality to a listed, rare or regionally sensitive species (or access to its critical habitat) is reduced directly by the action being implemented. Very High scores correspond to actions that help enhance or restore ecosystem processes (e.g., fire regimes; seasonal flooding and a natural hydrograph; water storage and erosion control capacity; connectivity for dispersal, pollination, seed/spore dispersal) in target habitats.

The summary for the 52 vertebrate SAR provided in Appendix A, Table A4 will be very helpful in evaluating proposals with respect to listed vertebrate species and their associations with habitat sub-types and habitat targets. This table also indicates whether Recovery Plans (RPs) or Management Plans (MPs) have been completed at the federal and/or provincial level for these species or subspecies. Where this is the case, they could be reviewed to determine those priority conservation actions and management recommendations that are most applicable to the Kootenay Lake study area. It is important to note that listed invertebrate and plant species and listed ecological communities were not included in this analysis and this information gap should be addressed in future.

High feasibility/effectiveness scores were assigned where a management plan, regulations, bylaws or guidelines are implemented that clearly enhance listed species and/or target habitat

protection on private land. High scores were also assigned where a landowner, land manager, or community group implement stewardship actions that clearly benefit listed, rare, or sensitive species and/or target habitats. Such stewardship actions could include a wide variety of measures such as invasive species treatment or other forms of habitat enhancement or restoration of habitat for listed and priority fish and wildlife species. Actions involving implementation of assessments, inventories, research and/or monitoring initiatives to identify critical and/or priority habitat and/or threats to listed species or to ecosystems (e.g., climate change) were all considered required steps to guide defensible “on the ground” conservation actions in the future, hence the implementation of such measures were ranked as High.

Moderate feasibility/effectiveness scores were assigned to other required measures for future conservation actions such as: planning or inventory; research and monitoring actions; stewardship planning; development of assistance programs; associated financial incentives; and, development of management plans, regulations/bylaws, guidelines, or land use planning initiatives on private land. Some actions potentially guiding future conservation actions and involving larger groups of participants (i.e., stewardship awareness training, guardian program development) as well as research and management on restoring natural ecosystem processes or reducing disease incidence were also scored as Moderate.

Low feasibility/effectiveness scores were assigned to more indirect measures (which may potentially lead to future conservation actions) that are focused on problem wildlife management, citizen science, public education and awareness, and participation in other planning and management initiatives underway.

Finally, nine other key conservation actions deemed important in a local context, but that are typically addressed on crown land and/or under the responsibility of government were listed for reference below. Steps to guide conservation actions by government or other jurisdictions include:

- Predator management (e.g., manage wolves to reduce caribou mortality; piscivorous fish in Kootenay Lake);
- Harvest management (e.g., protect beavers to maintain wetland habitat);
- Land use planning on crown land;
- Recreation planning/zoning and implementation of “no-go” areas;
- Improve legislation, policy, or guidelines for species and habitats at risk;
- Improve compliance and enforcement for species and habitats at risk;
- Improve legislation, policy and oversight for private forest & range management;
- Improve environmental impact assessment and referral processes on crown land;
- Re-institute government control and oversight over crown forest & range management; and
- Increase constructive engagement on forest & range management.

Table 5: Conservation Actions Summary Table

		Decreasing Level of Threat Relative to Availability of Habitat Targets											
		Habitat Target Type Rank:											
		3	3	3	3	3	3	3	3	3	2	1	
		Hydro-Riparian Systems	Fish Habitat	At Risk Aquatic Vertebrates	At Risk Terrestrial Vertebrates	Wetlands	Dry ICH (dw1, xw)	Connectivity	Old ICHmw	Cottonwood-Dominated Floodplain	Brushlands/Grasslands	Shrub and Herb-dominated Floodplain	Karst (Hot & Cold Springs)
Feasibility and Effectiveness Rank	Activity Type and Description (Conservation Action Type Rank)												
	Direct Conservation Actions (3 points)												
4	• Acquire critical or high value habitat; purchase and manage for conservation (see Appendix A, Table A4 for SAR habitat associations and RPs/MPs, if available; other regionally important species)	10	10			10	10	10	10	10	9	8	
4	• Protect critical or high habitat; establish covenant, landowner agreement (see Appendix A, Table A4 for SAR habitat associations and RPs/MPs, if available; other regionally important species)	10	10			10	10	10	10	10	9	8	
4	• Protect identified critical, rare or sensitive habitats or features (see Table A4 in App. A for SAR habitat associations and RPs/MPs, if available; other regionally important species)	10	10			10	10	10	10	10	9	8	
4	• Implement other actions recommended in recovery plans focused on target listed species/habitats (see species with RPs/MPs available Appendix A, Table A4)			10	10								
4	• Reduce mortality to listed, rare or sensitive species (e.g., develop wildlife crossing structures where roadkill mortality is a known concern)			10	10								
4	• Reduce access to critical, rare or sensitive habitat (e.g., close a key access road, gate a bat hibernacula, fence off a raptor breeding territory, angling closures, shoal spawning)	10	10			10	10	10	10	10	9	8	
4	• Restore or enhance ecosystem processes/functions (e.g., fire, seasonal flooding, water storage, erosion control, fish & wildlife dispersal, pollination)	10	10			10	10	10	10	10	9	8	
3	• Implement a management plan to enhance species or habitat protection (e.g., FKLSS implementing a plan for wetland creation at Sunshine Bay)	9	9	9	9	9	9	9	9	9	8	7	
3	• Implement regulations/by-laws that enhance habitat or species protection (e.g., implement dog bylaws in regional parks used by listed waterfowl and shorebirds, no anchoring zones in shoal)	9	9	9	9	9	9	9	9	9	8	7	
3	• Implement guidelines that enhance habitat or species protection (e.g. implement BMPs for beaver lodge or muskrat den protection on private land)	9	9	9	9	9	9	9	9	9	8	7	
3	• Implement other landowner or land manager stewardship actions for listed, rare, sensitive species/habitats (see Appendix A, Table A4)	9	9	9	9	9	9	9	9	9	8	7	
3	• Implement community group stewardship program for priority habitats or species (e.g., to manage problem grizzly and black bears in a local community)	9	9	9	9	9	9	9	9	9	8	7	
3	• Implement a long term community-driven invasive species treatment program (e.g., implement Scotch broom treatment by North Shore resident group)	9	9	9	9	9	9	9	9	9	8	7	
3	• Invasive species treatment with (emphasis on riparian, wetland, sensitive, high value sites (e.g., knotweed yellow flag iris control on Fishermen's Road); suppression of non-native fish)	9	9			9	9	9	9	9	8	7	
3	• Enhance habitat of listed, rare or sensitive fish and wildlife species (see Table A4 in App. A for SAR habitat associations; e.g., restore degraded marsh or hardened shorelines)	9	9			9	9	9	9	9	8	7	
3	• Restore or create fish or wildlife habitat (e.g., remove barriers to restore fish passage; improve habitat suitability for bank swallows or yellow-breasted chats)	9	9			9	9	9	9	9	8	7	
3	• Restore or create habitat features important for fish and wildlife (e.g., create wildlife tree for woodpeckers, painted turtle nesting sites, fish spawning areas)	9	9			9	9	9	9	9	8	7	
Required Steps to Guide Future Conservation Actions (2 points)													
3	• Species or habitat assessment/inventory to identify critical, rare or sensitive habitat (e.g., survey of listed SAR at sites with high breeding potential; additional spawning areas for Bull Trout and Kokanee)	8	8	8	8	8	8	8	8	8	7	6	
3	• Species or habitat research to help identify threats and mitigation measures (e.g., bat research to identify threat of white-nose syndrome)	8	8	8	8	8	8	8	8	8	7	6	
3	• Species or habitat monitoring to effectiveness of enhancement, restoration, and mitigation measures (e.g., occupancy monitoring of artificial hibernacula; fish use at enhanced shoreline sites)	8	8	8	8	8	8	8	8	8	7	6	
3	• Monitoring and/or inventory that aids in identification and/or establishment of the location of threats (e.g., monitoring leopard frog roadkill at Duck Lake; Kokanee shoal spawning)	8	8			8	8	8	8	8	7	6	
3	• Climate change monitoring that enhances understanding of habitat changes and/or risk to survival (e.g., water quantity and quality monitoring streams, groundwater, aquifers; snow & glacier monitoring)	8	8	8	8	8	8	8	8	8	7	6	
2	• Invasive species inventory for priority species; see CKISS lists (e.g., giant hogweed, knotweeds, purple loosestrife, Eurasian milfoil, Scotch broom, flag iris)	7	7			7	7	7	7	7	6	5	
2	• Invasive species research based on CKISS priorities (to develop new tools/techniques, and evaluate non-target impacts); non-native/native fish overlaps	7	7	7	7	7	7	7	7	7	6	5	
2	• Invasive species monitoring to evaluate change in status/condition or effectiveness of control and containment measures (e.g., periodic knotweed monitoring)	7	7	7	7	7	7	7	7	7	6	5	
2	• Stewardship planning and implementation assistance programs for landowners and managers at stand and landscape scales	7	7	7	7	7	7	7	7	7	6	5	
2	• Financial incentives for developing future stewardship actions (e.g., funding for developing plans such as vegetation or prescribed fire in degraded habitat; sensitive habitat inventory mapping)	7	7	7	7	7	7	7	7	7	6	5	
2	• Develop a management plan to improve habitat or species protection (e.g., a plan to protect old forest via management of the surrounding younger forest matrix)	7	7	7	7	7	7	7	7	7	6	5	
2	• Develop regulations that improve habitat or species protection (e.g., work with land managers to develop access restrictions for floodplains)	7	7	7	7	7	7	7	7	7	6	5	
2	• Develop guidelines that improve habitat or species protection (e.g., for a listed plant community in relation to existing threats)	7	7	7	7	7	7	7	7	7	6	5	
2	• Land use planning for private land (e.g. work with large land managers/owners to develop access management or wildfire management plans)	7	7	7	7	7	7	7	7	7	6	5	
Potential Steps to Guide Future Conservation Actions (1 point)													
2	• Training for target groups (e.g., commercial recreation operators, industry, recreation groups) operating in at-risk, rare or sensitive areas	6	6	6	6	6	6	6	6	6	5	4	
2	• Guardian program development (First Nations, group) for key habitats/species (e.g., small lake or streams with over-fishing, poaching or intensive recreation)	6	6	6	6	6	6	6	6	6	5	4	
2	• Research to restore/improve natural ecosystem processes and functions (e.g., water, fire, flood, and other management regimes)	6	6	6	6	6	6	6	6	6	5	4	
2	• Disease research and management (e.g., chytrid fungus, white-nose, honeybee diseases, whirling disease)			6	6								
1	• Problem wildlife management on private land (e.g., to address problem bear, beaver, woodpecker, porcupine, elk and other forms of wildlife damage)			5	5								
1	• Citizen science programs to supplement other information (e.g., osprey, water quality and quantity monitoring in smaller watersheds)	5	5	5	5	5	5	5	5	5	4	3	
1	• Public education and awareness, including interpretive information, signage, brochures (e.g., brochure to improve awareness of local listed plants; brochure to educate foreshore landowners)	5	5	5	5	5	5	5	5	5	4	3	
1	• Participation in planning/management initiatives (for ecosystems, habitats, species, climate adaptation, ecosystem function)	5	5	5	5	5	5	5	5	5	4	3	

Notes: A blank cell indicates that the activity is not applicable to the Habitat Target listed. Cells in the main body provide the overall scores, based on summing the scores for feasibility/effectiveness (scored from 1-4), action group (scored from 1-3), and threat (scored from 1-3) for each target habitat type. Maximum total score for each cell possible is 10. Brief examples are provided in parentheses for each action, where applicable.

8.0 INFORMATION GAPS & NEEDS

The following is a list of information gaps and needs identified during the program:

- This analysis did not consider or interpret the potential for listed invertebrate and plant species and listed ecological communities in the Kootenay Lake Forest District (based on CDC data in Appendix A, Tables A4, A5 and A6) occurring in the study area. In addition, these listed taxa were not considered in the threat analysis and relative ranking of importance of habitat types. CDC tracking lists for these other listed values have changed dramatically in the last year and there is a need to screen the lists for a range of criteria to determine likelihood for occurrences in the study area, followed by ground-truthing for taxa with highest potential. The outcome of such work may ultimately influence the importance of particular habitat targets and/or lead to the identification of additional targets;
- Although climate change has been recognized as a significant threat, little local information is available on the degree or rate of change that is occurring. Therefore monitoring of habitat change (aquatic and terrestrial) is needed to better understand the breadth, magnitude and potential rate of increasing risk that climate change may pose at any given time or place for all of the identified conservation targets;
- There are still many information gaps with respect to climate change adaptation and improving resilience at multiple spatial scales. For example, the concept of “climate refugia” was raised during the information gathering phase of this project. Climate refugia are safe havens on the landscape that provide the diversity of habitats and stability needed to promote persistence of biodiversity as regional biotic and abiotic environmental conditions change. They are locations that biodiversity can retreat to, persist in, and can potentially expand from under changing climate. Identifying climate refugia is a key climate change adaptation objective arising from unavoidable constraints on the capacities of species to evolve tolerances at a rate that is commensurate with the rate of climate change. Species may become extirpated through parts of their geographic ranges and protecting climate refugia may reduce such losses (Conservation Biology Institute 2018). Approaches and tools for identifying refugia (at the population, species, ecosystem and landscape scale) are currently being developed and pilot tested in the US (Conservation Biology Institute 2018). Variable methods and results have been reported on, and most approaches emphasize topographic and geologic complexity, but a clear accepted methodology for doing so has not yet emerged. No work has been done in the West Kootenay, and addressing climate refugia locally would require development of criteria, an accepted methodology, and then a series of mapping/modeling evaluations to be undertaken. Clearly, this is an important information gap that remains to be further explored and implemented;
- Actual karst abundance and distribution and susceptibility to threats requires further evaluation, including field verification, in the study area. Also, relatively little is known about species dependencies on karst and degree of use of karst by different guilds of wildlife, plants (especially ferns, mosses and non-vascular species), fungi, partly due to the remoteness of this resource. Improving the existing spatial information base and characterisation of karst resources are key objectives to understand if existing protection on private land is representative and/or adequate;

- Many sensitive habitats and species at risk have not been systematically surveyed in the Kootenay Lake study area, and much of the existing terrestrial information base comes from work confined mainly to the CVWMA, the NCC Darkwoods property, Fish & Wildlife Compensation properties at Meadow Creek, the Marsden Face Nature Trust properties near Grohman Creek, and various other small protected areas (e.g., Kokanee Creek and Grohman Provincial Parks, and more recently Harrop Wetlands Regional Park). There is an obvious need to broaden the geographic scope of future inventories, management, monitoring and threat evaluations to private and adjacent crown lands in the study area. Greater collaboration and information sharing with additional large landowners and managers (e.g., Teck Metals Ltd., forest licensees with some private forest land, woodlot owners) would be helpful in this regard. Incentive programs to promote greater participation on the part of private landowners may be necessary;
- The FWCP conducts Bull Trout spawning surveys in priority stream watersheds, but there are additional priority streams that they are not able to cover annually. Additional surveys for those streams that are not included by the FWCP are necessary to further evaluate this habitat target and apply conservation actions for further protection, enhancement and/or restoration opportunities;
- The current study compiled stream, lake and wetland areas as having native/non-native fish species presence and this was represented as a 'fish-bearing' (Appendix B, Figure B3). However, many streams depicted as fish bearing were inferred based on fish presence data points and may not be fish bearing along their entire length. Streams identified as 'no fish observations/unknown fish status' may also be lacking surveyed information. Therefore, additional fish inventory in streams, small lakes and wetland areas is required in unknown status areas to further populate the provincial FISS database to identify native and non-native fish habitats. Areas of native/non-native fish overlaps for species that may hybridize like trout are also informative for determining additional conservation actions that may help reduce non-native species and/or enhancement of native fish habitats, where possible. Trends in fish abundance, distribution and productivity are lacking for medium and small lake systems within the study area;
- It was not possible to evaluate aquatic connectivity issues associated with water quantity, such as low stream flows (or flows that go subsurface) that can also inhibit fish movements and migrations. Additional inventory or study may be required; and
- Although this analysis was intended to focus on ecological values, the findings are relevant to the ability of First Nations people to effectively connect with all values at multiple spatial scales. Conservation actions put forward in this document were discussed with representatives of the Ktunaxa First Nation and it is anticipated that the proposed protection, enhancement, and restoration of ecosystem, habitat, and species targets will align well with the goal of improved protection of cultural and archeological values in the study area (N. Kapell, pers. comm., 2018).

9.0 RECOMMENDATIONS

In addition to addressing the data gaps, it is also recommended that the conservation actions matrix developed during this study (Table 5) be used to further evaluate the relative merit of proposed conservation actions. For simplicity, ranking was based on a 10-point system that could be combined with scoring for other criteria (e.g., proposal quality, team experience, project cost) to evaluate proposals for prioritized funding under the KLLCF.

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Note: All personal communications have been included in Acknowledgements.

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Appendix A



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Table A2. Baseline GIS layers

Target Data	Source	Date	Notes
Biogeoclimatic Zone, version 10	https://catalogue.data.gov.bc.ca/dataset/biogeoclimatic-ecosystem-classification-bec-map	Nov 2017 download	
Bull Trout points and stream obstructions	Wood		
Cadastral	RDCK	Nov 2017 download	Contains ownership information
Connectivity	G. Utzig, R. Holt	2014, 2015	
Deciduous Forests (cottonwood)	Bob Jameison for FWCP	2010	Rank 1 = >80% (pure AC stand), Rank 2 = 41 – 80% (mixed w/ significant AC component)
Fish Observation points	https://catalogue.data.gov.bc.ca/dataset/known-bc-fish-observations-and-bc-fish-distributions	Nov 2017 download	Spatial selection of fish points within 200 m of streams (to account for data differences)
Fish passage assessment locations	https://catalogue.data.gov.bc.ca/dataset/pscis-assessments	Nov 2017 download	
Fresh Water Atlas - lakes	https://catalogue.data.gov.bc.ca/dataset/freshwater-atlas-lakes		
Fresh Water Atlas - stream routes	DataBC	Nov 2017 download	
Fresh Water Atlas - wetlands	https://catalogue.data.gov.bc.ca/dataset/freshwater-atlas-wetlands	Nov 2017 download	
Karst - reconnaissance, potential	https://catalogue.data.gov.bc.ca/dataset/reconnaissance-karst-potential-mapping	Nov 2017 download	Likelihood - primary to tertiary
KCP conservation properties	https://catalogue.data.gov.bc.ca/dataset/conservation-properties-kcp-fwcp	May 2017	Fee Simple only
National parks	https://catalogue.data.gov.bc.ca/dataset/national-parks-of-canada-within-british-columbia	Nov 2017 download	Small piece of Glacier National Park
Obstacles to fish passage	https://catalogue.data.gov.bc.ca/dataset/provincial-obstacles-to-fish-passage	Nov 2017 download	
Predictive Ecosystem Mapping - Arrow	D. McKillop, MFLNRO	2013	Wetlands, structural stage
Predictive Ecosystem Mapping - Darkwoods	Nature Conservancy of Canada	2015	Wetlands, structural stage
Predictive Ecosystem Mapping - Kootenay Lake	D. McKillop, MFLNRO	2015 version	Wetlands, mid-bench cottonwood, structural stage, brushland
Provincial Parks	https://catalogue.data.gov.bc.ca/dataset/bc-parks-ecological-reserves-and-protected-areas	Nov 2017 download	There are no ecological reserves in the study area
Species at Risk - masked and unmasked	https://catalogue.data.gov.bc.ca/dataset/species-and-ecosystems-at-risk-masked-secured-publicly-available-occurrences-cdc	Nov 2017 download	Requested unmasked directly
Species at Risk - Wildlife Species Inventory	https://catalogue.data.gov.bc.ca/dataset/wildlife-species-inventory-incident-observations-all	Nov 2017 download	
Stream Classification - Kootenay-Boundary Higher Level Plan	Geosense Consulting for Nelson Forest Region	2000	Grouped (S1 Large, S2-S6 Small/Medium), centerline buffered by 200 m each side (to
Wetlands/Cottonwood - Duncan area	B. Herbison		

Table A3. Fish species present in study area based on available records in the B.C. Fisheries Information Summary System (FISS)

Common Name	Number of FISS Observations	Species Type	Notes
All Fish	3	-	
Bass/Sunfish (General)	3	Non-Native	
Bridgelip Sucker	1	Native	
Brook Trout	142	Non-Native	
Bull Trout	562	Native	
Burbot	225	Native	
Carp	1	Non-Native	
Chub (General)	9	Native	
Cutthroat Trout	25	Native	
Cutthroat/Rainbow cross	2	Native	
Dolly Varden	14	Native	Assumes these are Bull Trout
Fish Unidentified Species	25	-	
Floater Mussel (General)	21	Native	
Kokanee	457	Native	
Lake Chub	6	Native	
Lake Trout	2	Non-Native	
Lake Whitefish	5	Non-Native	
Largemouth Bass	4	Non-Native	
Largescale Sucker	24	Native	
Leopard Dace	1	Native	
Longnose Dace	64	Native	
Longnose Sucker	3	Native	
Minnow (General)	6	-	
Mountain Whitefish	276	Native	
Northern Pikeminnow	111	Native	
Peamouth Chub	124	Native	
Prickly Sculpin	6	Native	
Pygmy Whitefish	1	Native	
Rainbow Trout	1410	Native	
Redside Shiner	196	Native	
Salmon (General)	6	Native	
Sculpin (General)	42	Native	
Slimy Sculpin	92	Native	
Steelhead	2	Native	Assumes these are Rainbow Trout
Sucker (General)	27	Native	
Tench	2	Non-Native	
Torrent Sculpin	8	Native	
Westslope (Yellowstone) Cutthroat Trout	323	Native	
White Sturgeon	8	Native	
Whitefish (General)	8	Native	

Table A4. Provincially and/or federally listed vertebrate species potentially occurring in the study area

Scientific Name	Common Name	B.C. List Status ¹	Species-At-Risk-Act (SARA) ²	Provincial Biogeoclimatic Units ³	Provincial Habitat Subtype	Confirmed in Areas A, D, E (Y,N)	Use of Kootenay Lake Area ⁴	Use of Local Habitat Targets Based on Habitat Suitability and Use Information										Diet	Other Relevant Comments	Recovery Plan (N = no or year)	Management Plan (N = no or year)
								Connectivity & Linkages	Hydro-Riparian (L,M,S) ⁵	Wetlands (M,O,F,B,S) ⁶	Moist ICH (mw2, mw4) ⁷	Dry ICH (dw1, xw, dm) ⁸	Old/Mature Forest (Structure) ⁹	Karst (rock-dominated) Habitat	Brushland/Grassland	Cottonwood (Act)-dominated Floodplain	Shrub and Herb-dominated Floodplain				
AMPHIBIANS (3)																					
<i>Plethodon idahoensis</i>	Coeur d'Alene Salamander	Yellow	SC	ICH;IDF	Riparian Forest;Stream/River;Caves;Sub-soil;Cliff/Rock/Sparsely Vegetated Rock;Talus;Conifer Forest - Moist/wet;Splash Zone	Y	R	lack of connectivity to other populations threatening viability	M,S (pools, splash zones)	n/a	mw2, mw4	dw1,xw	O, M (CWD)	cave, cliff, rock, waterfall, splash zone	n/a	Act riparian & mixed forest	n/a	invertivore	moist to wet splash zone of waterfall	2017	2015
<i>Lithobates pipiens</i>	Northern Leopard Frog	Red	E	CDF;ICH;IDF;PP	Bog;Fen;Swamp;Marsh;Stream/River;Lake;Meadow;Pond/Open Water;Riparian Herbaceous	N	R	lack of connectivity to other populations threatening viability	M,S	B,F,S,M,O	n/a	xw	(CWD)	n/a	n/a	n/a	riparian herbaceous	invertivore	only known in CVWMA out of study area	2016	2012
<i>Anaxyrus boreas</i>	Western Toad	Yellow	SC	BG;BWBS;CDF;CWH;ESSF;ICH;IDF;PP;SBS;SWB	Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian Shrub;Stream/River;Lake;Meadow;Grassland;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Pond/Open Water;Riparian Herbaceous;Warm Spring;Gravel Bar	Y	R	limited connectivity between breeding ponds and other habitats	L, M,S (lake)	B,F,S,M,O	mw2, mw4	dw1, xw	O, M (CWD)	n/a	shrub, meadow	Act riparian & mixed forest	riparian shrub, gravel bar	invertivore		N	2016
REPTILES (3)																					
<i>Chrysemys picta</i> pop. 2	Painted Turtle - Intermountain - Rocky Mountain Population	Blue	SC	BG;ICH;IDF;PP;SBS	Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian Shrub;Lake;Urban/Suburban;Pond/Open Water;Riparian Herbaceous;Gravel Bar;Industrial	Y	R	limited connectivity & viability	M,S (lake)	B,F,S,M,O	mw2	dw1, xw	(CWD)	n/a	shrub	Act riparian & mixed forest	riparian shrub,gravel bar	invertivore		2017	N
<i>Charina bottae</i>	Northern Rubber Boa	Yellow	SC	BG;CWH;ICH;IDF;PP	Riparian Forest;Stream/River;Sub-soil;Rock/Sparsely Vegetated Rock;Talus;Meadow;Grassland;Sagebrush Steppe;Conifer Forest - Mesic (average);Conifer Forest - Dry;Mixed Forest (deciduous/coniferous mix);Antelope-brush Steppe	Y	R	n/a	M,S	n/a	n/a	xw,dw1	(CWD)	rock, talus	shrub, grassland	Act riparian	riparian herbaceous	invertivore		2017	2015
<i>Plestiodon skiltonianus</i>	Western Skink	Blue	SC	BG;ICH;IDF;PP	Riparian Forest;Riparian Shrub;Stream/River;Sub-soil;Rock/Sparsely Vegetated Rock;Talus;Meadow;Grassland;Sagebrush Steppe;Conifer Forest - Mesic (average);Conifer Forest - Dry;Mixed Forest (deciduous/coniferous mix);Riparian Herbaceous;Antelope-brush Steppe;Gravel Bar	Y	R	n/a	M,S	n/a	n/a	xw, dw1	(CWD)	rock, talus	shrub, meadow, grassland	Act riparian & mixed forest	riparian shrub and soil	invertivore	nests in rock, talus, burrow	N	2015
BIRDS (31)																					
<i>Recurvirostra americana</i>	American Avocet	Blue	-	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS	Estuary;Bog;Fen;Swamp;Marsh;Alkali Ponds/Salt Flats;Lake;Intertidal Marine;Pond/Open Water	Y	B,S	n/a	n/a	O,F,S,M (lake, islands,	n/a	xw	n/a	n/a	n/a	n/a	mudflat	invertivore	readily nests on artificial islands	N	N
<i>Botaurus lentiginosus</i>	American Bittern	Blue	-	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS	Estuary;Marsh;Lake;Pasture/Old Field;Cultivated Field;Hedgerow;Grassland;Pond/Open Water;Riparian Herbaceous	Y	B,S	n/a	n/a	M,O (lake, estuary,	n/a	xw	n/a	n/a	cultivated/old field	n/a	riparian herbaceous	pisivore		N	N
<i>Pelecanus erythrorhynchos</i>	American White Pelican	Red	-	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS	Marsh;Stream/River;Lake;Intertidal Marine;Subtidal Marine;Beach;Pond/Open Water;Sheltered Waters - Marine	Y	NB,S	n/a	M,S	O,M (lake, estuary, islands)	n/a	xw	n/a	n/a	cultivated/old field	n/a	gravel or sand bar	pisivore		N	N
<i>Riparia riparia</i>	Bank Swallow	Yellow	T			Y	B,S	n/a	L,M,S	O,M (lake)	mw2	xw, dw1	n/a	n/a	n/a	Act riparian & mixed forest	riparian shrub; sand, dirt, or	insectivore	bank nester	N	N
<i>Hirundo rustica</i>	Barn Swallow	Blue	T	BAFA;BG;BWBS;CDF;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBP S;SBS;SWB	Estuary;Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian Shrub;Stream/River;Lake;Pasture/Old Field;Cultivated Field;Hedgerow;Meadow;Grassland;Shrub - Natural;Sagebrush Steppe;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Urban/Suburban;Pond/Open Water;Riparian Herbaceous;Antelope-brush Steppe;Gravel Bar;Shrub Logged;Industrial	Y	B,S	n/a	L,M,S	O,B,F,M,S (lake)	mw2, mw4	dw1, xw	n/a	n/a	shrub, meadow, grassland	Act riparian & mixed forest	riparian shrub; sand, dirt, or gravel banks	insectivore, invertivore	bank/building nester	N	N
<i>Cypseloides niger</i>	Black Swift	Blue	-	BAFA;BG;CDF;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS;SWB	Bog;Fen;Swamp;Marsh;Stream/River;Lake;Cliff;Pond/Open Water	Y	B,S	n/a	L,M,S	O,B,F,M,S (lake)	mw2, mw4	dw1, xw	n/a	wet cliff, rock, waterfall, limestone cave	n/a	n/a	n/a	insectivore	nests behind cliffs and rocks in waterfalls	N	N
<i>Dolichonyx oryzivorus</i>	Bobolink	Blue	T	BG;BWBS;CDF;CWH;ICH;IDF;P P;SBS	Pasture/Old Field;Cultivated Field;Meadow;Grassland	Y	B,S	n/a	n/a	n/a	n/a	dw1, xw	n/a	n/a	shrub, meadow, old hayfield	n/a	n/a	insectivore		N	N
<i>Phalacrocorax auritus</i>	Double-crested Cormorant	Blue	-	BWBS;CDF;CWH;ICH;IDF;PP;S BPS;SBS	Estuary;Stream/River;Lake;Cliff;Rock/Sparsely Vegetated Rock;Intertidal Marine;Conifer Forest - Mesic (average);Subtidal Marine;Marine Island;Urban/Suburban;Sheltered Waters - Marine	Y	B,S	n/a	L,M,S	O,B,F,M,S (lake)	n/a	xw	O, M	cliff, rock	n/a	Act riparian	gravel bar	pisivore		N	N
<i>Podiceps nigricollis</i>	Eared Grebe	Blue	-	BAFA;BG;BWBS;CMA;CWH;ES SF;ICH;IDF;IMA;MH;MS;PP;SB PS;SBS	Estuary;Bog;Fen;Swamp;Marsh;Lake;Sheltered Waters - Marine	Y	B,S	n/a	n/a	O,B,F,M,S (lake)	mw2, mw4	dw1, xw	n/a	n/a	n/a	n/a	n/a	invertivore, pisivore		N	N
<i>Psiloscops flammeolus</i>	Flammulated Owl	Blue	SC	BG;IDF;PP	Conifer Forest - Mesic (average);Conifer Forest - Dry	N	B,S	n/a	n/a	n/a	n/a	dw1, xw	O, M (veteran trees, snags; moderate canopy; interior forest)	n/a	shrubby understory, grassland	n/a	n/a	insectivore, invertivore	low to moderate density forest, multi-layered canopy with Fd; snags with cavities, thickets, patches of grassland and shrub for feeding	N	2013

Table A4 continued

Scientific Name	Common Name	B.C. List Status ¹	Species-At-Risk-Act (SARA) ²	Provincial Biogeoclimatic Units ³	Provincial Habitat Subtype	Confirmed in Areas A, D, E (Y,N)	Use of Kootenay Lake Area ⁴	Use of Local Habitat Targets Based on Habitat Suitability and Use Information										Diet	Other Relevant Comments	Recovery Plan (N = no or year)	Management Plan (N = no or year)	
								Connectivity & Linkages	Hydro-Riparian (L,M,S) ⁵	Wetlands (M,O,F,B,S) ⁶	Moist ICH (mw2, mw4) ⁷	Dry ICH (dw1, xw, dm) ⁸	Old/Mature Forest (Structure) ⁹	Karst (rock-dominated) Habitat	Brushland/Grassland	Cottonwood (Act)-dominated Floodplain	Shrub and Herb-dominated Floodplain					
<i>Sterna forsteri</i>	Forster's Tern	Red	-	BG;BWBS;CDF;CWH;ICH;IDF;P	Estuary;Marsh;Stream/River;Lake;Intertidal Marine;Beach;Pond/Open Water	N	B,S	n/a	L,M,S	O,M (lake)	n/a	xw	n/a	n/a	n/a	n/a	n/a	n/a	insectivore, piscivore	confirmed breeding in CVWMAonly; nesting platforms made of bundles of PHRAGMITES or TYPHA on floating base of styrofoam and wood or tires were readily used for nesting	N	N
<i>Ardea herodias herodias</i>	Great Blue Heron, <i>herodias</i> subspecies	Blue	-	BG;ICH;IDF;MS;PP;SBS	Swamp;Marsh;Vernal Pools/Seasonal Seeps;Riparian Forest;Stream/River;Lake;Pasture/Old Field;Cultivated Field;Hedgerow;Meadow;Deciduous/Broadleaf Forest;Conifer Forest Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Urban/Suburban;Pond/Open Water;Riparian Herbaceous	Y	B, R/S	connectivity between heronries and feeding areas	L,M,S	O,M,S (lake)	mw2, mw4	dw1, xw	O, M	n/a	shrub, meadow	Act riparian & mixed forest	riparian herbaceous, gravel bar	n/a	piscivore, invertivore, other	nests in both Act and conifer stands within 1 km of water	N	N
<i>Podiceps auritus</i>	Horned Grebe	Yellow	SC		Estuary;Swamp;Marsh;Lake;Pond/Open Water;Sheltered Waters - Marine	Y	B, S	n/a	M,S (non-breeding)	O,M,S (lake)	mw2, mw4	dw1, xw	n/a	n/a	n/a	n/a	n/a	invertivore, piscivore	nests among tall vegetation in shallow water	N	N	
<i>Melanerpes lewis</i>	Lewis's Woodpecker	Blue	T	BG;CDF;CWH;ICH;IDF;PP;SBS	Riparian Forest;Pasture/Old Field;Cultivated Field;Hedgerow;Meadow;Grassland;Sagebrush Steppe;Deciduous/Broadleaf Forest;Conifer Forest -	Y	B, S	n/a	n/a	O (lake)	n/a	xw,dw1	O, M (snags, burns, open forest,	n/a	shrub, meadow, old field,	Act & mixed riparian forest (snags)	n/a	insectivore	open tree canopy,with brushy understory, burns, riparian forest,snag with nest cavities	2017	2014	
<i>Numenius americanus</i>	Long-billed Curlew	Blue	SC	BG;CDF;CWH;ICH;IDF;PP;SBPS;SBS	Pasture/Old Field;Cultivated Field;Intertidal Marine;Meadow;Grassland;Mudflats - Intertidal	Y	B, S	n/a	n/a	O	n/a	xw	n/a	n/a	moist meadow, old field, dry grassland	n/a	mudflat	invertivore	often found near water	N	2012	
<i>Clangula hyemalis</i>	Long-tailed Duck	Blue	-	SBS (breeding)	Estuary;Riparian Shrub;Stream/River;Lake;Tundra;Intertidal Marine;Pond/Open Water;Eelgrass Beds;Riparian Herbaceous;Sheltered Waters - Marine	Y	NB, S	n/a	L,M,S	O	mw2, mw4	dw1, xw	n/a	n/a	n/a	n/a	n/a	riparian herbaceous	invertivore		N	N
<i>Accipiter gentilis atricapillus</i>	Northern Goshawk	Blue	-	BAFA;BG;BWBS;CDF;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBP;S;SBS;SWB	Riparian Forest;Pasture/Old Field;Cultivated Field;Hedgerow;Meadow;Deciduous/Broadleaf Forest;Conifer Forest Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Urban/Suburban;Industrial;Alpine/Subalpine Meadow	Y	B, R	landscape scale connectivity required (2400 ha forested home range)	L,M,S	O (lake)	mw2, mw4	dw1, xw	O, M (veteran trees, snags, interior forest)	n/a	n/a	Act & mixed riparian forest	n/a	carnivore	large tracts of conifer and mixed stands needed (>40-100 ha nest reserve and 2400 home range)	N	2012	
<i>Contopus cooperi</i>	Olive-sided Flycatcher	Blue	T	BWBS;CDF;CWH;ESSF;ICH;IDF;MH;MS;PP;SBPS;SBS;SWB	Bog;Fen;Swamp;Riparian Forest;Conifer Forest - Mesic (average);Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Pond/Open Water	Y	B, S	n/a	n/a	B,F,S,O (lake)	mw2, mw4	dw1	O, M (snags, open)	n/a	n/a	mixed riparian forest	n/a	invertivore	conifer & mixed forest often near riparian	2016	N	
<i>Falco peregrinus anatum</i>	Peregrine Falcon, <i>anatum</i> subspecies	Red	SC	BG;BWBS;CDF;CWH;ICH;IDF;P;SBS	Bog;Fen;Swamp;Marsh;Alkali Ponds/Salt Flats;Stream/River;Lake;Pasture/Old Field;Cultivated Field;Hedgerow;Cliff;Rock/Sparsely Vegetated Rock;Talus;Meadow;Grassland;Shrub - Natural;Sagebrush Steppe;Beach;Urban/Suburban;Pond/Open Water;Riparian Herbaceous;Antelope-brush Steppe;Gravel Bar	Y	B, S	n/a	L,M,S	O,B,F,M,S (lake)	n/a	xw,dw1	n/a	cliff, rock, talus	shrub	Act riparian	riparian herbaceous, gravel bar	carnivore	nests on vertical cliffs	1988	N	
<i>Falco mexicanus</i>	Prairie Falcon	Red	-	BG;BWBS;CDF;CWH;ESSF;ICH;IDF;MS;PP;SBS	Pasture/Old Field;Cultivated Field;Hedgerow;Cliff;Tundra;Meadow;Grassland;Sagebrush Steppe;Antelope-brush Steppe	Y	B, S	n/a	n/a	n/a	n/a	xw	n/a	cliff, rock, talus	shrub, meadow,old field, grassland	n/a	n/a	carnivore	nests in vertical cliffs with rock structure overhanging	N	N	
<i>Phalaropus lobatus</i>	Red-necked Phalarope	Blue	-	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS;SWB	Bog;Fen;Swamp;Marsh;Lake;Tundra;Meadow;Pond/Open Water;Alpine/Subalpine Meadow;Sheltered Waters - Marine	Y	NB, S	n/a	n/a	O,B,F,M,S (lake)	mw2, mw4	dw1, xw	n/a	n/a	meadow, grassland	n/a	n/a	invertivore	extends to alpine and subalpine	N	N	
<i>Euphagus carolinus</i>	Rusty Blackbird	Blue	SC	BG;BWBS;CDF;CWH;ESSF;MS;PP;SBPS;SBS;SWB	Bog;Fen;Swamp;Marsh;Lake;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Urban/Suburban;Pond/Open Water;Industrial	Y	NB, T	n/a	L,M,S	O,B,F,M,S	mw2, mw4	dw1,xw	n/a	n/a	n/a	Act & mixed forest	riparian shrub	frugivore, grainivore, invertivore,	uses wooded wetland and riparian year-round	N	N	
<i>Limnodromus griseus</i>	Short-billed Dowitcher	Blue	-	BG;BWBS;CDF;CWH;ICH;IDF;P;SWB	Estuary;Bog;Fen;Swamp;Pasture/Old Field;Cultivated Field;Hedgerow;Intertidal Marine;Meadow;Beach;Urban/Suburban;Mudflats - Intertidal;Alpine/Subalpine Meadow	Y	NB, T	n/a	n/a	B,F,S	n/a	xw	n/a	n/a	shrub, meadow,old field, grassland	n/a	mudflat	invertivore		N	N	
<i>Asio flammeus</i>	Short-eared Owl	Blue	SC	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS;SWB	Estuary;Marsh;Pasture/Old Field;Cultivated Field;Hedgerow;Meadow;Grassland;Urban/Suburban;Pond/Open Water;Riparian Herbaceous;Alpine/Subalpine Meadow;Alpine Grassland	Y	B, S	n/a	n/a	O,M (lake)	mw2	xw, dw1	n/a	n/a	shrub, meadow,old field, grassland	n/a	riparian herbaceous	carnivore		2016	N	
<i>Melanitta perspicillata</i>	Surf Scoter	Blue	-	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS;SWB	Riparian Forest;Riparian Shrub;Lake;Subtidal Marine;Pond/Open Water;Riparian Herbaceous;Sheltered Waters - Marine	Y	NB, S	n/a	L,M	O (lake)	mw2	xw, dw1	n/a	n/a	n/a	Act & mixed riparian forest	riparian shrub & herbaceous	invertivore	littoral areas, freshwater lake and rivers	N	N	
<i>Cygnus columbianus</i>	Tundra Swan	Blue	-		Estuary;Bog;Fen;Swamp;Marsh;Stream/River;Lake;Pasture/Old Field;Cultivated Field;Hedgerow;Meadow;Pond/Open Water;Riparian Herbaceous;Mudflats - Intertidal;Sheltered Waters - Marine	Y	NB, S	n/a	L,M	O,B,F,M,S (lake,ponds)	mw2, mw4	dw1,xw	n/a	n/a	shrub, meadow,old field, grassland	n/a	riparian herbaceous	herbivore		N	N	
<i>Aechmophorus occidentalis</i>	Western Grebe	Red	SC	BG;BWBS;CDF;CWH;ICH;IDF;MS;PP;SBPS;SBS	Estuary;Marsh;Lake;Subtidal Marine;Pond/Open Water;Sheltered Waters - Marine	Y	B, S	n/a	L,M	O,M (lake,ponds)	mw2	xw,dw1	n/a	n/a	n/a	n/a	n/a	piscivore, invertivore	known to breed in Creston Valley Wildlife Management Area only in this study area	N	N	
<i>Megascops kennicottii macfarlanei</i>	Western Screech-Owl, <i>macfarlanei</i> subspecies	Blue	T	BG;ICH;IDF;PP	Riparian Forest;Pasture/Old Field;Cultivated Field;Hedgerow;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Urban/Suburban	Y	B, S	n/a	L,M,S	n/a	mw2, mw4	dw1,xw	O, M (snags,CWD)	n/a	shrub, meadow,old field	Act and mixed riparian forest	n/a	carnivore, invertivore	nests in deciduous snags	2008	N	
<i>Picoides albolarvatus</i>	White-headed Woodpecker	Red	E	BG;ICH;IDF;PP	Riparian Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Mixed Forest (deciduous/coniferous mix)	N	NB, S	n/a	n/a	n/a	n/a	xw	O (snags)	n/a	n/a	Act and mixed riparian forest	n/a	granivore, invertivore	nests in old pine-dominated forest	2014	N	
<i>Aeronautes saxatilis</i>	White-throated Swift	Blue	-	BAFA;BG;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS	Stream/River;Lake;Cliff;Rock/Sparsely Vegetated Rock;Talus	Y	B, S	n/a	L,M	O (lake)	n/a	xw	n/a	cliff	n/a	n/a	n/a	insectivore	nests on steep cliffs and canyons; forages in forest and open habitats	N	N	

Table A4 continued

Scientific Name	Common Name	B.C. List Status ¹	Species-At-Risk-Act (SARA) ²	Provincial Biogeoclimatic Units ³	Provincial Habitat Subtype	Confirmed in Areas A, D, E (Y,N)	Use of Kootenay Lake Area ⁴	Use of Local Habitat Targets Based on Habitat Suitability and Use Information										Diet	Other Relevant Comments	Recovery Plan (N = no or year)	Management Plan (N = no or year)
								Connectivity & Linkages	Hydro-Riparian (L,M,S) ⁵	Wetlands (M,O,F,B,S) ⁶	Moist ICH (mw2, mw4) ⁷	Dry ICH (dw1, xw, dm) ⁸	Old/Mature Forest (Structure) ⁹	Karst (rock-dominated) Habitat	Brushland/Grassland	Cottonwood (Act)-dominated Floodplain	Shrub and Herb-dominated Floodplain				
<i>Icteria virens</i>	Yellow-breasted Chat	Red	E	BG;CDF;CWH;ICH;IDF;PP;SBS	Riparian Forest;Riparian Shrub;Hedgerow;Shrub - Natural;Deciduous/Broadleaf Forest;Mixed Forest (deciduous/coniferous mix)	Y	B, S	n/a	M,S	O,M (lake)	n/a	xw	n/a	n/a	shrub	Act & mixed riparian forest	riparian shrub	insectivore	nests in dense shrubland and regeneratinf forest with shrubs dominant near water; known to breed in Creston Valley Wildlife Management Area only	2016	N
MAMMALS (11)																					
<i>Taxidea taxus</i>	American Badger	Red	E	BG;ESSF;ICH;IDF;IMA;MS;PP;SBS	Sub-soil;Pasture/Old Field;Talus;Meadow;Grassland;Shrub - Natural;Sagebrush Steppe;Conifer Forest - Mesic (average);Conifer Forest - Dry;Krummholtz;Antelope-brush Steppe;Shrub - Logged;Alpine Grassland	Y	E?	landscape scale connectivity and linkages needed mean 67 km2 home range)	n/a	n/a	n/a	xw	n/a	n/a	shrub, meadow, grassland	n/a	n/a	carnivore	friable soil for burrowing	2008	N
<i>Rangifer tarandus</i> pop. 1	Caribou (southern mountain population)	Red	T	BAFA;ESSF;ICH;IMA	Bog;Fen;Swamp;Marsh;Riparian Forest;Cliff;Rock/Sparsely Vegetated Rock;Talus;Tundra;Avalanche Track;Meadow;Grassland;Shrub - Natural;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Krummholtz;Alpine/Subalpine Meadow;Alpine Grassland	Y	R	landscape scale connectivity and linkages required	M,S	B,F,S, M	mw2, mw4	n/a	O (veteran trees,snags, lichen,interior forest)	rock,talus	shrub, meadow, old field, grassland (snags)	n/a	n/a	herbivore	lichens required; riparian forest and avalanche tracks used occasionally	2014	N
<i>Pekania pennanti</i>	Fisher	Blue	-	BAFA;BWBS;CDF;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBS;SBS;SWB	Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian Shrub;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Krummholtz;Riparian Herbaceous;Gravel Bar	N	E?	landscape scale connectivity and linkages required	L,M,S	B,F,S, M	mw2, mw4	dw1	O,M (wildlife trees, CWD,interior forest)	n/a	riparian shrub	Act riparian forest & shrub	riparian shrub & herbaceous	carnivore	use upland and lowland forests, including coniferous, mixed, and deciduous forests; require large tracts of contiguous interior forest with high canopy closure, large trees and snags, large woody debris, large hardwoods, multiple canopy layers, and overhead canopy cover	N	N
<i>Myotis thysanodes</i>	Fringed Myotis	Blue	SC	BG;ICH;IDF;PP	Stream/River;Caves;Cliff;Rock/Sparsely Vegetated Rock;Talus;Meadow;Grassland;Sagebrush Steppe;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Antelope-brush Steppe	Y	R	n/a	L,M,S	n/a	mw2, mw4	dw1	O,M (wildlife trees, CWD)	cave,cliff,rock,talus	shrub, meadow, grassland	Act riparian & mixed forest	riparian shrub & herbaceous	insectivore	roosts are in caves, mines, cliff faces, rock crevices, snags, old buildings, bridges	N	N
<i>Ursus arctos</i>	Grizzly Bear	Blue	-	BAFA;BWBS;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;SBPS;SBS;SWB	Estuary;Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian Shrub;Stream/River;Caves;Pasture/Old Field;Talus;Tundra;Avalanche Track;Meadow;Grassland;Sagebrush Steppe;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Beach;Urban/Suburban;Riparian Herbaceous;Gravel Bar	Y	R	landscape scale connectivity and linkages required	L,M,S	B,F,S, M	mw2, mw4	xw, dw1	O,M (CWD, old cedar feeding)	cave (den site)	shrub, meadow, old field, grassland (snags)	Act & mixed riparian forest and shrub	riparian shrub, herbaceous, gravel bar	omnivore	avalanche tracks important in spring; huckleberry patches through summer/fall	N	2002
<i>Myotis lucifugus</i>	Little Brown Myotis	Yellow	E	BG;BWBS;CDF;CWH;ESSF;ICH;IDF;MH;MS;PP;SBPS;SBS;SWB	Riparian Forest;Riparian Shrub;Caves;Meadow;Grassland;Shrub - Natural;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Urban/Suburban;Shrub - Logged;Industrial;Garry Oak Woodland;Garry Oak Coastal Bluffs	Y	R	n/a	L,M,S	n/a	mw2, mw4	dw1,xw	n/a	caves	shrub, meadow, grassland	Act & mixed riparian forest	riparian shrub	insectivore	overwinters in caves, mines, buildings	N	N
<i>Oreamnos americanus</i>	Mountain Goat	Blue	-	BAFA;BG;BWBS;CDF;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS;SWB	Cliff;Rock/Sparsely Vegetated Rock;Talus;Tundra;Avalanche Track;Meadow;Grassland;Shrub - Natural;Sagebrush Steppe;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Krummholtz;Alpine/Subalpine Meadow;Alpine Grassland	Y	R	landscape scale connectivity and linkages needed	n/a	n/a	mw2, mw4	unknown	n/a	cliff,rock,talus	shrub, meadow, grassland	n/a	n/a	herbivore	avalanche tracks ; mainly alpine and sub-alpine habitat	N	2010
<i>Thomomys talpoides segregatus</i>	Northern Pocket Gopher, <i>segregatus</i> subspecies	Red	-	ICH	Sub-soil;Pasture/Old Field;Cultivated Field;Hedgerow;Meadow	Y	R	lack of connectivity to other populationsreducing viability	n/a	n/a	n/a	xw	n/a	n/a	shrub,meadow, old field, grassland	n/a	n/a	unknown	needs friable soil for burrowing	N	N
<i>Neotamias ruficaudus simulans</i>	Red-tailed Chipmunk, <i>simulans</i> subspecies	Blue	-	ICH	Talus;Meadow;Mixed Forest (deciduous/coniferous mix);Krummholtz;Alpine/Subalpine Meadow	N	U	limited connectivity to other populations	n/a	n/a	n/a	xw,dw1	n/a	talus,rock	meadow, grassland	n/a	n/a	unknown	dens in talus/rock	N	N
<i>Corynorhinus townsendii</i>	Townsend's Big-eared Bat	Blue	-	BG;CDF;CWH;ICH;IDF;PP	Riparian Forest;Caves;Grassland;Shrub - Natural;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Urban/Suburban;Shrub - Logged;Industrial	Y	R	n/a	L,M,S	n/a	?	dw1,xw	n/a	caves	shrub, grassland	Act riparian & mixed forest	riparian shrub, herbaceous, gravel bar	insectivore	uses coniferous, mixed and deciduous forests of different ages; maternity roosts and winter hibernacula in caves, buildings, mines	N	N
<i>Gulo gulo luscus</i>	Wolverine, <i>luscus</i> subspecies	Blue	-	BAFA;BWBS;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;SBPS;SBS;SWB	Bog;Fen;Swamp;Marsh;Riparian Forest;Stream/River;Cliff;Rock/Sparsely Vegetated Rock;Talus;Avalanche Track;Meadow;Grassland;Shrub - Natural;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Krummholtz;Alpine/Subalpine Meadow;Alpine Grassland	Y	R	landscape scale connectivity and linkages needed	L,M,S	B,F,S, M	mw2, mw4	dw1,xw	O,M (CWD)	cliff, rock,talus	shrub,meadow	Act riparian forest & mixed forest	n/a	carnivore	uses coniferous, mixed and deciduous forests	N	N

Table A4 continued

Scientific Name	Common Name	B.C. List Status ¹	Species-At-Risk-Act (SARA) ²	Provincial Biogeoclimatic Units ³	Provincial Habitat Subtype	Confirmed in Areas A, D, E (Y,N)	Use of Kootenay Lake Area ⁴	Use of Local Habitat Targets Based on Habitat Suitability and Use Information										Diet	Other Relevant Comments	Recovery Plan (N = no or year)	Management Plan (N = no or year)
								Connectivity & Linkages	Hydro-Riparian (L,M,S) ⁵	Wetlands (M,O,F,B,S) ⁶	Moist ICH (mw2, mw4) ⁷	Dry ICH (dw1, xw, dm) ⁸	Old/Mature Forest (Structure) ⁹	Karst (rock-dominated) Habitat	Brushland/Grassland	Cottonwood (Act)-dominated Floodplain	Shrub and Herb-dominated Floodplain				
FISH (4)																					
<i>Salvelinus confluentus</i>	Bull Trout	Blue	-	BG;BWBS;CWH;ESSF;ICH;IDF;MS;PP;SBPS;SBS;SWB	n/a	Y	R	limited connectivity to other populations	L,M,S	O (connected to lake, river or stream)	mw2, mw4	dw1,xw	(LWD)	n/a	n/a	(LWD)	riparian shrub, herbaceous, gravel bar	carivore, invertivore, piscivore	spawning in gravel riffles of small tributary streams, including lake inlet streams, high stream channel complexity with various cover types, LWD, rubble; typically found where temperatures do not exceed 15°C for prolonged periods	N	N
<i>Lota lota</i> pop. 1	Burbot (lower Kootenay population)	Red	-	ICH	n/a	Y	R	limited connectivity to other populations	L, M (lake)	n/a	mw2, mw4	xw		n/a	n/a	n/a	riparian shrub, herbaceous, gravel bar	invertivore, piscivore	prefers cold water in Kootenay Lake, uses hypolimnion or deep river pools in summer; migrates to spawning areas in Kootenai River or tributary streams; spawns in low velocity areas in main or side channels over fine gravel, sand, or silt, spawns in winter under ice	N	2005 ¹⁰
<i>Oncorhynchus clarkii lewisi</i>	Cutthroat Trout, <i>lewisi</i> subspecies	Blue	SC	BWBS;ESSF;ICH;IDF;MS;SBS	n/a	Y	R	limited connectivity to other populations	L, M,S	O (connected to lake, river or stream)	mw2, mw4	dw1,xw	(LWD)	n/a	n/a	(LWD)	riparian shrub, herbaceous, gravel bar	invertivore	small mountain streams, main rivers, and large natural lakes; requires cool, clean, well oxygenated water; in rivers, adults prefer large pools and slow velocity areas	N	2017
<i>Acipenser transmontanus</i> pop. 1	White Sturgeon (Kootenay River population)	Red	E	ICH	n/a	Y	R, NB	limited connectivity to other populations	L, (lake)	n/a	mw2, mw4	dw1,xw		n/a	n/a	n/a	riparian shrub & herbaceous	invertivore, piscivore	uses deepest holes in lake and a large river habitat; individuals migrate freely from Kootenay Lake to the Kootenai River upstream into Montana to spawn	2014	N
Total number of species using habitat target								15	35	35	27	39	19	16	31	26	30				

Notes:

n/a = not applicable

¹ Red = Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia; Blue = Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in British Columbia; Yellow - Includes species that are apparently secure and not at risk of extinction.

² SC = species of special concern; T = threatened; E = endangered; "-" = no listing

³ BAFA = Boreal Altai Fescue Alpine; BG = Bunchgrass; BWBS = Boreal White and Black Spruce; CDF = Coastal Douglas-fir; CMA = Coastal Mountain-heather Alpine; CWH = Coastal Western Hemlock; ESSF = Engelmann Spruce -- Subalpine Fir; ICH = Interior Cedar -- Hemlock; IDF = Interior Douglas-fir; IMA = Interior Mountain-heather Alpine; MH = Mountain Hemlock; MS = Montane Spruce; PP = Ponderosa Pine; SBPS = Sub-Boreal Pine -- Spruce; SBS = Sub-Boreal Spruce; SWB = Spruce -- Willow -- Birch

⁴ B = breeding bird; E = extirpated?; NB = non-breeder; R = resident year-round; S = seasonal visitor; T = transient; U = unknown

⁵ S = small; M = medium; L = large

⁶ B = bog; F = fen; M = marsh; O = open shallow water; S = swamp

⁷ mw = moist warm

⁸ dw = dry warm; dm = dry mild; xw = very dry warm

⁹ O = old; M = mature; CWD = coarse woody debris; LWD = large woody debris

¹⁰ Joint International Conservation Strategy available that covers Kootenai River in the US and Kootenay Lake in Canada (see KVR 2005).

Table A5. Provincially and/or federally listed invertebrate species at risk potentially occurring in the study area

Scientific Name	Common Name	B.C. List Status ¹	Species-At-Risk-Act (SARA) ²	Provincial Biogeoclimatic Units ³	Provincial Habitat Subtype
Bivalves					
<i>Sphaerium occidentale</i>	Herrington Fingernailclam	Blue	-	BG;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS	Vernal Pools/Seasonal Seeps
<i>Musculium transversum</i>	Long Fingernailclam	Blue	-	CDF;CWH;ESSF;ICH	
<i>Sphaerium striatinum</i>	Striated Fingernailclam	Blue	-	BAFA;BG;BWBS;CDF;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS;SWB	
<i>Musculium partumeium</i>	Swamp Fingernailclam	Blue	-	CDF;CWH;ESSF;ICH	Vernal Pools/Seasonal Seeps;Stream/River;Lake;Pond/Open Water
Gastropods					
<i>Galba truncatula</i>	Attenuate Fossaria	Blue	-	ICH;IDF;PP;SWB	Marsh;Stream/River;Lake;Pond/Open Water
<i>Anguispira kochi</i>	Banded Tigersnail	Blue	-	ICH;IDF;PP	Mixed Forest (deciduous/coniferous mix)
<i>Cryptomastix mullani</i>	Coeur d'Alene Oregonian	Blue	-	ESSF;ICH;IDF;PP	Mixed Forest (deciduous/coniferous mix)
<i>Galba dalli</i>	Dusky Fossaria	Blue	-	BG;CDF;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP	
<i>Magnipelta mycophaga</i>	Magnum Mantleslug	Blue	SC	ESSF;ICH;IDF;MS	Talus;Conifer Forest - Moist/wet
<i>Hemphillia camelus</i>	Pale Jumping-slug	Blue	-	CWH;ICH;IDF;MS;PP	Conifer Forest - Mesic (average);Conifer Forest - Moist/wet
<i>Kootenaia burkei</i>	Pygmy Slug	Blue	-	ICH	Riparian Forest;Mixed Forest (deciduous/coniferous mix)
<i>Physella columbiana</i>	Rotund Physa	Red	-	ICH	Stream/River;Lake;Pond/Open Water
<i>Zacoleus idahoensis</i>	Sheathed Slug	Blue	-	ICHdw	Conifer Forest - Moist/wet
<i>Gyraulus crista</i>	Star Gyro	Blue	-	BAFA;BG;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP	
<i>Oreohelix subrudis</i>	Subalpine Mountainsnail	Blue	-	ESSF;ICH;IDF;PP	Meadow;Mixed Forest (deciduous/coniferous mix)

Table A5 continued

Scientific Name	Common Name	B.C. List Status ¹	Species-At-Risk-Act (SARA) ²	Provincial Biogeoclimatic Units ³	Provincial Habitat Subtype
<i>Valvata tricarinata</i>	Threeridge Valvata	Red	-	BAFA;BWBS;ESSF;ICH;IDF;IMA;MS;SBS	Stream/River;Lake;Pond/Open Water
<i>Stagnicola traski</i>	Widelip Pondsail	Blue	-	BG;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS	
Insects					
<i>Sympetrum vicinum</i>	Autumn Meadowhawk	Blue	-	CDF;CWH	Riparian Shrub;Stream/River;Lake;Mixed Forest (deciduous/coniferous mix);Pond/Open Water;Riparian Herbaceous
<i>Pyrgus communis</i>	Checkered Skipper	Blue	-	BG;ESSF;ICH;IDF;IMA;MS;PP	Pasture/Old Field;Meadow;Grassland;Conifer Forest - Dry;Urban/Suburban;Industrial
<i>Copablepharon absidum</i>	Columbia Dune Moth	Red	-	BG;ICH	Sand Dune
<i>Cupido comyntas</i>	Eastern Tailed Blue	Blue	-	ESSF;ICH;IDF;MS	
<i>Cicindela hirticollis</i>	Hairy-necked Tiger Beetle	Blue	-	BAFA;BG;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS;SBS	Beach
<i>Lycaena nivalis</i>	Lilac-bordered Copper	Blue	-	BG;ESSF;ICH;IDF;MS;PP	Riparian Forest;Riparian Shrub;Meadow;Grassland;Sagebrush Steppe;Deciduous/Broadleaf Forest;Conifer Forest - Dry;Mixed Forest (deciduous/coniferous mix);Riparian Herbaceous;Antelope-brush Steppe;Gravel Bar
<i>Danaus plexippus</i>	Monarch	Blue	SC	BG;CDF;CWH;ESSF;ICH;IDF;MS;PP	Pasture/Old Field;Cultivated Field;Hedgerow;Meadow;Grassland;Sagebrush Steppe;Urban/Suburban
<i>Colias pelidne</i>	Pelidne Sulphur	Blue	-	ESSF;ICH;IMA;MS	Tundra;Meadow
<i>Cicindela pugetana</i>	Sagebrush Tiger Beetle	Blue	-	BG;PP	Sagebrush Steppe

Table A5 continued

Scientific Name	Common Name	B.C. List Status ¹	Species-At-Risk-Act (SARA) ²	Provincial Biogeoclimatic Units ³	Provincial Habitat Subtype
<i>Epargyreus clarus</i>	Silver-spotted Skipper	Blue	-	CDF;CWH;ESSF;ICH;IDF;MH;MS;PP	Pasture/Old Field;Cultivated Field;Hedgerow;Meadow;Grassland;Shrub - Natural;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Dry;Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Urban/Suburban
<i>Epargyreus clarus clarus</i>	Silver-spotted Skipper, <i>clarus</i> subspecies	Blue	-	ESSF;ICH;IDF;PP	Riparian Forest;Riparian Shrub;Meadow;Conifer Forest - Dry;Conifer Forest - Moist/wet;Urban/Suburban;Riparian Herbaceous;Gravel Bar
<i>Ophiogomphus occidentis</i>	Sinuuous Snaketail	Blue	-	BAFA;BG;CDF;CMA;CWH;ESSF;ICH;IDF;IMA;MH;MS;PP;SBPS	Stream/River;Lake
<i>Polites themistocles themistocles</i>	Tawny-edged Skipper, <i>themistocles</i> subspecies	Blue	-	ESSF;ICH;IDF;IMA;MS;PP	Pasture/Old Field;Grassland;Conifer Forest - Dry;Riparian Herbaceous
<i>Libellula pulchella</i>	Twelve-spotted Skimmer	Blue	-	BG;IDF;PP	Marsh;Lake;Pond/Open Water
<i>Euptoieta claudia</i>	Variiegated Fritillary	Blue	-	ESSF;ICH;IMA;PP	
<i>Argia vivida</i>	Vivid Dancer	Blue	-	BG;CWH;ICH;IDF;PP	Stream/River;Hot Spring;Warm Spring;Cold Spring

Notes:

¹ Red = Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia; Blue = Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in British Columbia; Yellow - Includes species that are apparently secure and not at risk of extinction.

² SC = species of special concern; T = threatened; E = endangered; "-" = no listing

³ BAFA = Boreal Altai Fescue Alpine; BG = Bunchgrass; BWBS = Boreal White and Black Spruce; CDF = Coastal Douglas-fir; CMA = Coastal Mountain-heather Alpine; CWH = Coastal Western Hemlock; ESSF = Engelmann Spruce -- Subalpine Fir; ICH = Interior Cedar – Hemlock; IDF = Interior Douglas-fir; IMA = Interior Mountain-heather Alpine; MH = Mountain Hemlock; MS = Montane Spruce; PP = Ponderosa Pine; SBPS = Sub-Boreal Pine – Spruce; SBS = Sub-Boreal Spruce; SWB = Spruce -- Willow -- Birch

Table A6. Provincially and/or federally listed plant species at risk potentially occurring in the study area

Scientific Name	Common Name	B.C. List	Species-At-Risk-	Provincial Biogeoclimatic Units ^{3,4}	Provincial Habitat Subtype
Fugus					
<i>Cladonia luteoalba</i>	lemon pixie	Blue	-	ESSFdk;ICHwk	
<i>Peltigera degenii</i>	lustrous pelt	Red	-	CDFmm;CWHvm;CWHws;CWHxm;ESSFvc;ESSFwc;ESSFwv;ESSFxc;ICHmw;IDFdk	
<i>Nephroma isidiosum</i>	pebbled paw	Blue	-	BAFAun;BGxh;CWHwm;ESSFwc;ESSFwcp;ESSFwv;ESSFwvp;ICHmc;ICHmw;ICHvk;ICHwk;IDFdk;MHmm;MSdm;SBSdh;SBSdw;SBSwk	
<i>Hypogymnia heterophylla</i>	seaside bone	Red	T	CWHxm;ESSFwc	
Nonvascular Plant					
<i>Entosthodon fascicularis</i>	banded cord-moss	Blue	SC	CDF;CWH;ICHdm;ICHdw	Garry Oak Maritime Meadow
<i>Scouleria marginata</i>	marginated streamside moss	Red	E	ICH	
<i>Microbryum vlassovii</i>	nugget moss	Red	E	BG;PP	
<i>Tortula obtusifolia</i>		Blue	-	BG;CDF;ICH;IDF	
<i>Hygroamblystegium noterophilum</i>		Red	-		
<i>Lescurea saxicola</i>		Blue	-	BAFA;CWH;ESSF;SWB	
<i>Pohlia longicollis</i>		Red	-	ESSF	
<i>Platyhypnidium riparioides</i>		Blue	-	CDF;CWH;ESSF;ICH;MH	
<i>Hygroamblystegium fluviatile</i>		Blue	-		
<i>Bryum blindii</i>		Blue	-	ESSF	
<i>Atrichum tenellum</i>		Red	-	BAFA;ESSF	
<i>Hygrohypnum alpinum</i>		Blue	-	BAFA;CWH;ESSF;ICH;IDF;SWB	
<i>Barbula convoluta</i> var. <i>eustegia</i>		Red	-	ICHdw	
<i>Campylium calcareum</i>		Red	-	ESSFdk;ICHdw	
<i>Racomitrium pygmaeum</i>		Blue	-	BAFA;ESSF;MH	
<i>Warnstorfia pseudostraminea</i>		Blue	-	CMA;IMA;MH	
<i>Grimmia anomala</i>		Blue	-	CWH;MH	
Vascular Plant					

Table A6 continued

Scientific Name	Common Name	B.C. List	Species-At-Risk	Provincial Biogeoclimatic Units ^{3,4}	Provincial Habitat Subtype
<i>Pinus albicaulis</i>	whitebark pine	Blue	E	BAFAun;BAFAunp;CMAunp;CWHdm;CWHds;CWHms;CWHun;CWHvm;CWHws;ESSFdc;ESSFdcp;ESSFdcw;ESSFdk;ESSFdkp;ESSFdku;ESSFdkw;ESSFdm;ESSFdmf;ESSFdmw;ESSFdv;ESSFdvf;ESSFdvw;ESSFmc;ESSFmcp;ESSFmk;ESSFmkp;ESSFmm;ESSFmmp;ESSFmv;ESSFmvp;ESSFmw;ESSFmwp;ESSFmww;ESSFvc;ESSFvcp;ESSFvcw;ESSFwc;ESSFwcp;ESSFwcw;ESSFwk;ESSFwm;ESSFwmp;ESSFwmw;ESSFwv;ESSFwvp;ESSFxc;ESSFxcp;ESSFxcw;ESSF xv;ESSF xvp;ESSF xv v;ICHdm;ICHdw;ICHmc;ICHmk;ICHmm;ICHmw;ICHvk;ICHwk;IDFdc;IDFdk;IDFdm;IDFd w;IDFww;IDFxc;IDFxh;IMAun;IMAunp;MHmm;MHmmp;MSdc;MSdk;MSdm;MSdv;MSmw;MSxk;MSxv;SBPSxc;SBSdh;SBSmc;SBSvk;SBSwk	Cliff;Rock/Sparsely Vegetated Rock;Talus;Conifer Forest - Mesic (average);Conifer Forest - Dry
<i>Senecio hydrophilus</i>	alkali-marsh butterweed	Red	-	ICHdw;ICHxw	Marsh;Riparian Herbaceous
<i>Stellaria obtusa</i>	blunt-sepaed starwort	Blue	-	CWHms;ESSFdk;ESSFwc;ESSFwcp;ESSFwk;ICHdw;ICHwk;IDFdm;IDFww;IDFxh	Riparian Forest;Riparian Shrub;Meadow;Alpine/Subalpine Meadow
<i>Polemonium californicum</i>	California Jacob's ladder	Red	-	ICHdw;IDFmw	
<i>Anemone canadensis</i>	Canada anemone	Blue	-	BWBSmw;ICHdw;ICHmc;IDFdm;MSdk;SBSdh	Swamp;Riparian Shrub;Meadow;Beach;Riparian Herbaceous
<i>Downingia elegans</i>	common downingia	Red	-	IDFd w	Vernal Pools/Seasonal Seeps;Riparian Forest;Riparian Shrub;Riparian Herbaceous;Gravel Bar

Table A6 continued

Scientific Name	Common Name	B.C. List	Species-At-Risk	Provincial Biogeoclimatic Units ^{3,4}	Provincial Habitat Subtype
<i>Epilobium halleanum</i>	Hall's willowherb	Blue	-	BGxh;BGxw;CDFmm;ESSFdc;ICHdw;ICHwk;SBSwk;SWBun	Vernal Pools/Seasonal Seeps;Stream/River;Meadow;Conifer Forest - Moist/wet;Alpine/Subalpine Meadow
<i>Plagiobothrys hispidulus</i>	harsh popcornflower	Red	-	ICHdw;MSdk	
<i>Heterocodon rariflorus</i>	heterocodon	Blue	-	CDFmm;CWHds;CWHxm;ICHdw;IDFdm;IDFxh;PPdh	Vernal Pools/Seasonal Seeps;Conifer Forest - Mesic (average);Conifer Forest - Moist/wet;Garry Oak Maritime Meadow
<i>Polygonum polygaloides</i> ssp. <i>kelloggii</i>	Kellogg's knotweed	Blue	-	ESSFwc;ICHdw;ICHmk;IDFdk;IDFww;IDFxh;IDFxm;MSdm;MSxk	Vernal Pools/Seasonal Seeps
<i>Scrophularia lanceolata</i>	lance-leaved figwort	Blue	-	CWHms;ICHmw;IDFxh	Meadow;Grassland;Shrub - Natural;Conifer Forest - Mesic (average)
<i>Monardella odoratissima</i> ssp. <i>discolor</i>	monardella	Red	-	ESSFwc;ICHdw;ICHmw	
<i>Delphinium bicolor</i> ssp. <i>bicolor</i>	Montana larkspur	Blue	-	ESSFdk;ESSFdkp;ESSFmcp;ICHdw;ICHmw;IDFdm;MSdk	Meadow;Grassland;Shrub - Natural;Sagebrush Steppe;Conifer Forest - Dry;Antelope-brush Steppe;Alpine Grassland
<i>Lupinus arbustus</i> ssp. <i>pseudoparviflorus</i>	Montana lupine	Red	-	ESSFmw;ICHxw;IDFdm	Grassland;Sagebrush Steppe;Conifer Forest - Dry
<i>Impatiens aurella</i>	orange touch-me-not	Blue	-	BWBSmw;ICHdw;ICHmc;ICHmw;IDFxh	Bog;Fen;Swamp;Marsh;Riparian Forest;Riparian Shrub;Meadow;Conifer Forest - Moist/wet
<i>Limosella acaulis</i>	Owyhee mudwort	Red	-	BGxh	Bog;Fen;Swamp;Marsh
<i>Veronica catenata</i>	pink water speedwell	Blue	-	ESSFmw;IDFdm	Marsh;Meadow;Pond/Open Water;Riparian Herbaceous
<i>Anemone piperi</i>	Piper's anemone	Red	-	ESSFwc	Conifer Forest - Mesic (average);Conifer Forest - Moist/wet

Table A6 continued

Scientific Name	Common Name	B.C. List	Species-At-Risk-	Provincial Biogeoclimatic Units ^{3,4}	Provincial Habitat Subtype
<i>Thermopsis rhombifolia</i>	prairie golden bean	Red	-	BWBSdk;ESSFdk;ICHdw;ICHmk;IDFdm;MSdk;PPdh	Meadow;Grassland
<i>Thalictrum dasycarpum</i>	purple meadowrue	Red	-	ESSFdk;ICHdw;ICHxw;IDFdm	Riparian Forest;Riparian Shrub;Meadow;Riparian Herbaceous
<i>Idahoia scapigera</i>	scalegod	Blue	-	CDFmm;CWHxm;ICHxw;IDFww;PPxh	Vernal Pools/Seasonal Seeps;Rock/Sparsely Vegetated Rock;Meadow;Sagebrush Steppe;Garry Oak Maritime Meadow
<i>Impatiens ecornuta</i>	spurless touch-me-not	Red	-	ICHdw;ICHxw;IDFdm	Marsh;Riparian Forest;Stream/River;Lake;Meadow;Pond/Open Water
<i>Senecio hydrophiloides</i>	sweet-marsh butterweed	Red	-	ESSFdk;ICHdw;ICHmk;MSdk;PPdh	Marsh;Vernal Pools/Seasonal Seeps;Riparian Forest;Meadow;Riparian Herbaceous
<i>Bidens vulgata</i>	tall beggarticks	Blue	-	BGxh;ICHxw	Bog;Fen;Swamp;Marsh;Vernal Pools/Seasonal Seeps;Riparian Shrub;Riparian Herbaceous
<i>Mertensia paniculata</i> var. <i>borealis</i>	tall bluebells	Blue	-	ESSFwc;ICHdw;ICHmw;ICHxw	Riparian Forest;Talus;Meadow;Deciduous/Broadleaf Forest;Conifer Forest - Mesic (average);Conifer Forest - Moist/wet;Mixed Forest (deciduous/coniferous mix);Riparian Herbaceous;Cold Spring
<i>Lewisia triphylla</i>	three-leaved lewisia	Blue	-	BAFA;CMA;ESSFdc;ESSFwc;ICHdw;IDFdm;IMA	Vernal Pools/Seasonal Seeps;Rock/Sparsely Vegetated Rock
<i>Glycyrrhiza lepidota</i>	wild licorice	Blue	-	ICHdw;IDFdm;PPdh	Riparian Forest;Grassland;Riparian Herbaceous

Table A6 continued

Scientific Name	Common Name	B.C. List	Species-At-Risk	Provincial Biogeoclimatic Units ^{3,4}	Provincial Habitat Subtype
<i>Acorus americanus</i>	American sweet-flag	Red	-	ICHdw;ICHxw;IDFmw;SBSdk;SBSmh;SBSwk	Swamp;Marsh;Riparian Shrub;Lake;Pond/Open Water;Riparian Herbaceous
<i>Carex comosa</i>	bearded sedge	Blue	-	BGxh;CWHdm;CWHds;ICHmw;ICHxw;IDFmw;IDFxh	Marsh;Riparian Herbaceous
<i>Elymus curvatus</i>	beardless wildrye	Red	-	ICHxw	Riparian Forest;Conifer Forest - Dry;Mixed Forest (deciduous/coniferous mix);Gravel Bar
<i>Carex heleonastes</i>	Hudson Bay sedge	Blue	-	BWBSdk;ESSFwk;ICHdw;ICHmw;IDFdk;SBPSxc	Bog;Fen;Meadow;Conifer Forest - Moist/wet
<i>Calamagrostis montanensis</i>	plains reedgrass	Blue	-	BWBSmw;ICHdw;IDFdm;IDFun;IDFwk;PPdh	Grassland;Conifer Forest - Dry
<i>Sphenopholis obtusata</i>	prairie wedgegrass	Red	-	BGxh;ICHdw;IDFdm	Bog;Fen;Swamp;Marsh;Stream/River;Meadow;Hot Spring;Pond/Open Water
<i>Sphenopholis intermedia</i>	slender wedgegrass	Blue	-	BWBSdk;BWBSmw;ICHdw;ICHmk;ICHmw;IDFdm;IDFxh;PPdh	Marsh;Meadow;Hot Spring;Gravel Bar

Notes:

¹ Red = Includes any indigenous species or subspecies that have, or are candidates for, Extirpated, Endangered, or Threatened status in British Columbia; Blue = Includes

² SC = species of special concern; T = threatened; E = endangered; "-" = no listing

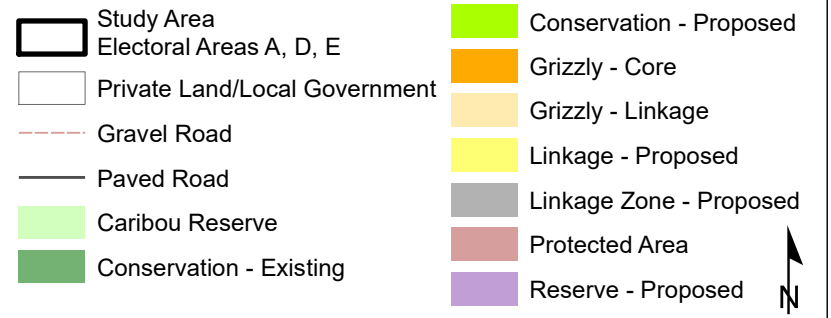
³ BAFA = Boreal Altai Fescue Alpine; BG = Bunchgrass; BWBS = Boreal White and Black Spruce; CDF = Coastal Douglas-fir; CMA = Coastal Mountain-heather Alpine; CWH =

⁴ dc = dry cold; dh = dry hot; dk = dry cool; dm = dry mild; ds = dry subarctic; dv = dry very cold; dw = dry warm; mc = moist cold; mh = moist hot; mk = moist cool; mm

Appendix B



Habitat Targets



Albers EA Conic, NAD 83

Date: 2018-03-13

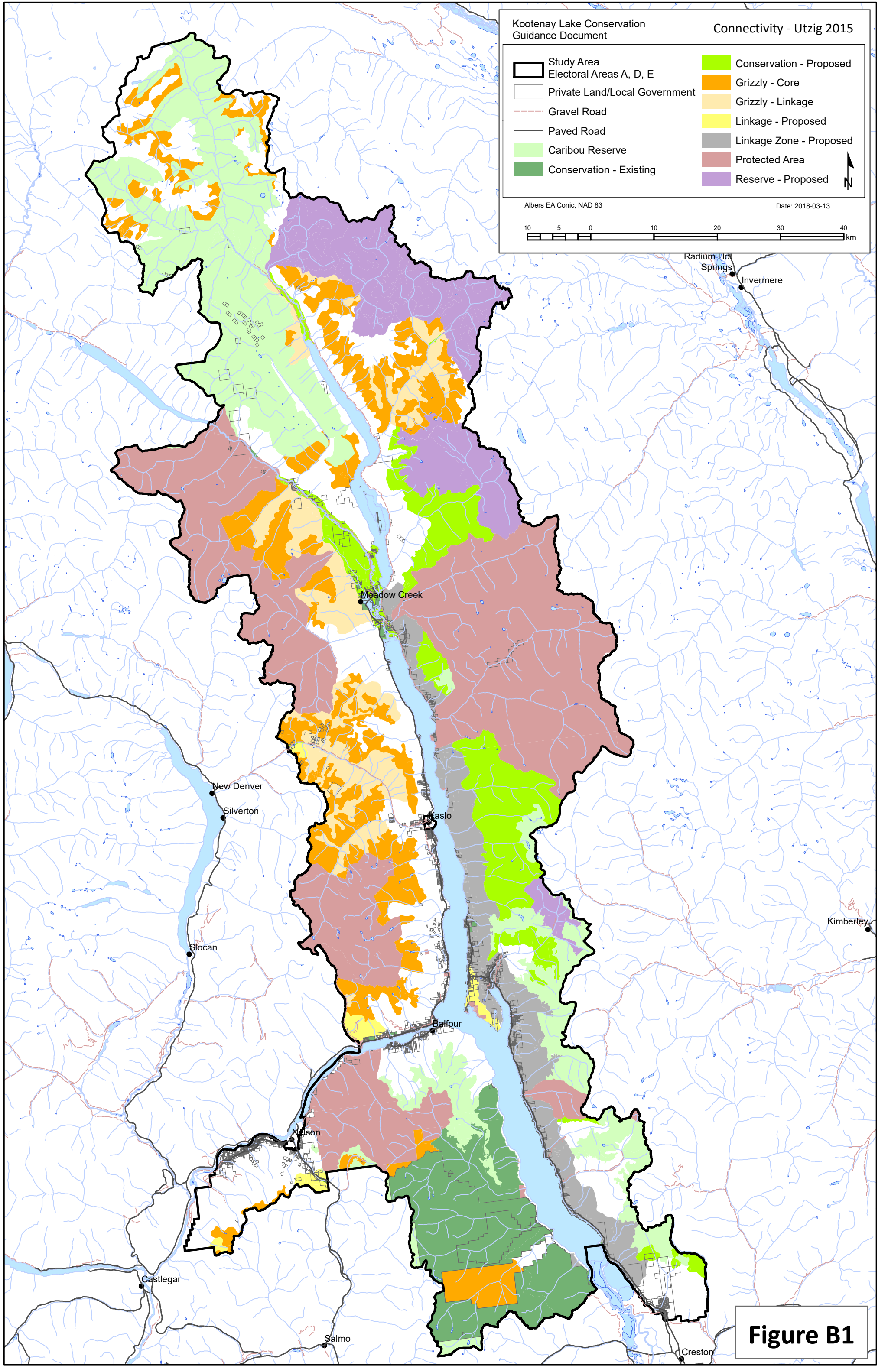
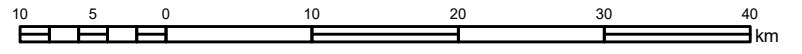
























Figure B1

Kootenay Lake Conservation Guidance Document

Obstacles and Barriers

- | | | | |
|-------------------------------------------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|-----------------------------|
|  | Study Area |  | Bridge |
|  | Electoral Areas A, D, E |  | Culvert: Unknown |
|  | Private Land/Local Government |  | Dam |
|  | Above 20% Gradient |  | Hydro Dam |
|  | Below 20% Gradient |  | Barrier |
|  | Beaver dam |  | Potential barrier |
|  | Canyon |  | Passable - No barrier |
|  | Cascade or chute |  | MOT Culvert Unknown Quality |
|  | Falls |  | Gravel Road |
|  | LWD dam |  | Paved Road |
|  | Not Specified | | |
|  | Rocks | | |

Albers EA Conic, NAD 83

Date: 2018-03-13

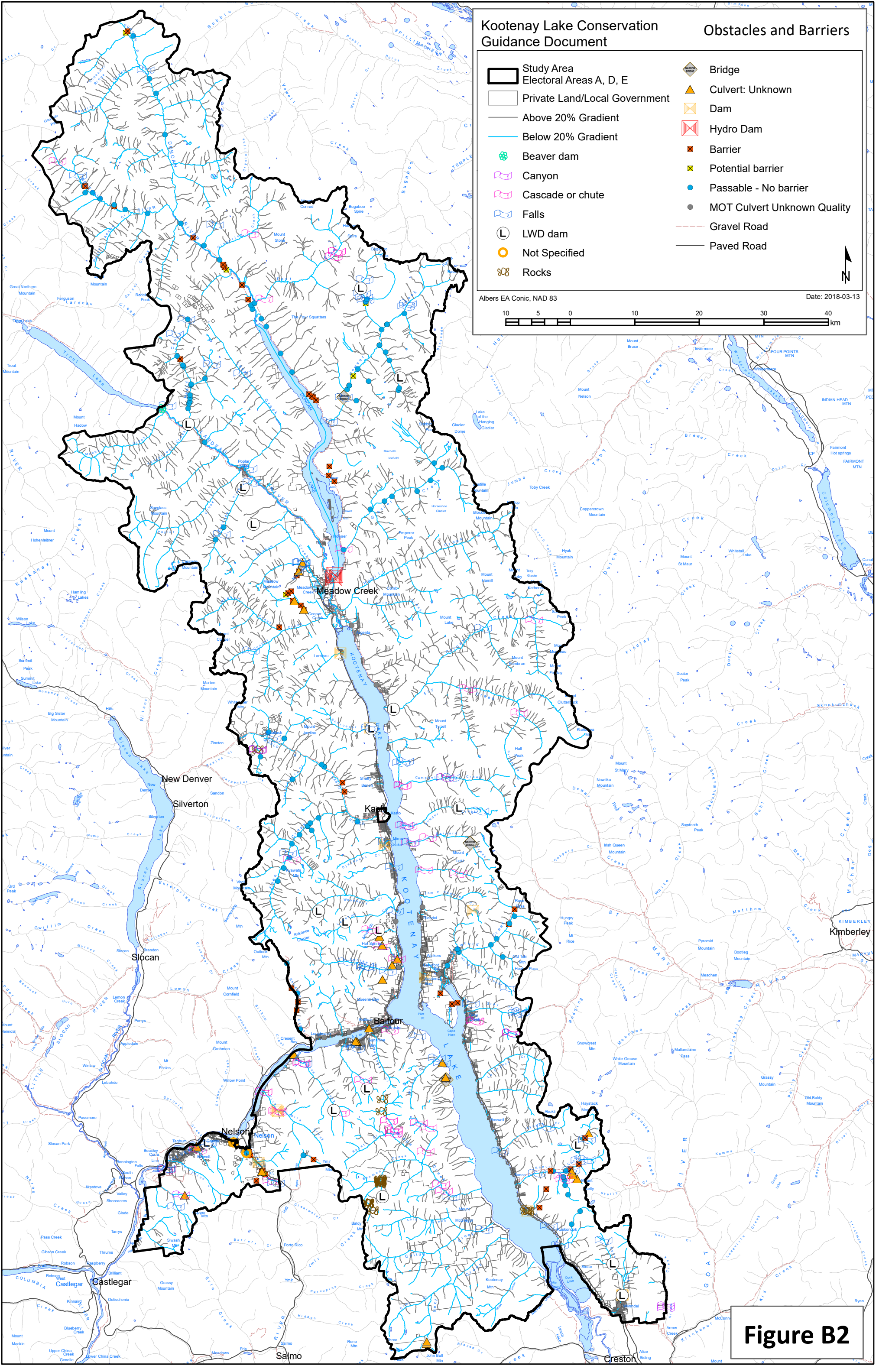
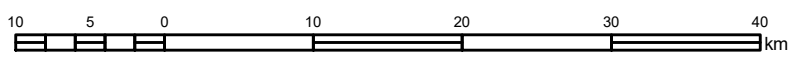











Figure B2

Kootenay Lake Conservation
Guidance Document
Hydroriparian - 200m Buffer

-  Study Area
-  Electoral Areas A, D, E
-  Private Land/Local Government
-  Large Hydroriparian
-  Small/Medium Hydroriparian
-  Fish-bearing Stream
-  No Fish Observations/
Unknown Fish Status
-  Gravel Road
-  Paved Road

Albers EA Conic, NAD 83 Date: 2018-04-18

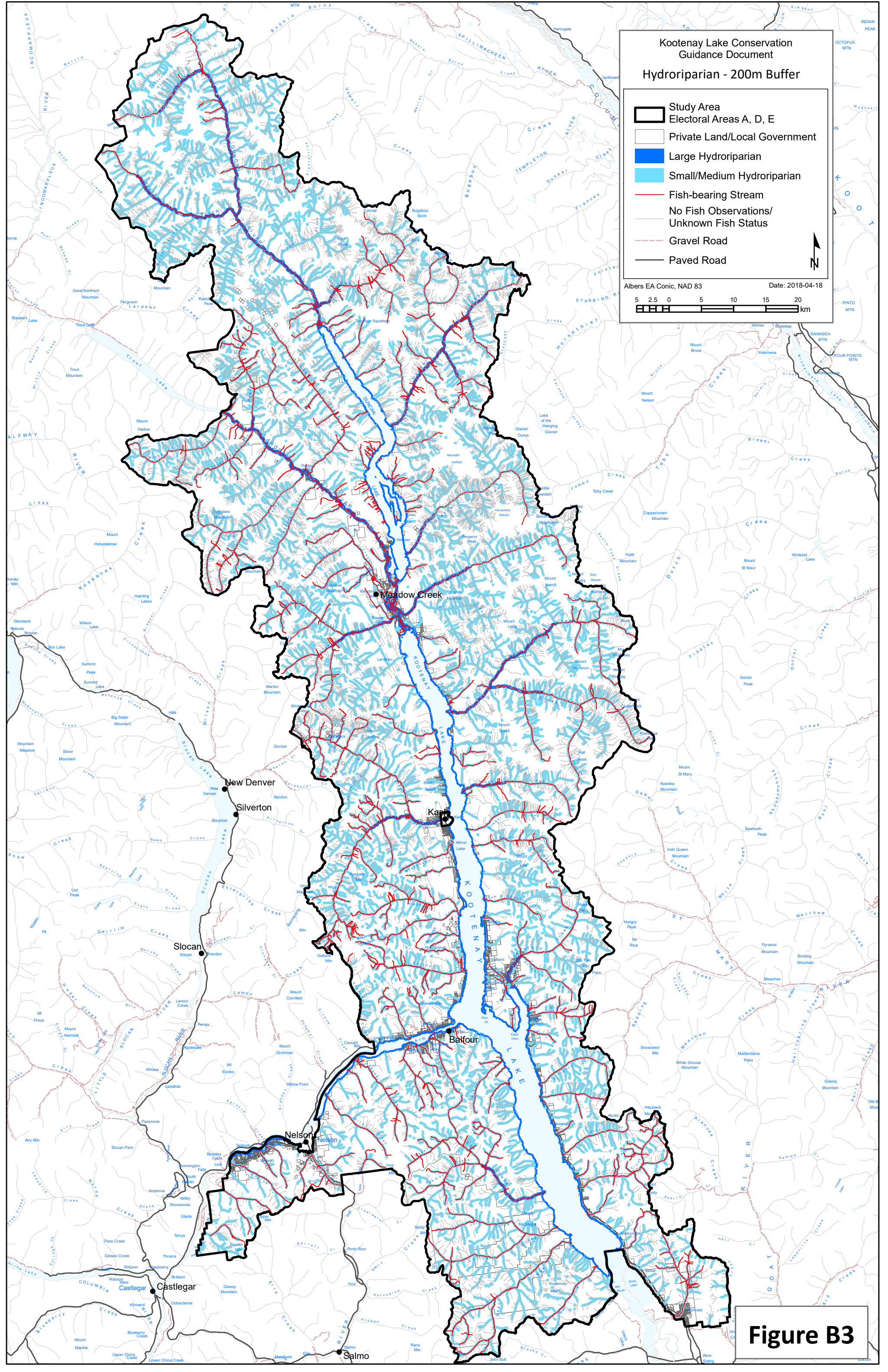
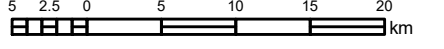
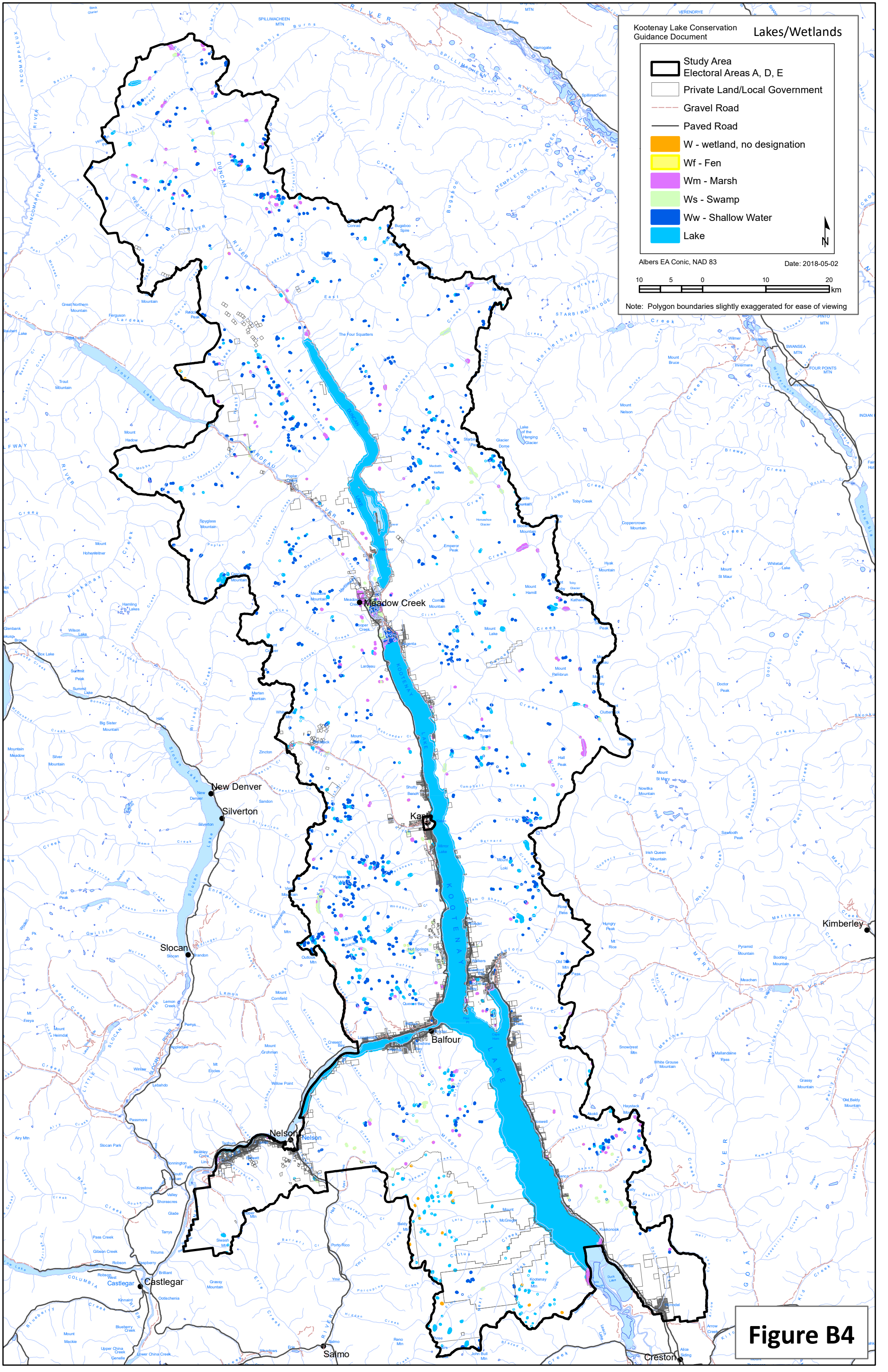


Figure B3



Kootenay Lake Conservation Guideline Document **Lakes/Wetlands**

- Study Area
- Electoral Areas A, D, E
- Private Land/Local Government
- Gravel Road
- Paved Road
- W - wetland, no designation
- Wf - Fen
- Wm - Marsh
- Ws - Swamp
- Ww - Shallow Water
- Lake

Albers EA Conic, NAD 83 Date: 2018-05-02










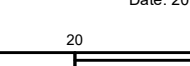

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km

Note: Polygon boundaries slightly exaggerated for ease of viewing

Figure B4

Kootenay Lake Conservation Guidance Document

Biogeoclimatic Zones

	Study Area		Target BGC Zones
	Electoral Areas A, D, E		ICH mw 2
	Priv/Local		ICH mw 4
	Crown		ICH dw 1
	Gravel Road		ICH xw
	Paved Road		

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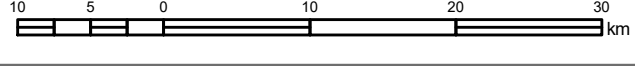
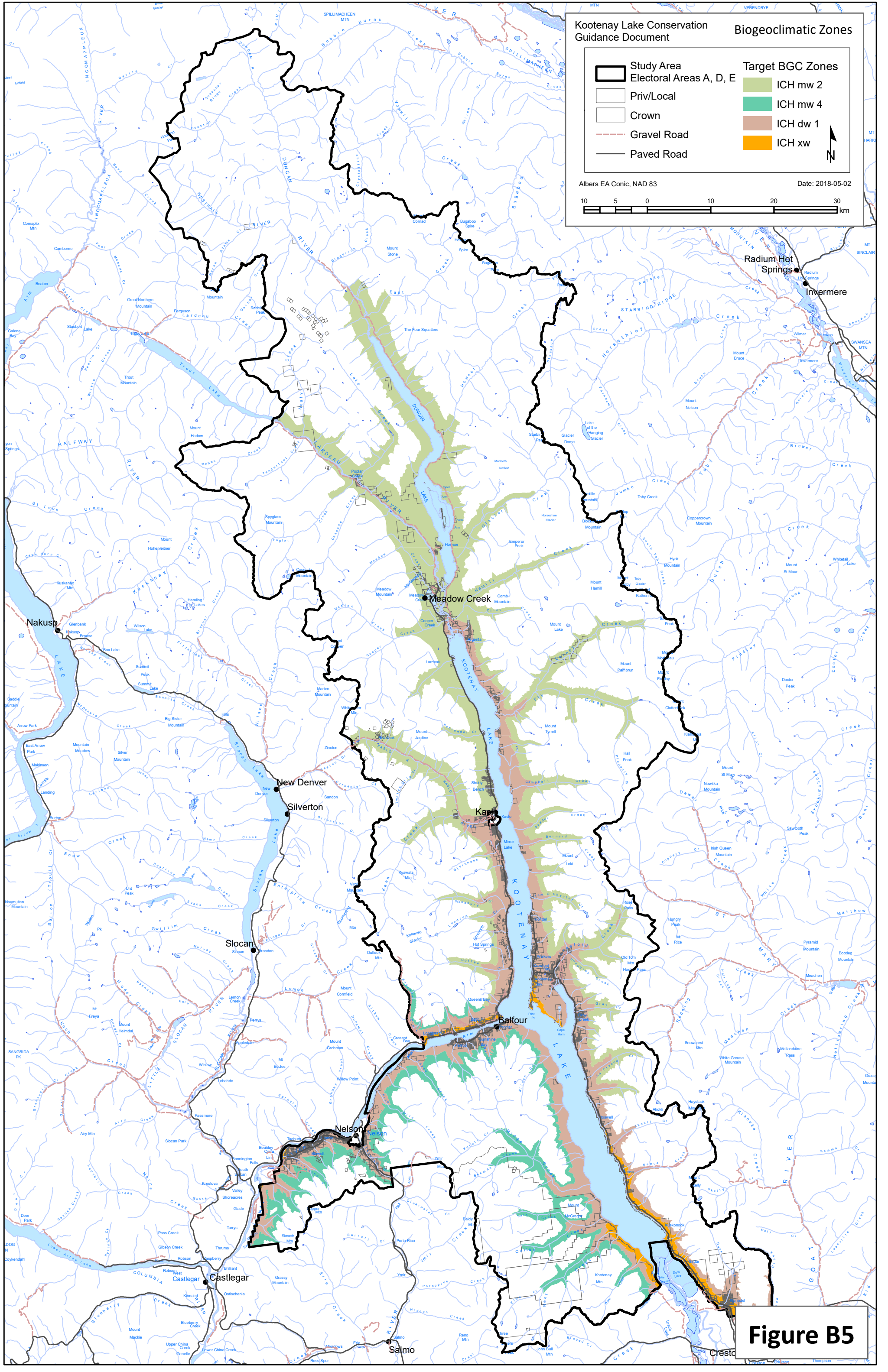
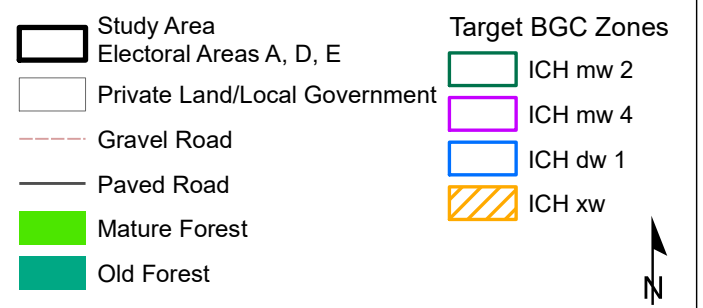



Figure B5



Albers EA Conic, NAD 83

Date: 2018-05-02

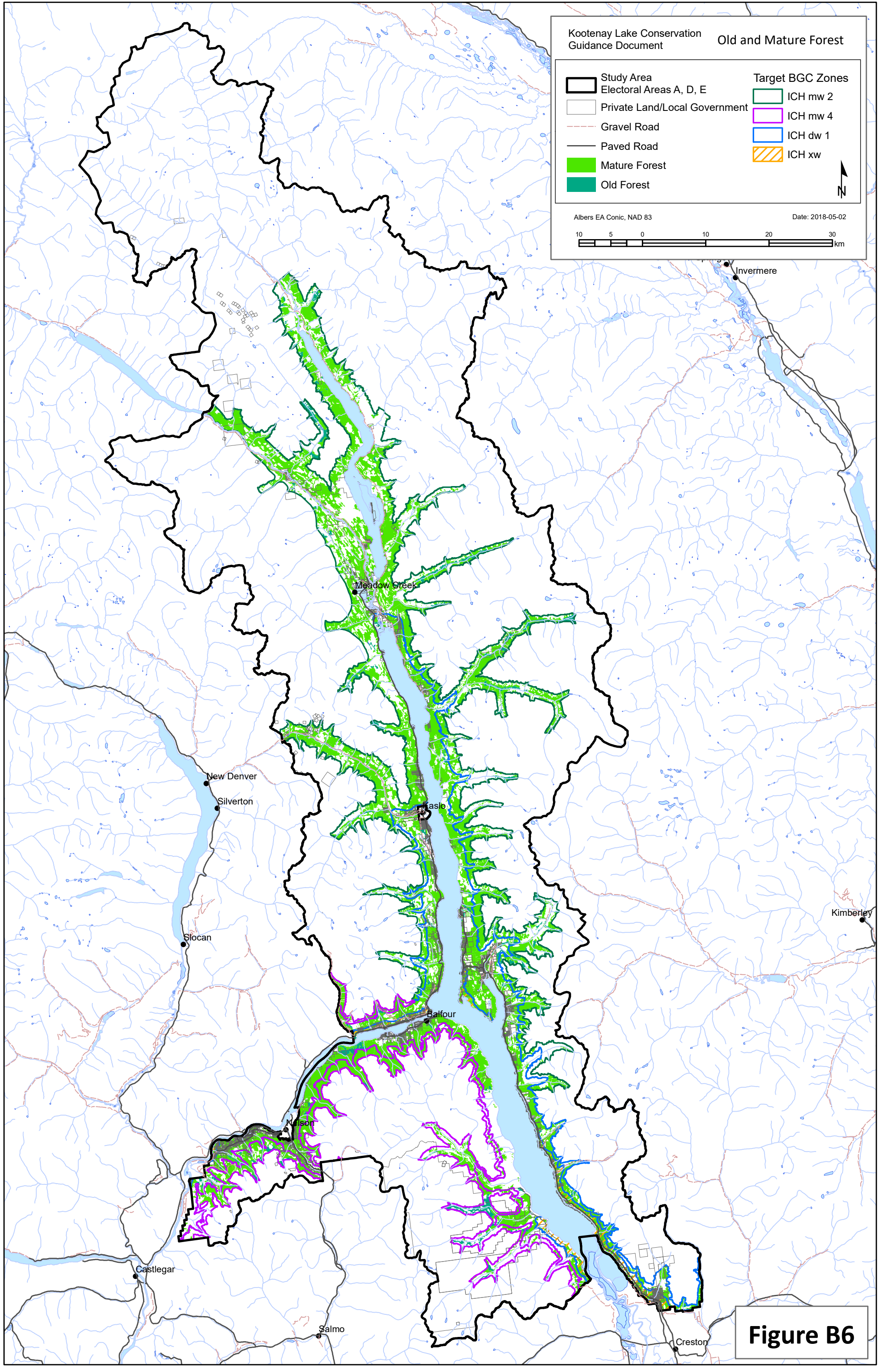
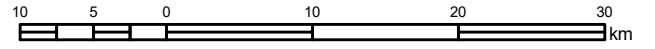
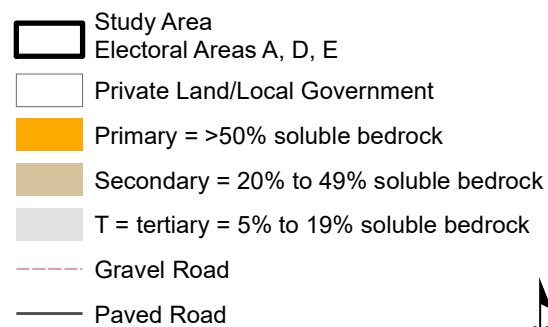


Figure B6



Albers EA Conic, NAD 83

Date: 2018-05-02

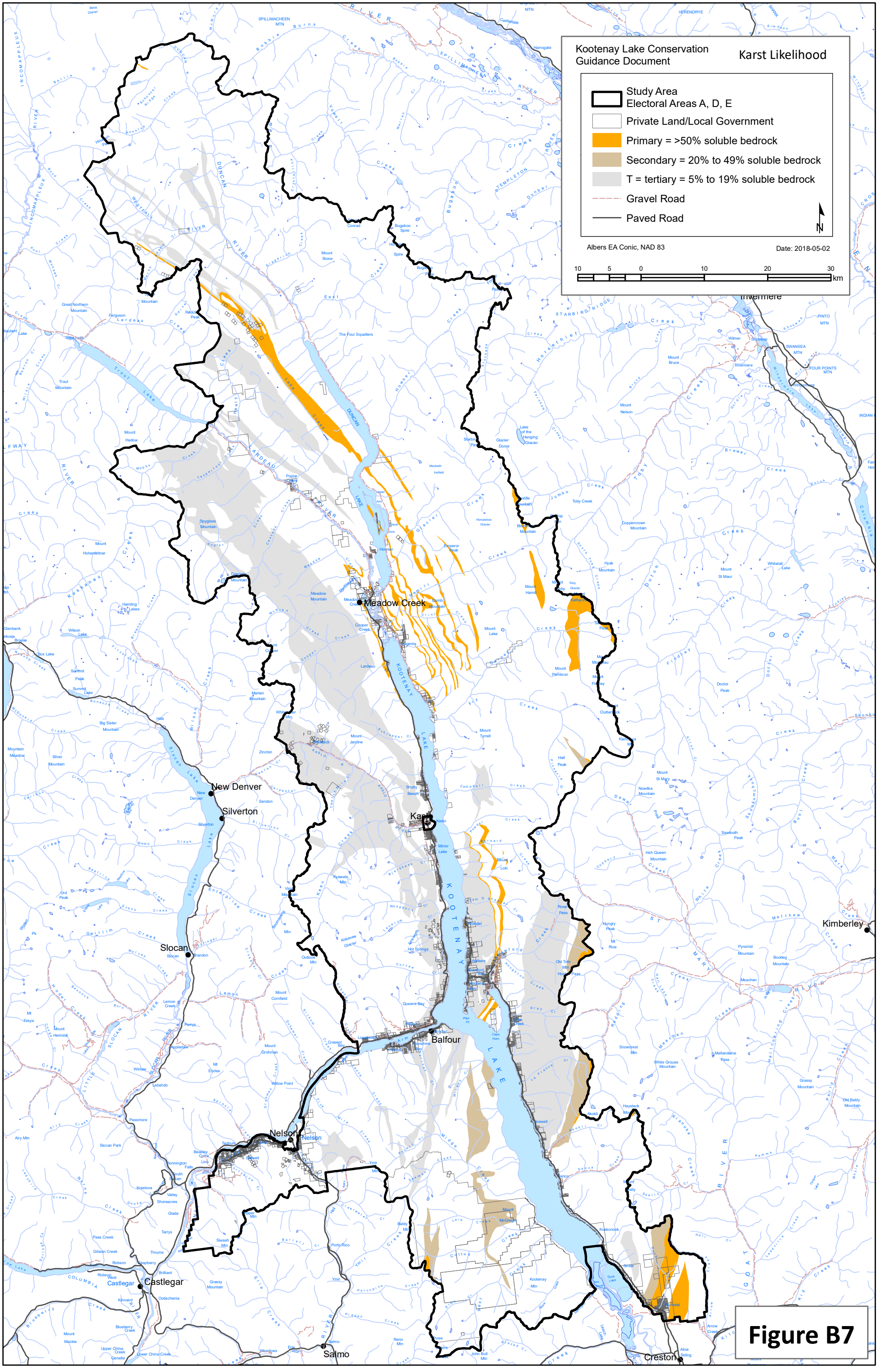
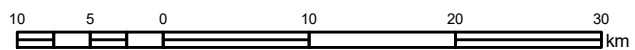


Figure B7

Kootenay Lake Conservation
Guidance Document
Brushland - PEM

Study Area
Electoral Areas A, D, E
Private Land/Local Government
Brushland
Gravel Road
Paved Road

NOTE: Size of brushland area is exaggerated for ease of viewing
Albers EA Conic, NAD 83 Date: 2018-05-02

5 2.5 0 5 10 15 20 km

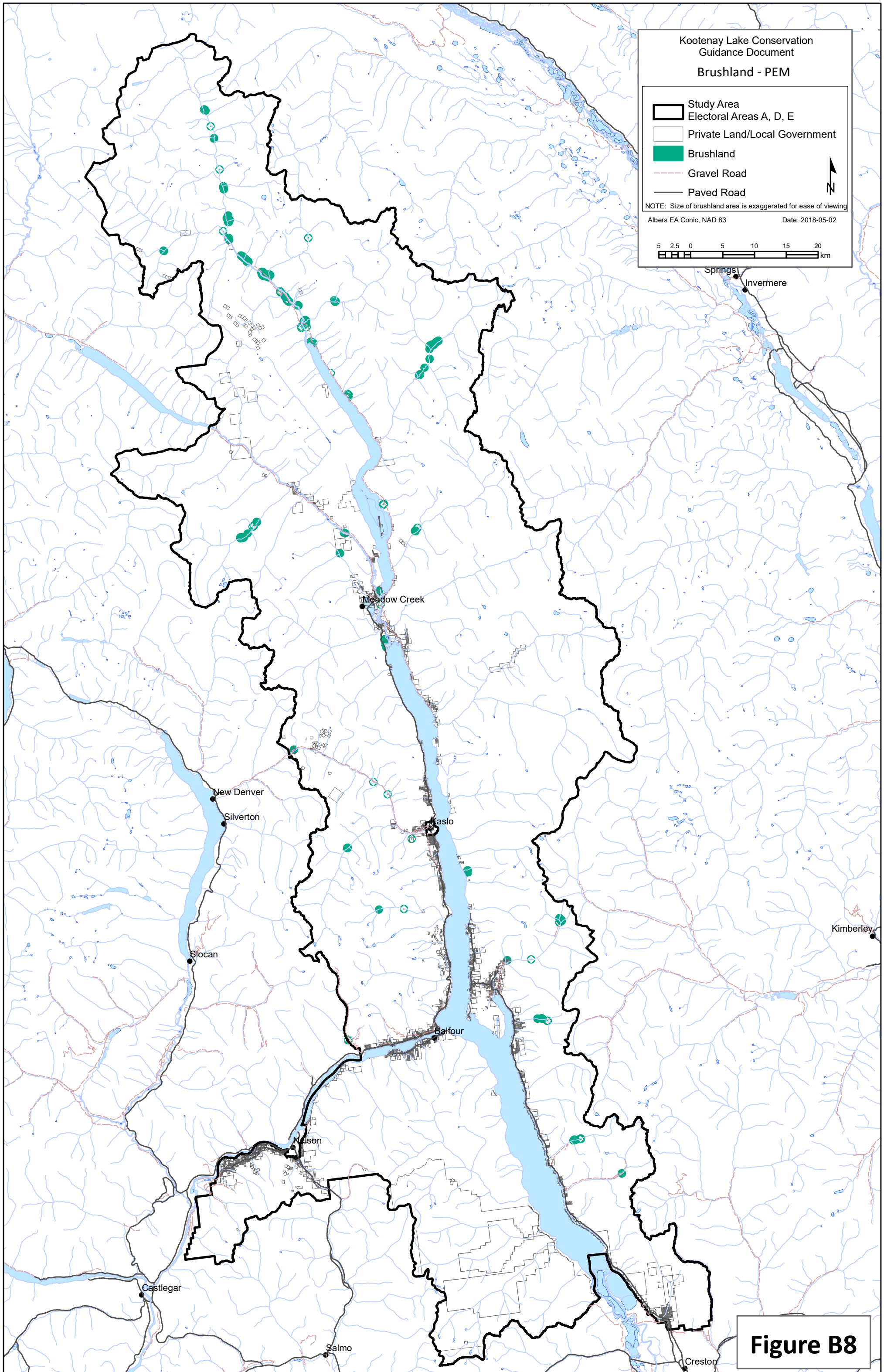











Figure B8

-  Study Area
-  Electoral Areas A, D, E
-  Private Land/Local Government
-  Rank 1 = 81-100% (pure AC stand)
-  Rank 2 = 41 – 80% (mixed w/ signifi. AC component)
-  Deciduous Floodplain (mid-bench)
-  Early Seral Cottonwood - Low Bench
(Not included in summary worksheet)
-  Gravel Road
-  Paved Road

Data Source: Jamieson 2010, Pem 2015, B. Herbison

Albers EA Conic, NAD 83

Date: 2018-05-02

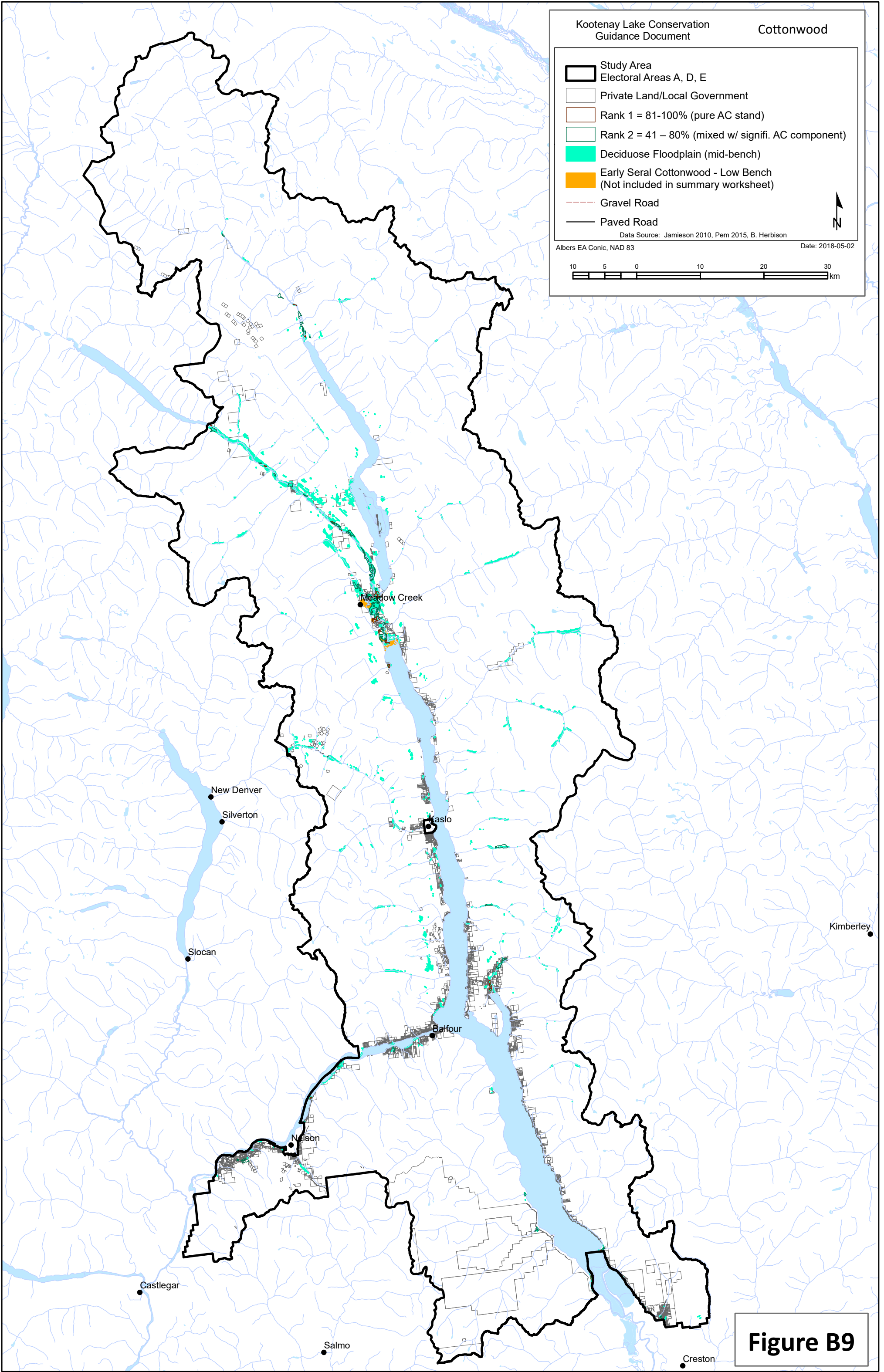
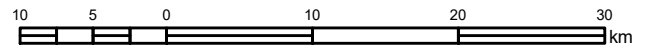


Figure B9

Table B1-1. Terrestrial connectivity feature distribution on crown and private land

Connectivity Feature	Crown (ha)	% Crown	Private Land/ Local Government (ha)	% Private/Local Government	Total Feature Area (ha)
Caribou Reserve	132456.18	17.65	1855.62	2.22	134341.53
Conservation - Existing	12173.56	1.62	44475.27	53.26	56692.78
Conservation - Proposed	51259.16	6.83	2994.22	3.59	56583.52
Grizzly - Core	81900.51	10.91	7140.88	8.55	92600.08
Grizzly - Linkage	37932.32	5.05	801.81	0.96	38942.03
Linkage - Proposed	4461.75	0.59	1299.89	1.56	7587.70
Linkage Zone - Proposed	37220.68	4.96	8272.40	9.91	46602.44
Protected Area	200641.48	26.73	1828.35	2.19	205099.80
Reserve - Proposed	65919.61	8.78	0	0	65919.61
Total	623965.25	83.12	68668.42	82.23	704369.51

Table B1-2. Terrestrial connectivity feature in protected areas on crown and private land

Connectivity Feature	Park (ha)	% Park	Conservation Property (ha)	% Conservation Property	Total Protected Area (ha)	% Protected of Total Area
Caribou Reserve	16.60	0.00	0.00	0.00	16.60	0.00
Conservation - Existing	0	0	44265.50	53.01	44265.50	5.31
Conservation - Proposed	22.91	0.00	69.43	0.08	92.34	0.01
Grizzly - Core	4.99	0.00	0.00	0.00	4.99	0.00
Grizzly - Linkage	5.75	0.00	0.00	0.00	5.75	0.00
Linkage - Proposed	0	0	0.68	0.00	0.68	0.00
Linkage Zone - Proposed	20.53	0.00	70.04	0.08	90.57	0.01
Protected Area	200409.82	26.70	0.21	0.00	200410.02	24.03
Reserve - Proposed	49.02	0.01	0	0	49.02	0.01
Total	200529.61	26.71	44405.86	53.18	244935.47	29.36

Table B2-1. Length of stream (km) potentially accessible to upstream fish migration (<20% gradient) compared to length of stream likely unaccessible to upstream fish migration (>20% gradient) on crown and private land including that within protected areas

Gradient	Crown		Private/ Local		Total
	Total	Park	Total	Conservation Property	
< 20%	2152.34	625.46	370.04	192.40	2522.38
>20%	4237.73	1166.31	286.66	160.06	4524.38

Table B2-2. Counts of aquatic connectivity features by type on crown and private land including counts within protected areas

Fish Passage Obstacle	Crown		Private/ Local Government		Total
	Total	Park	Total	Conservation Property	
Beaver dam	1	1			1
Bridge	3				3
Canyon	3				3
Cascade or chute	49	14	6		55
Culvert	18		8		26
Dam	7	2	4		11
Hydro dam	1		1		2
Falls	61	5	14	1	75
LWD dam	14	4	6	1	20
Not Specified			2		2
Rocks	3	2	21	18	24
Total	160	28	62	20	222

Table B2-3. Fish passage assessment results at potential barriers on crown and private land including counts within protected areas

Fish Passage Assessment Result	Crown		Private/ Local Government		Total
	Total	Park	Total	Conservation Property	
Barrier	49		3		52
Passable	104	2	9		113
Potential Barrier	6				6
Unknown	3				3
Total	162		12		174

Table B3-1. Large and small/medium hydro-riparian area feature distribution on crown and private land

Hydro Riparian Area Type	Crown (ha)	% Crown	Private/ Local Government (ha)	% Private/ Local Government	Total Area (ha)	% of Total Area
Large	16304.57	2.17	4853.03	5.81	21157.60	2.54
Small/Medium	237696.85	31.67	24376.21	29.19	262073.07	31.42
Total	254001.42	33.84	29229.24	35.00	283230.67	33.95

Table B3-2. Large and small/medium hydro-riparian features in protected areas on crown and private land

Hydro Riparian Area Type	Park (ha)	% Park	Conservation Property (ha)	% Conservation Property	Total Protected Area (ha)	% Protected of Total Area
Large	2544.11	0.34	384.02	0.46	2928.13	0.35
Small/Medium	67154.60	8.95	14202.66	17.01	81357.26	9.75
Total	69698.70	9.28	14586.68	17.47	84285.39	10.10

Table B4-1. Wetland distribution by type on crown and private land

Land Type	Wetland Types ¹										Total Wetland Area (ha)	% of Total Areas
	W (ha)	% W	Wf (ha)	% Wf	Wm (ha)	% Wm	Ws (ha)	% Ws	Ww (ha)	% Ww		
Crown	788.66	0.11	2.44	0.00	66.62	0.01	19.38	0.00	413.18	0.06	1290.28	0.17
Priv/Local	176.98	0.21	0.42	0.00	68.94	0.08	47.19	0.06	44.14	0.05	337.67	0.40
Total	965.64	0.12	2.86	0.00	135.56	0.02	66.58	0.01	457.32	0.05	1627.95	0.20

¹ W = Undifferentiated Wetland; Wf = Fen; Wm = Marsh; Ws = Swamp; Ww = Shallow water

Table B4-2. Native and non-native fish species presence in wetlands by type on crown and private land, including the amount of protected area within each classification

Land and Wetland Type ¹	Native Fish Species			Introduced Fish Species		
	Area (ha)	%	Park (ha)	Area (ha)	%	Conservation Property (ha)
Crown	68.08	0.01	13.97	32.13	0.00	n/a
W	60.47	0.01	13.97	30.63	0.00	n/a
Wf	0	0	0	0	0	n/a
Wm	2.00	0.00	0	1.51	0.00	n/a
Ws	0	0	0	0	0	n/a
Ww	5.62	0.00	0	0	0	n/a
Priv/Local	51.78	0.06	n/a	38.16	0.05	0.79
W	41.82	0.05	n/a	38.16	0.00	0.55
Wf	0	0	n/a	0	0	0
Wm	0	0	n/a	0	0	0
Ws	0.02	0.00	n/a	0	0	0
Ww	9.94	0.01	n/a	0	0	0.24
Total	119.86	0.01	13.97	70.29	0.01	0.79

¹ W = Undifferentiated Wetland; Wf = Fen; Wm = Marsh; Ws = Swamp; Ww = Shallow water; n/a = not applicable

Table B5-1. Stream length with and without fish species present on protected and unprotected crown and private land. Fish species type (i.e. native, non-native and unidentified) and also summarized for areas with fish species present

Land Type	Total Stream Length (km)	Stream Length (km)				
		With Fish Species	Without / Unconfirmed Fish Species	With Native Fish Species*	With Non-Native Fish Species*	With Unidentified Fish Species*
Crown	15205.2	2373.3	12831.9	2344.1	356.6	190.5
Park	4094.4	650.3	3444.1	642.8	62.6	20.0
All remaining Crown	11110.8	1723.0	9387.8	1701.3	294.0	170.4
Priv/Local Total	1332.8	335.1	997.8	328.3	99.5	18.8
Conservation Property	761.6	138.8	622.7	133.5	49.6	0.3
All Remaining Priv/Local	571.3	196.2	375.0	194.8	49.9	18.5
Total	16538.1	2708.4	13829.7	2672.3	456.1	209.3

*Numbers are not mutually exclusive

Table B5-2. Medium/small lake area on crown and private land and the area within each where native, non-native and unidentified fish species have been observed

Land Type	Small Lake Area (ha)	% of Total Areas	Small Lake Area					
			With Native Fish Species (ha)	% Native	With Non-Native Fish Species (ha)	% Non-Native	Unidentified (ha)	% Unidentified
Crown	1173.20	0.16	312.54	0.04	14.78	0.00	23.88	0.00
Priv/Local	198.26	0.24	46.72	0.06	8.14	0.01	0.05	0.00
Total	1371.46	0.16	359.26	0.04	22.92	0.00	23.93	0.00

Table B6-1. Mature and old Interior Cedar Hemlock (ICH) moist (mw) biogeoclimatic zones (BGC) on crown and private land

Ownership/BGC	Old Forest Interior Cedar-Hemlock (ICHmw) Forests			
	Mature Forest (ha)	% Mature	Old Forest (ha)	% Old
Crown	64371.86	8.58	4517.54	0.60
ICHmw2	52907.98		4102.43	
ICHmw4	11463.88		415.10	
Priv/Local	5294.84	6.34	1477.98	1.77
ICHmw2	3132.25		246.13	
ICHmw4	2162.59		1231.85	
Total	69666.69	8.35	5995.51	0.72

Table B6-2. Protected areas of mature and old Interior Cedar Hemlock (ICH) moist (mw) biogeoclimatic zones (BGC) on crown and private land

Ownership/BGC	Old Forest Interior Cedar-Hemlock (ICHmw) Forests			
	Mature Forest (ha)	% Mature	Old Forest (ha)	% Old
Parks (Crown)	10891.07	1.45	1284.68	0.17
ICH mw 2	7960.02		1229.39	
ICH mw 4	2931.05		55.28	
Conservation Properties (Priv/Local)	1470.64	1.76	1081.05	1.29
ICH mw 2	138.96		0	
ICH mw 4	1331.68		1081.05	
Total Protected	12361.71	1.48	2365.72	0.28

Table B7-1. Interior Cedar Hemlock (ICH) dry (dw) and very dry (xw) biogeoclimatic zone (BGC) areas on crown and private land, including the amount of protected area within each classification

BGC	Crown		Private/ Local Government		Total BGC Area (ha)
	Total (ha)	Park (ha)	Total (ha)	Conservation Property (ha)	
ICH dw1	42189.32	4371.14	18758.84	3381.02	60948.16
ICH xw	3010.85	272.31	5076.61	748.58	8087.46
Total Dry ICH	45200.17	4643.45	23835.45	4129.60	69035.61

Table B7-2. Mature and old Interior Cedar Hemlock (ICH) dry (dw) and very dry (xw) biogeoclimatic zones (BGC) on crown and private land

Ownership/BGC	Old Forest Interior Cedar-Hemlock (ICHmw) Forests			
	Mature Forest (ha)	% Mature	Old Forest (ha)	% Old
Crown	27915.31	3.72	2242.90	0.30
ICHdw1	25784.41		2153.08	
ICHxw	2130.90		89.82	
Priv/Local	14530.75	17.40	604.58	0.72
ICHdw1	11402.23		501.15	
ICHxw	3128.52		103.42	
Total	42446.06	5.09	2847.47	0.34

Table B7-3. Protected areas of mature and old Interior Cedar Hemlock (ICH) dry (dw) and very dry (xw) biogeoclimatic zones (BGC) on crown and private land

Ownership/BGC	Old Forest Interior Cedar-Hemlock (ICHmw) Forests			
	Mature Forest (ha)	% Mature	Old Forest (ha)	% Old
Parks (Crown)	3318.59	0.44	371.82	0.05
ICHdw1	3119.37		331.52	
ICHxw	199.22		40.30	
Conservation Properties (Priv/Local)	2192.72	2.63	135.70	0.16
ICHdw1	1837.60		136	
ICHxw	355.12		0.00	
Total Protected	5511.30	0.66	507.52	0.06

Table B8-1. Likelihood of Karst on crown and private land

Karst Likelihood	Crown (ha)	% Crown	Private/ Local Government (ha)	% Private/ Local Government	Total Area (ha)	% of Total Area
Primary = >50% soluble bedrock	20990.02	2.80	2044.03	2.45	23034.05	2.76
Secondary = 20% to 49% soluble bedrock	11117.41	1.48	4385.84	5.25	15503.25	1.86
Tertiary = 5% to 19% soluble bedrock	136503.72	18.18	7556.53	9.05	144060.25	17.27
Total	168611.15	22.46	13986.40	16.75	182597.55	21.89

Table B8-2. Likelihood of Karst in protected areas on crown and private land

Hydro Riparian Area Type	Park (ha)	% Park	Conservation Property (ha)	% Conservation Property	Total Protected Area (ha)	% Protected of Total Area
Primary = >50% soluble bedrock	6742.69	0.90	184.48	0.22	6927.17	0.83
Secondary = 20% to 49% soluble bedrock	1253.70	0.17	3876.77	4.64	5130.46	0.62
Tertiary = 5% to 19% soluble bedrock	33121.30	4.41	1035.25	1.24	34156.55	4.09
Total	41117.69	4.93	5096.49	0.61	46214.19	5.54

Table B9-1. Brushland area on crown and private land, including the amount of protected area within each

Brushland	Crown (ha)	% Crown	Private/ Local Government (ha)	% Private/ Local Government	Total Area (ha)	% of Total Area
Total Area	30.89	0.004	1.23	0.001	32.12	0.004
Conservation Property	n/a	-	0.89	0.00	0.89	0.00
Park	0	0	n/a	-	0	0

Table B10-1. Deciduous floodplain (mid-bench) on crown and private land, including the amount of protected area within each

Deciduous Floodplain (mid-bench)	Crown (ha)	% Crown	Private/ Local Government (ha)	% Private/ Local Government	Total Area (ha)	% of Total Area
Total	2343.42	0.312	934.15	1.119	3277.57	0.393
within Park	643.43	0.09	n/a	n/a	643.43	0.08
within Conservation Property	n/a	n/a	171.44	0.21	171	0
Total Protected	643.43	0.09	171.44	0.21	814.87	0.10

Table B10-2. Cottonwood area as identified by Jameison (2010) on crown and private land, including the amount of protected area within each

Cottonwood Rank	Crown (ha)	% Crown	Private/ Local Government (ha)	% Private/ Local Government	Total Area (ha)	% of Total Area
Rank 1 Cottonwood	80.57	0.011	124.22	0.149	204.79	0.025
within Park	8.40	0.00	n/a	n/a	8.40	0.00
within Conservation Property	n/a	n/a	35.10	0.04	35	0
Rank 2 Cottonwood	581.32	0.08	496.64	0.59	1077.96	0.13
within Park	61.03	0.01	n/a	n/a	61.03	0.01
within Conservation Property	n/a	n/a	190.27	0.23	190.27	0.02
Total Protected	69.43	0.01	225.37	0.27	294.79	0.04

Table B11-1. Length of stream where fish species of conservation concern have been observed

Land Type	Total Stream Length (km)	Stream Length (km)	
		Adfluvial Bull Trout Present	Westslope Cutthroat Trout Present
Crown	15205.2	257.45	741.48
Park	4094.4	58.74	220.33
All remaining Crown	11110.8	198.71	521.16
Priv/Local Total	1332.8	52.48	113.45
Conservation Property	761.6	25.82	48.23
All Remaining Priv/Local	571.3	26.67	65.22
Total	16538.1	309.93	854.93

Table B11-2. Small lake area on crown and private land and the area within each where Westslope Cutthroat Trout have been observed

Land Type	Small Lake Area (ha)	
	With Cutthroat Trout (ha)	% With Cutthroat Trout
Crown	202.5	0.03
Park	107.8	0.01
Priv/Local	20.5	0.02
Conservation Property	17.8	0.02

Table B11-3. Westslope Cutthroat Trout presence in wetlands by type on crown and private land, including the amount of protected area within each classification

Land Type	Wetland Types ¹								Total Wetland Area (ha)	% of Total Area
	W (ha)	% W	Wm (ha)	% Wm	Ws (ha)	% Ws	Ww (ha)	% Ww		
Crown	6.94	0.00	1.88	0.00	1.55	0.00	12.48	0.00	22.85	0.00
Park	3.21	0.00	0.19	0.00	-	-	4.56	0.00	7.96	0.00
Priv/Local	0.49	0.00	0.31	0.00	7.08	0.01	5.77	0.01	13.65	0.02
Conservation Property	-	-	0.31	-	6.96	0.01	5.77	0.01	13.04	0.02
Total	7.43	0.00	2.18	0.00	8.63	0.00	18.25	0.00	36.49	0.00

¹ W = Undifferentiated Wetland; Wf = Fen; Wm = Marsh; Ws = Swamp; Ww = Shallow water

Appendix C



Conservation Actions

Table C1 - Summary of Conservation Actions by Activity Type and Neighbourhood Conservation Action Bins

	Activity Type and Description	Protect critical, valuable and/or under-represented habitats	Protect species at risk/of concern	Enhance or restore landscape connectivity	Restore or create habitats or sites	Prevent/address invasive species	Reduce recreational pressure	Advance climate resilience	Other (e.g., restore ecosystem processes/functions)
	Direct Conservation Actions (3 points)								
	• Acquire critical or high value habitat; purchase and manage for conservation (see Appendix A, Table A4 for SAR habitat associations and RPs/MPs, if available)	x		x					
	• Protect critical or high habitat; establish covenant, landowner agreement (see Appendix A, Table A4 for SAR habitat associations and RPs/MPs, if available)	x		x					
	• Protect identified critical, rare or sensitive habitats or features (see Table A4 in App. A for SAR habitat associations and RPs/MPs, if available)	x	x	x				x	
	• Implement other actions recommended in recovery plans focused on target listed species/habitats (see species with RPs/MPs available Appendix A, Table A4)		x						
	• Reduce mortality to listed, rare or sensitive species (e.g., develop wildlife crossing structures where roadkill mortality is a known concern)		x						
	• Reduce access to critical, rare or sensitive habitat (e.g., close a key access road, gate a bat hibernacula, fence off a raptor breeding territory, angling closures)	x	x	x	x	x	x	x	
	• Restore or enhance ecosystem processes/functions (e.g., fire, seasonal flooding, water storage, erosion control, fish & wildlife dispersal, pollination)			x	x			x	x
	• Implement a management plan to enhance species or habitat protection (e.g., FKLSS implementing a plan for wetland creation at Sunshine Bay)	x	x	x			x	x	
	• Implement regulations/by-laws that enhance habitat or species protection (e.g., implement dog bylaws in regional parks used by listed waterfowl and shorebirds)	x	x	x			x		
	• Implement guidelines that enhance habitat or species protection (e.g. implement BMPs for beaver lodge or muskrat den protection on private land)	x	x	x			x		
	• Implement other landowner or land manager stewardship actions for listed, rare, sensitive species/habitats (see Appendix A, Table A4)	x	x	x	x	x			
	• Implement community group stewardship program for priority habitats or species (e.g., to manage problem grizzly and black bears in a local community)	x	x	x	x	x			
	• Implement a long term community-driven invasive species treatment program (e.g., implement Scotch broom treatment by North Shore resident group)				x	x		x	
	• Invasive species treatment with (emphasis on riparian, wetland, sensitive, high value sites (e.g., knotweed yellow flag iris control on Fishermen's Road); suppression of non-native fish)		x		x	x		x	
	• Enhance habitat of listed, rare or sensitive fish and wildlife species (see Table A4 in App. A for SAR habitat associations; e.g., restore degraded marsh or hardened shorelines)		x	x				x	
	• Restore or create fish or wildlife habitat (e.g., remove barriers to restore fish passage; improve habitat suitability for bank swallows or yellow-breasted chats)	x		x	x			x	x
	• Restore or create habitat features important for fish and wildlife (e.g., create wildlife tree for woodpeckers, painted turtle nesting sites, fish spawning areas)	x		x	x			x	x
	Required Steps to Guide Future Conservation Actions (2 points)								
	• Species or habitat assessment/inventory to identify critical, rare or sensitive habitat (e.g., survey of listed invertebrates at sites with high breeding potential; additional spawning areas for Bull Trout and Kokanee)	x	x	x	x			x	
	• Species or habitat research to help identify threats and mitigation measures (e.g., bat research to identify threat of white-nose syndrome)	x	x	x	x			x	x
	• Species or habitat monitoring to effectiveness of enhancement, restoration, and mitigation measures (e.g., occupancy monitoring of artificial hibernacula; fish use at enhanced shoreline sites)	x	x	x	x			x	x
	• Monitoring and/or inventory that aids in identification and/or establishment of the location of threats (e.g., monitoring leopard frog roadkill at Duck Lake; Kokanee shoal spawning)	x	x					x	x
	• Climate change monitoring that enhances understanding of habitat changes and/or risk to survival (e.g., water quantity and quality monitoring streams, groundwater, aquifers; snow & glacier monitoring)		x					x	x
	• Invasive species inventory for priority species; see CKISS lists (e.g., giant hogweed, knotweeds, purple loosestrife, Eurasian milfoil, Scotch broom, flag iris)				x	x		x	
	• Invasive species research based on CKISS priorities (to develop new tools/techniques, and evaluate non-target impacts); non-native/native fish overlaps				x	x		x	
	• Invasive species monitoring to evaluate change in status/condition or effectiveness of control and containment measures (e.g., periodic knotweed monitoring)				x	x		x	
	• Stewardship planning and implementation assistance programs for landowners and managers at stand and landscape scales	x	x	x	x	x	x	x	x
	• Financial incentives for developing future stewardship actions (e.g., funding for developing plans such as vegetation or prescribed fire in degraded habitat; sensitive habitat inventory mapping)	x	x	x	x	x	x	x	x
	• Develop a management plan to improve habitat or species protection (e.g., a plan to protect old forest via management of the surrounding younger forest matrix)	x	x	x			x		
	• Develop regulations that improve habitat or species protection (e.g., work with land managers to develop access restrictions for floodplains)	x	x				x		
	• Develop guidelines that improve habitat or species protection (e.g., for a listed plant community in relation to existing threats)	x	x				x		
	• Land use planning for private land (e.g. work with large land managers/owners to develop access management or wildfire management plans)	x		x			x	x	
	Potential Steps to Guide Future Conservation Actions (1 point)								
	• Training for target groups (e.g., commercial recreation operators, industry, recreation groups) operating in at-risk, rare or sensitive areas	x	x						
	• Guardian program development (First Nations, group) for key habitats/species (e.g., small lake or streams with over-fishing, poaching or intensive recreation)	x			x		x	x	x
	• Research to restore/improve natural ecosystem processes and functions (e.g., water, fire, flood, and other management regimes)		x					x	
	• Disease research and management (e.g., chytrid fungus, white-nose, honeybee diseases, whirling disease)		x						
	• Problem wildlife management on private land (e.g., to address problem bear, beaver, woodpecker, porcupine, elk and other forms of wildlife damage)	x	x			x			
	• Citizen science programs to supplement other information (e.g., osprey, water quality and quantity monitoring in smaller watersheds)	x	x		x	x		x	
	• Public education and awareness, including interpretive information, signage, brochures (e.g., brochure to improve awareness of local listed plants; brochure to educate foreshore landowners)	x	x	x	x	x	x	x	
	• Participation in planning/management initiatives (for ecosystems, habitats, species, climate adaptation, ecosystem function)	x	x	x	x		x	x	x
	Steps to Guide Conservation Actions by Government or Other Jurisdictions								
	• Predator management (e.g., manage wolves to reduce caribou mortality)		x						
	• Harvest management (e.g., protect beavers to maintain wetland habitat)		x						
	• Land use planning on crown land	x		x	x		x	x	x
	• Recreation planning/zoning and implementation of "no-go" areas	x		x		x	x		
	• Improve legislation, policy, or guidelines for species and habitats at risk	x	x				x		
	• Improve compliance and enforcement for species and habitats at risk	x	x				x		
	• Improve legislation, policy and oversight for private forest & range management	x	x	x		x		x	x
	• Improve environmental impact assessment and referral processes on crown land	x	x	x				x	x
	• Re-institute government control and oversight over crown forest & range management	x	x					x	x
	• Increase constructive engagement on forest & range management	x	x						