

Appendix 4.8-A Wildlife Baseline Report



Tenas Project

Wildlife Baseline Report

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VERSION 3.1

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EXECUTIVE SUMMARY

The wildlife baseline program for the Tenas Project (the Project) covers several study areas including the Wildlife Local Study Area (W-LSA), which includes the project components and 5 km buffer zone around project components. Project components are the minesite area between Goathorn and Tenas Creeks, the rail infrastructure area near the Bulkley River, and the access corridor connecting the minesite area to the rail infrastructure area. A Wildlife Regional Study Area (W-RSA) that encompasses the W-LSA, plus the intersection of all the watersheds that overlap within a 10 km buffer around the Project. A Wide-Ranging Wildlife RSA was delineated around the W-RSA to provide a wider regional context for species such as grizzly bear, moose and wolverine. Three RSAs were also identified for the Telkwa Caribou Herd to allow for specific assessments and analyses related to management requirements under Provincial and Federal management initiatives and the Recovery Strategy for Caribou (Environment Canada 2014).

Field assessments, surveys and mapping were completed from 2017 to 2019 to characterize the wildlife species and their habitat use that could be affected by the Project, following recognized standards by professional biologists and experienced technical staff.

Terrestrial Invertebrates

Terrestrial invertebrate information from previous work is limited within the Tenas Project W-RSA. A review of literature, species lists, and distribution information in BC, a total of nine invertebrate species of conservation concern may occur within the W-RSA: two lady beetle species (*Coccinella novemnotata*; *Coccinella transversoguttata*); three bumble bee species (*Bombus bohemicus*; *B. occidentalis* [two subspecies *mckayi* and *occidentalis*]; and *B. terricola*); three butterfly species (*Boloria epithore sigridae*; *Euchloe ausonides ogilvia*; *Polites draco*); and one dragonfly species (*Somatochlora kennedyi*).

Field studies conducted in 2017 and 2018 used a variety of passive (e.g. malaise traps, blue vane traps and bowl traps) and active (e.g. sweep and beating nets) sampling techniques to collect information on terrestrial invertebrates of conservation concern within the Project area. Sampling in 2017 found no listed terrestrial invertebrate species observed or collected in 2017, while two listed bumble bee species; western bumble bee and yellow-banded bumble bee, were collected and observed at ten survey sites in July 2018. A total of 13 yellow-banded bumble bee specimens were collected and two western bumble bee specimens were collected within the W-LSA.

An assessment of the extent of potential habitats for the listed terrestrial invertebrate species was completed using available ecosystem mapping and species habitat use information from literature. Some species, such as the transverse and nine-spotted lady beetles, gypsy cuckoo bumble bee, western bumble bee, and the yellow-banded bumble bee are habitat generalists that use a wide variety of potential habitats that can be found in over 70% of the W-LSA and 50% of the W-RSA. Other species such as the draco skipper butterfly, Kennedy's emerald dragonfly are more restricted in their potential habitat requirements and have smaller potential habitat use areas ranging from 3 to 18% of the W-LSA, and 2 to 20% of the W-RSA.

Amphibians and Reptiles

A review of literature, species lists, and distribution information for amphibians and reptiles in BC provided a list of five amphibian and two reptile species of conservation concern that may potentially occur within the W-RSA; coastal tailed frog (*Ascaphu truei*), Columbia spotted frog (*Rana luteiventris*), long-toed salamander (*Ambystoma macrodactylum*), western toad (*Anaxyrus boreas*), wood frog (*Lithobates sylvatica*), common garter snake (*Thamnophis sirtalis*), and terrestrial garter snake (*Thamnophis elegans*). Of these, both coastal-tailed frog, and western toad are listed as Special Concern.

The following herptile species were observed during visual herptile surveys and incidental sightings; Columbia spotted frogs, long-toed salamander, western toad, wood frog, and common garter snake. Breeding sites were identified for all observed species with the exception of wood frog although one site was identified as being likely breeding habitat for wood frog as several juveniles were observed. eDNA samples were collected and analysis identified Columbia spotted frog, western toad, and wood frog within water bodies in the W-LSA. Coastal tailed frog was not identified during any of the visual or eDNA surveys, or observed incidentally within the W-LSA, despite extensive searches within typical habitats. This is consistent with searches conducted in 2015 by BC MFLRNRO that found no tailed frogs in streams that are tributaries to the Telkwa River.

Western toads were the most common amphibian observed during surveys and were found at 23 sites with confirmed breeding at six sites. Two potential western toad movement corridors were identified along the access corridor during baseline surveys. Movement paths for western toad are largely undocumented and research is lacking on how landscape and habitat type shapes movement for the species.

The results of the amphibian and reptile surveys conducted in the W-LSA indicate that productivity and habitat use is generally low in the higher elevation areas of the minesite area, with more use is found in the lower elevations of the minesite area, access corridor and rail infrastructure areas. Amphibian breeding areas have a patchy distribution and are generally associated with ephemeral streams, wet depressions, ditches, backchannels and small wetlands. Snake habitats were limited to a few exposed bedrock and boulder areas associated with natural landscape features and field cultivation in the lower elevation areas of the W-LSA.

Several wetlands and snake breeding areas were identified as significant for the W-LSA and are considered critical for sustaining healthy populations of the species that reside within and provide multiple life requisites for herptiles and are spatially distributed across the W-LSA.

Habitat suitability modelling for western toad model found that suitable habitat during the spring, summer and fall seasons was identified and makes up approximately 22% of the W-LSA, primarily within mature, moist coniferous forests within the SBSdk and SBSmc2 subzones. The majority (55%) of the W-LSA was identified as Low value habitats, within the higher elevation ESSFmc and BAFAun subzones, as well as early seral, agricultural and rural/urban areas within the lower elevation SBSmc2 and SBSdk subzones. Reproducing habitats are limited within the W-LSA, with only 4.3% (1,553.3 ha) identified as Low to High value habitat, primarily within wetlands, ponds and riparian habitats. Habitat modeling for Hibernation habitats, identified 4,703.4 ha (13.2% of the W-LSA) as High value Hibernation habitats, primarily within riparian areas and mature conifer habitats within the SBSmc2 and SBSdk subzones.

Bats

The current status on the presence, distribution and habitat use of bat species in the W-RSA is relatively limited. The BC CDC information and a bat inventory for the Skeen region (Roberts and Roberts 2000) was reviewed resulting in identification of seven bat species as potentially occurring in the W-RSA: long-legged myotis (*Myotis volans*), little brown myotis (*M. lucifugus*), Yuma myotis (*M. yumanensis*), California myotis (*M. californicus*), western long-eared myotis (*M. evotis*), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*). Ultrasonic monitoring using ultrasonic recorders was undertaken in 2017 and 2018 within a variety of habitats in the W-LSA associated with the Project components. Recordings were analyzed using classification software designed to identify bat echolocation calls, additional manual reviews of a sub-sample of the recordings were completed to check the reliability of bat classifications. Based on the results of the 2017 season and their being classified in the recordings, Eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*) and pallid bat (*Antrozous pallidus*), were included as potential species of interest, although they are all normally found in other regions in BC. Classification of all available the bat recording were conducted after the 2018 field season, using an analysis of the full frequency (8 to 200 kHz) of the recording as well as a low frequency analysis (8 to 50 kHz) to attempt to classify species such as Eastern red bat and pallid bat that call at those lower frequencies.

Based on the results of the software classification and manual reviews of the ultrasonic bat recordings, five species (big brown bat, little brown myotis, long-eared myotis, long-legged myotis and silver-haired bat) were identified as *Likely Present* in the W-RSA. Northern myotis was assessed as *Possibly Present*, along with hoary and pallid bats, with these latter two likely vagrant individuals or mis-identifications. Neither California or Yuma myotis were detected by the classification software or during the manual review of calls.

Assessments for bat roost sites were completed within the W-LSA at 54 sites to identify potential day/night and maternity roosting habitats. At each site, an assessment of the trees within the plot was completed to identify trees containing cavities, loose bark or features that would allow bats to roost. Large diameter deciduous trees with accelerating decay were identified as providing the highest potential for maternal habitat for forest roosting bats. The assessments found that only one site had no potential day/night roosting for bats and 52% of the sites could potentially provide roosting for 6 to 20 bats within the 400 m² plot area. For maternal roosting, 28% of the sites contained suitable trees, and that for trees greater than 15 cm DBH, 12% were suitable for maternal roosting. The average DBH for maternal trees was 45.1 cm, with black cottonwood, lodgepole pine and trembling aspen identified as having the most maternal roosting potential.

Habitat suitability modelling for forest bats found that food habitats rated high were limited within both the W-LSA (1%, 436 ha) and the W-RSA (1%, 1,957 ha), while moderate rated habitats made up approximately 30% and 20% respectively of the W-LSA and W-RSA. Security/Thermal (day/night roosting) habitats quite relatively common in the making up 32% (11,350 ha) of the W-LSA and 26% (49,831 ha) of the W-RSA. Modeling of Reproduction (maternal roosting) habitats identified 2,334 ha (6.5%) of high value habitat in the W-LSA and 9,867 ha (5.1%) in the W-RSA, while Hibernation habitats were very limited with only 23.4 ha identified as suitable within the W-LSA and only 414 ha within the W-RSA.

Furbearers

A wide variety of furbearing species were included in the baseline assessments including; American marten, American mink, beaver, Canada lynx, cougar, coyote, fisher, grey wolf, red fox, red squirrel, river otter, short-tailed weasel, snowshoe hare and wolverine. Listed species included wolverine and fisher and are both identified as regionally important wildlife. A review of previous studies related to proposed coal mines, trapper harvest data and big game harvest data from the previous 20 years confirmed the historical presence and varying levels of harvesting of many of the species listed above. Marten accounted for over 70% of the reported trapped animals from 1998 to 2017 in the W-RSA, while fisher and wolverine accounted for only 1% of reported trapped animals each. Wolves have been consistently harvested within the W-RSA, while Canada lynx harvesting has been variable. Snow tracking surveys completed in 2018 showed extensive snowshoe hare use of the W-LSA and relatively high densities of marten use throughout mixed mature forests. Snow tracking observations of listed species included one set of wolverine tracks in the minesite area and two sets of fisher tracks.

The habitat suitability model for American marten identified 11,567 ha of high value habitat within the W-LSA and 74,028 ha in the W-RSA based on a model developed by Steventon (2020) that incorporates foraging and denning habitat attributes as well as predicting potential home range territories. An estimated 37 to 48 female home range territories were calculated by the model within the W-LSA and 262 to 277 territories within the W-RSA.

Black and Grizzly Bear

American black bears (*Ursus americanus*) and grizzly bears (*Ursus arctos*) are both found throughout the WRW-RSA and within portions of the W-LSA. Black bear are a yellow listed species and grizzly bears are blue listed and are designated as Special Concern with COSEWIC and SARA registry.

There are no population estimates for black bear within northern BC; an estimated half a million black bears in live in Canada with about a quarter of those living in BC (ref). Although habitat is shrinking due to land development, black bear abundance is not considered to be suffering. The greatest causes of black bear

mortality are conflicts with humans followed by legal hunting. Black bears are recreationally hunted throughout the province with approximately 3,000 black bears harvested from Management Units (MUs) overlapping the WRW-RSA in the past 20 years. Black bear sign was observed throughout the WRW-RSA during wildlife surveys including six visual observations of bears. Photos of black bears were frequently captured during remote wildlife camera surveys throughout the W-LSA. The information summarized here suggests the extensive use of landscape by black bears throughout the W-RSA and W-LSA.

Grizzly bear population estimates for the WRW-RSA are presented in GBPU's which overlap the W-RSA (Bulkley Lakes and Babine GBPU's) and is estimated at 313-429 bears with corresponding densities of roughly 20 bears/1000 km². Both units are considered to have extensive useable grizzly bear habitat. Up until 2017, grizzly bears were hunted annually within the WRW-RSA. As of 2018, no grizzly bears have been harvested within the WRW-RSA. Grizzly bear sign was recorded a total of 24 instances throughout the minesite and access corridor. One grizzly bear sighting was recorded within the W-LSA, and one grizzly was captured during remote camera surveys.

The output from the spring and summer grizzly bear suitability models indicated that relatively more high, moderately high, and moderate rated habitat was present in the WRW-RSA than the W-LSA, whereas the opposite was true in the fall habitat model. No moderate to high rated suitable spring habitat was modelled within the W-LSA and little was modelled in the WRW-RSA (<3%). The summer habitat model indicated that most moderate to high rated habitat was located at mid to upper elevations, with concentrations in the centre and western portions of the WRW-RSA.

Caribou

Historical information, recent studies, and the analyses presented here on the ecology of Telkwa Caribou Herd show that the herd has been in a state of continuous conservation concern since the mid 1900s. During the most recent decline the herd dropped from a high of 83 caribou in 2007 to a low of 11 in 2013. The most recent surveys of the Telkwa Caribou Herd in 2018 and 2019 counted a minimum of 25 animals. Various recovery efforts have been successful and resulted in brief periods of increased caribou numbers, but after completion of these efforts, the herd returned to low numbers.

The current distribution of Telkwa caribou is driven by selection primarily for alpine and secondarily for subalpine habitats. The recent distribution and movement exhibited by collared caribou indicates that the annual range of the Telkwa Caribou Herd is well defined by the combination of alpine and subalpine habitats and movement within the herd annual range is mostly confined to the higher elevation terrain. Documented movements outside of the alpine and subalpine habitats were mostly by translocated caribou during the first years of the population augmentation program.

The information reviewed and summarized here, and supported by studies of other woodland caribou herds, supports the hypothesis that the Telkwa Caribou Herd is limited primarily by mortality from predation. Telkwa caribou mortality rates are disproportionately higher when caribou move to lower elevation forested habitats. Caribou were more than ten times more likely to die in forested habitats compared to alpine habitats. While the proximate cause of Telkwa caribou mortality is likely predation by wolves, the ultimate cause is habitat-mediated apparent competition with other large ungulate prey species (i.e., moose and deer) and facilitated predator movement from human-caused landscape changes (i.e., linear features). Ultimately, the disturbed habitat has indirectly increased predation risk for Telkwa caribou.

Land management practices in the areas that surround the annual range of the Telkwa Caribou Herd have resulted in a large area of human-influenced (i.e., disturbed) habitat that provides high quality forage for moose and deer in forested areas. In the caribou study areas, the amount of disturbed habitat in the area currently exceeds the 35% total disturbance threshold recommended in the Recovery Strategy (Environment Canada 2014), with the exception of the TCH-RSA2 Core, an area that is the best approximation of the Telkwa Caribou Herd's annual range, with a total estimated disturbance of 23%.

A review of arboreal and terrestrial lichen surveys completed historically within the Telkwa Caribou Herd study areas were combined with new surveys in the W-LSA to assess the availability of forage lichens for caribou. Arboreal lichen abundance was highest in the ESSFmc subzone, with a mean of 35.3 kg/ha, while the means for the SBSmc2 and SBSdk subzones were 22.7 kg/ha and 4 kg/ha respectively. Terrestrial lichens were generally 20 times more abundant than arboreal lichens, with the mean values for the ESSFmc SBSmc2 and SBSdk subzones being 855 kg/ha, 329 kg/ha and 89 kg/ha.

Moose

Moose continue to be of special conservation concern and are a culturally important to the Wet'suwet'en. Population declines have been determined throughout the province and has prompted various research programs and management initiatives including land use planning and best management practices. Despite current management initiatives and recent hunting restrictions, moose populations throughout BC's interior are still in decline. Current density estimates for the WRW-RSA (Bulkley Valley and Bulkley Valley and Lakes District) was between 0.59 ± 0.08 moose/km² and 0.73 ± 0.14 moose/km² with an overall decrease in moose populations of 33.5% between 2004 and 2018, although the 2012 and 2018 surveys had similar population estimates.

Predation of moose is the most common cause of natural mortality followed by starvation and health issues. Human involvement including hunting and vehicle/train accidents contributes to almost 20% of all moose mortalities. Train collisions were estimated to have killed 82 ± 12 moose in 2018 along the rail line within the WRW-RSA. Drops in overall harvests from legal hunting in MUs overlapping with the WRW-RSA is also observed with an overall decline of 57% from 2003 to 2018.

Historical information and recent studies suggest that moose use of habitat and movement within the WRW-RSA is common and relatively continuous. Collar data summarized here suggests strong selection for the SBSdk subzone during growing and winter seasons within the WRW-RSA and W-RSA while SBSmc2 and ESSF subzones are weakly selected for. SBSdk supports moose habitat with lower snow levels and more access to riparian and deciduous habitat types. Collared moose also displayed limited movement throughout late winter months when snow is deepest and increasing movements in summer months.

Other Ungulates

Other ungulates included in this baseline report consist of rocky mountain elk, mule deer, white-tailed deer and mountain goat. Elk, mule deer and white-tailed deer are yellow listed species. Collar data and historical sightings suggest elk have limited distribution in the W-RSA during winter months but are likely found throughout the valley floor to mountain tops during growing season. Limited elk sign was observed during baseline surveys. Mule deer are found throughout the W-RSA and this baseline confirmed their use of a wide variety of habitats throughout the W-LSA through wildlife cameras and evidence of use observations (tracks, excrement, browse sign). White-tailed deer are also known to use the W-RSA however are less abundant and movement tends to be ecotonal moving along habitat edges and with weather and seasonal changes. Limited observations of white-tail were recorded during baseline surveys. Mountain goats are a blue listed species and have a limited overlap (81.6 ha) between UWR 6-007 and the south eastern portion of the W-LSA and no interactions with mountain goats is anticipated during project activities.

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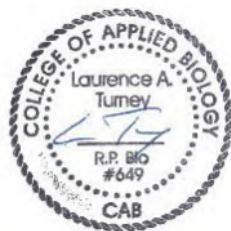
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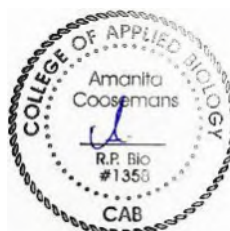
PROFESSIONAL CERTIFICATIONS

The undersigned certify that they are responsible for the work completed and reported on in this document, and that they were working within their area of expertise and within the Regulations and Policies of the College of Applied Biology.



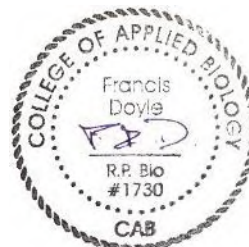
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Tenas Project

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GLOSSARY AND ABBREVIATIONS

ABBREVIATION	LONG FORM OF ABBREVIATION
ARU	Automatic Recording Units
BAFAun	Boreal Altai Fescue Alpine Undifferentiated
BC	British Columbia
BC CDC	British Columbia Conservation Data Centre
BEC	Biogeoclimatic Ecosystem Classification
BGC	Biogeoclimatic
BMP	Best Management Practices
BUB	Bulkley Basin
BUB	Bulkley Basin ecosection
BUR	Bulkley Ranges
BUR	Bulkely Ragnes ecosection
BV	Bulkley Valley
BWBS	Boreal White and Black Spruce
CDC	Conservation Data Centre
CN	Canadian National Railway
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CUS	Cultural Use Study
CWD	Coarse Woody Debris
CWH	Coastal Western Hemlock
DBH	Diameter at Breast Height
ECCC	Environment and Climate Change Canada
eDNA	Environmental DNA
ESSF	Engelmann Spruce
ESSFmc	Engelmann Spruce - Subalpine Fir Moist Cold
ESSFmcp	Engelmann Spruce - Subalpine Fir Moist Cold Parkland
ESSFmcw	Engelmann Spruce - Subalpine Fir Moist Cold Woodland
FIZ	Fisher Habitat Zones
FRPA	<i>Forest and Range Practices Act</i>
LSA	Local Study Area
MAP	Mean Annual Precipitation
MAT	Mean Annual Temperature

ABBREVIATION	LONG FORM OF ABBREVIATION
MECCS	Ministry of Environment and Climate Change Strategy
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Regional Development
MH	Mountain Hemlock
MOE	Ministry of Environment
MOELP	Ministry of Environment, Lands and Parks
MOFR	Ministry of Forests and Range
MOTI	Ministry of Transportation and Infrastructure
MPB	Mountain Pine Beetle
MU	Management Unit
PEM	Predictive Ecosystem Mapping
RSA	Regional Study Area
SARA	<i>Species at Risk Act</i>
SBS	Sub-Boreal Spruce
SBSdk	Sub-Boreal Spruce Dry Cool
SBSmc2	Sub-Boreal Spruce Babine Moist Cold
SRB	Stratified Random Block
SRMP	Sustainable Resource Management Plan
TCH	Telkwa Caribou Herd
TEM	Terrestrial Ecosystem Mapping
TK	Traditional Knowledge
TKDSS	tracks/km/days since snowfall
UNBC	University of Northern British Columbia
UTM	Universal Transverse Mercator
UWR	Ungulate Winter Range
VHF	Very High Frequency
VRI	Vegetation Resources Inventory
WARS	Wildlife Accident Reporting System
WHA	Wildlife Habitat Area
WNS	White-Nose Syndrome
WRW	Wide-Ranging Wildlife

1. INTRODUCTION

Telkwa Coal Limited (TCL) is proposing to develop the Tenas Project (the Project), a surface coal mine designed to produce metallurgical coal at a planned annual production rate of between 775,000 and 825,000 metric tonnes, with a maximum daily production rate of 2,500 metric tonnes of processed coal, to be used in the manufacture of steel. The Project requires a Certificate under the *BC Environmental Assessment Act* and major mines permitting under the *Mines Act* and *Environmental Management Act*, and subsequent permitting. These requirements trigger the need for baseline studies followed by assessment of potential effects of the Project on various Valued Components.

The proposed Project is located in northwestern BC, approximately 25 kilometres (km) south of Smithers and 7 km southwest of the village of Telkwa. The Project is on three freehold land parcels owned by TCL and nine coal licences on provincial Crown land held by TCL. The Project falls within Wet'suwet'en traditional territories: the mine site is located in Cas'Yex House territory; the rail loop and loadout are located in Kwen Bea Yex House territory (Budhwa et al. 2020).

The Project will be a conventional shovel and truck operation like other rock quarry and surface mine operations in the region. Coal will be extracted using heavy machinery and sent to an on-site coal processing plant. Following processing, the coal will be trucked to a rail loadout facility and associated rail loop connecting to the existing main Canadian National Railway line. In addition to the mine pit, coal processing plant and rail infrastructure, the Project will include the following major components: a materials handling system, various rock and soil storage piles, water management features, mine access and haul roads, a powerline, a water pipeline, propane storage, explosives storage, administrative and warehouse buildings, and various other supporting infrastructure. The Project life will be approximately 25 years including the construction, operation, and decommissioning/reclamation phases.

The objective of the wildlife baseline program was to characterize the wildlife species and habitats they used that are found in the vicinity of the Project to support a subsequent assessment of potential Project effects on wildlife and their habitats and to identify any potential constraints on the Project related to wildlife and their habitats.

This *Wildlife Baseline Report* summarizes the current knowledge and baseline conditions for wildlife species and habitats associated with the proposed Project based on a review of existing information and the results of Project-specific surveys, mapping and analysis. The various components and methods used in the baseline program are outlined in Section 2, the results are provided in Section 3 and summarized in Section 4.

1.1 Project Components and Study Areas

The **Project Area** is 1,095 ha and encompasses the area that would potentially be directly disturbed by Project activities. To facilitate data analyses and discussions in this baseline report, Project components within the Project area were divided into three general areas: the minesite area, where coal mining and processing will occur; the rail infrastructure area, where the coal will be loaded onto rail cars; and the access corridor, which connects the minesite and rail infrastructure areas (Figure 1.1-1).

The **Wildlife Local Study Area** (W-LSA) is approximately 35,726 ha and encompasses a minimum 5 km buffer around the Project Area (Figure 1.1-1). The W-LSA includes the Village of Telkwa and part of Tyhee Lake to the north; Round Lake to the east; the lower slopes of Hunter Basin to the south, and the lowest reaches of Pine Creek to the west. It overlaps portions of both the Telkwa and Bulkley rivers, as well as Tenas and Goathorn creeks. The W-LSA has a notable anthropogenic footprint including the Village of Telkwa and overlaps with the Highway 16 corridor. Agricultural development and rural residences are

common in the lower elevations of the W-LSA, while higher elevation areas show a history of forest harvest activities.

There are five regional study areas (RSAs) for wildlife: a **Wildlife RSA**; a **Wide-Ranging Wildlife RSA** for grizzly bear, moose and wolverine; and three **Telkwa Caribou Herd RSAs** which are described in more detail below.

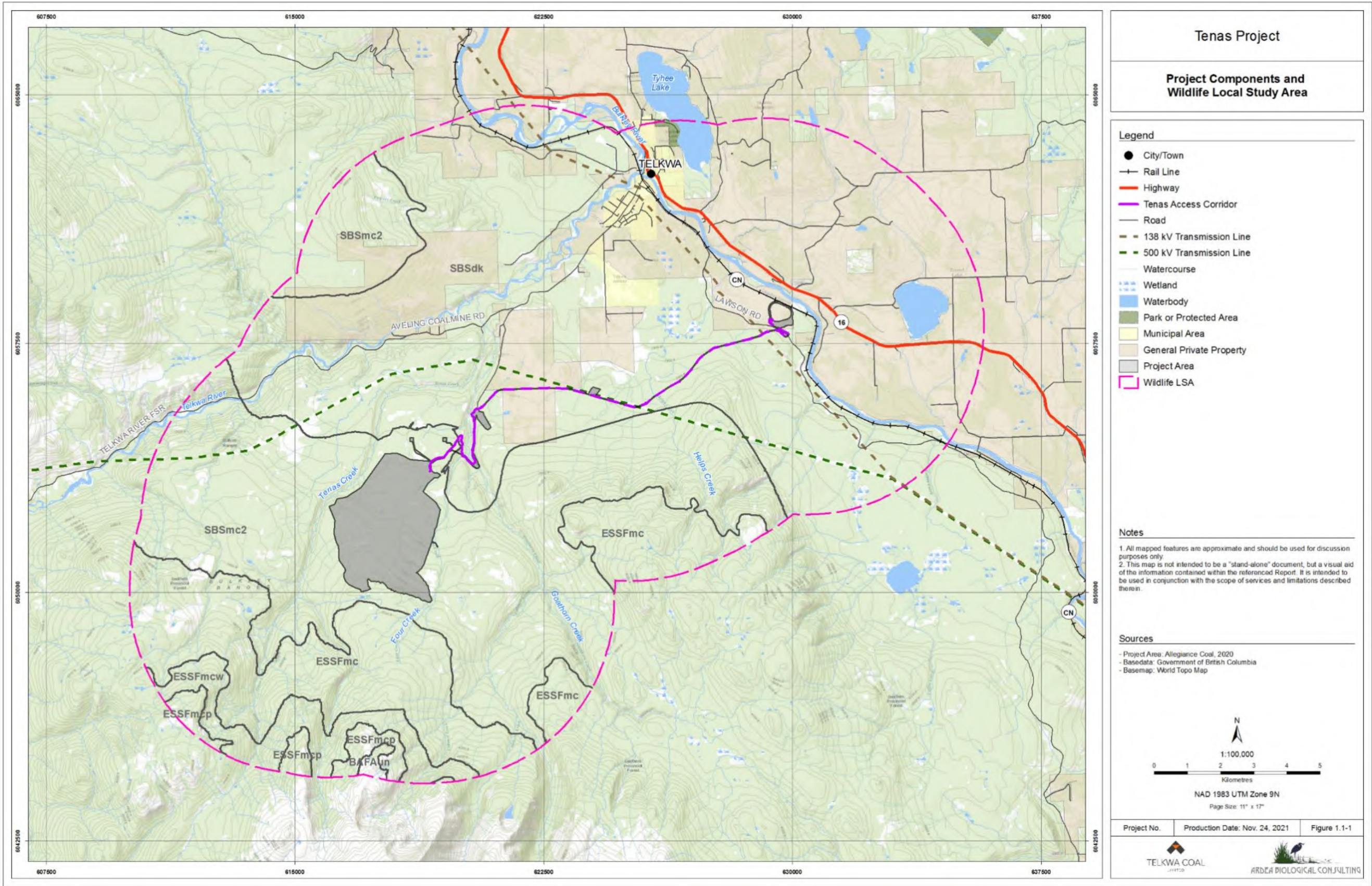
The **Wildlife RSA** (W-RSA) is 194,651 ha and encompasses the W-LSA plus the intersection of all watersheds that overlap within a 10 km buffer around the Project Area. For major watersheds (e.g. the Telkwa River, the Bulkley River) a sub-watershed boundary was chosen that was close to the 10 km buffer (Figure 1.1-2). The W-RSA is used to provide regional context on the spatial distribution and abundance of wildlife species that have moderately-sized home ranges (e.g. marten) and is the area within which potential Project effects are expected to interact with the effects of other past, present, and reasonably foreseeable future projects or activities. The W-RSA is characterized by a mixed landscape of Crown and private lands. Pre-existing habitat loss and fragmentation due to road development, forest harvesting, and mineral exploration activities have altered habitats within the W-RSA over time. The W-RSA overlaps primarily with the traditional territory of the Wet'suwet'en, and also includes the village of Telkwa and is adjacent to the town of Smithers. Elevation within the W-RSA ranges from approximately 470 to 2,300 metres (m).

The **Wide-Ranging Wildlife RSA** (WRW-RSA) is 357,587 ha and encompasses the W-LSA and the W-RSA, providing a regional context for grizzly bear, moose and wolverine, which have large home ranges and are wide-ranging over the landscape (Figure 1.1-3). Similar to the W-RSA, it is the area within which potential Project effects are expected to interact with the effects of other past, present, and reasonably foreseeable future projects or activities. The WRW-RSA, like the W-RSA is also primarily within the traditional territory of the Wet'suwet'en, includes the village of Telkwa and adjacent to the town of Smithers. Elevation within the WRW-RSA ranges from approximately 310 to 2,670 m.

There are three **Telkwa Caribou Herd RSAs** (TCH-RSA1 and TCH-RSA2 Core and Matrix) that describe regionally available habitat for caribou (Figure 1.1-4). TCH-RSA1 is the boundary of the draft critical habitat developed for the Telkwa Caribou Herd as part of the *Recovery Strategy for the Woodland Caribou, Southern Mountain Population in Canada* (Environment Canada 2014). The TCH-RSA2 is the habitat described by the Province of BC in 2019 that includes both Core habitat and Matrix habitat; Matrix habitat forms a concentric circle around Core habitat. Within the TCH-RSA2, 1,613 km² is Core habitat and 4,047 km² is Matrix habitat (Dodd and Carswell 2019).

The TCH-RSA1 was used as the spatial extent for analysis of existing telemetry data because it encompasses most of the collar data used for the analysis and includes a reasonable buffer of the surrounding area that reflects available habitat. TCH-RSA1 is 2,625 km² and is generally centred on the alpine and subalpine areas of the Telkwa Mountains, bounded by the Telkwa River to the north, the Bulkley River to the east, the Morice River to the south and the high elevation divide of the Coast Mountains to the west (Figure 1.1-4). The TCH-RSA1 closely corresponds to the provincial Wildlife Habitat Area (WHA) 6-333. The WHA was created for the conservation of caribou habitat, specifically through the management of forest harvest practices on public lands. The boundary of the Critical Habitat area was chosen for the TCH-RSA1 over the WHA because it matches better with natural features than the WHA, whose boundaries accommodate administrative tenures such as private land.

The TCH-RSA2 is used as the spatial extent for the disturbed habitat analysis. Core and Matrix habitats are defined, respectively, as “the area the encompasses the annual range for a subpopulation” and “the area adjacent to core habitat that has periodic or low use by caribou but supports primary prey and associated predators that have the potential to affect the caribou subpopulation” (Dodd and Carswell 2019). There are thresholds for disturbed habitat defined within the Recovery Strategy for the Core and Matrix caribou habitats.



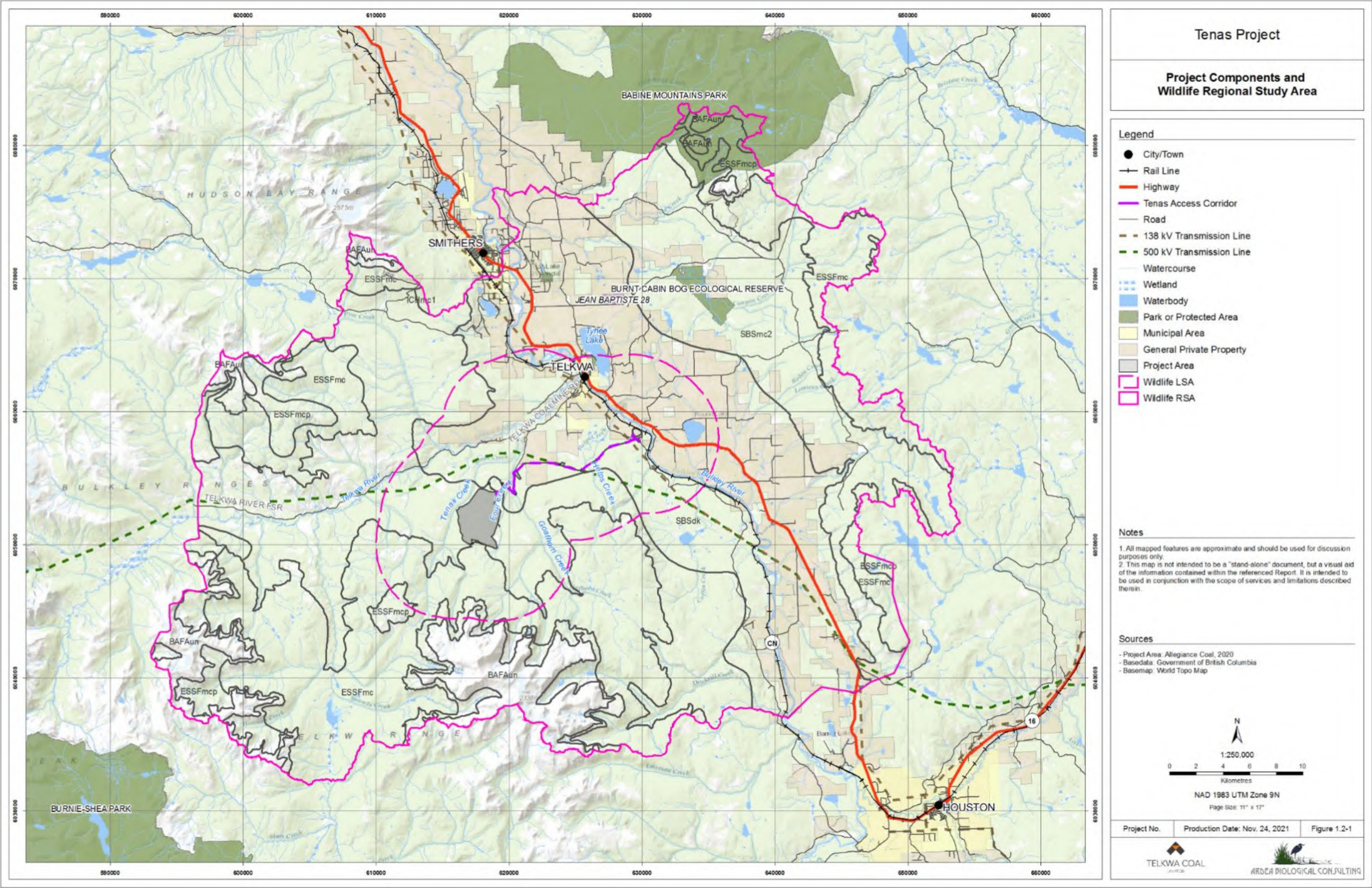


Figure 1.1-2 Local and regional study area boundaries for most wildlife species.

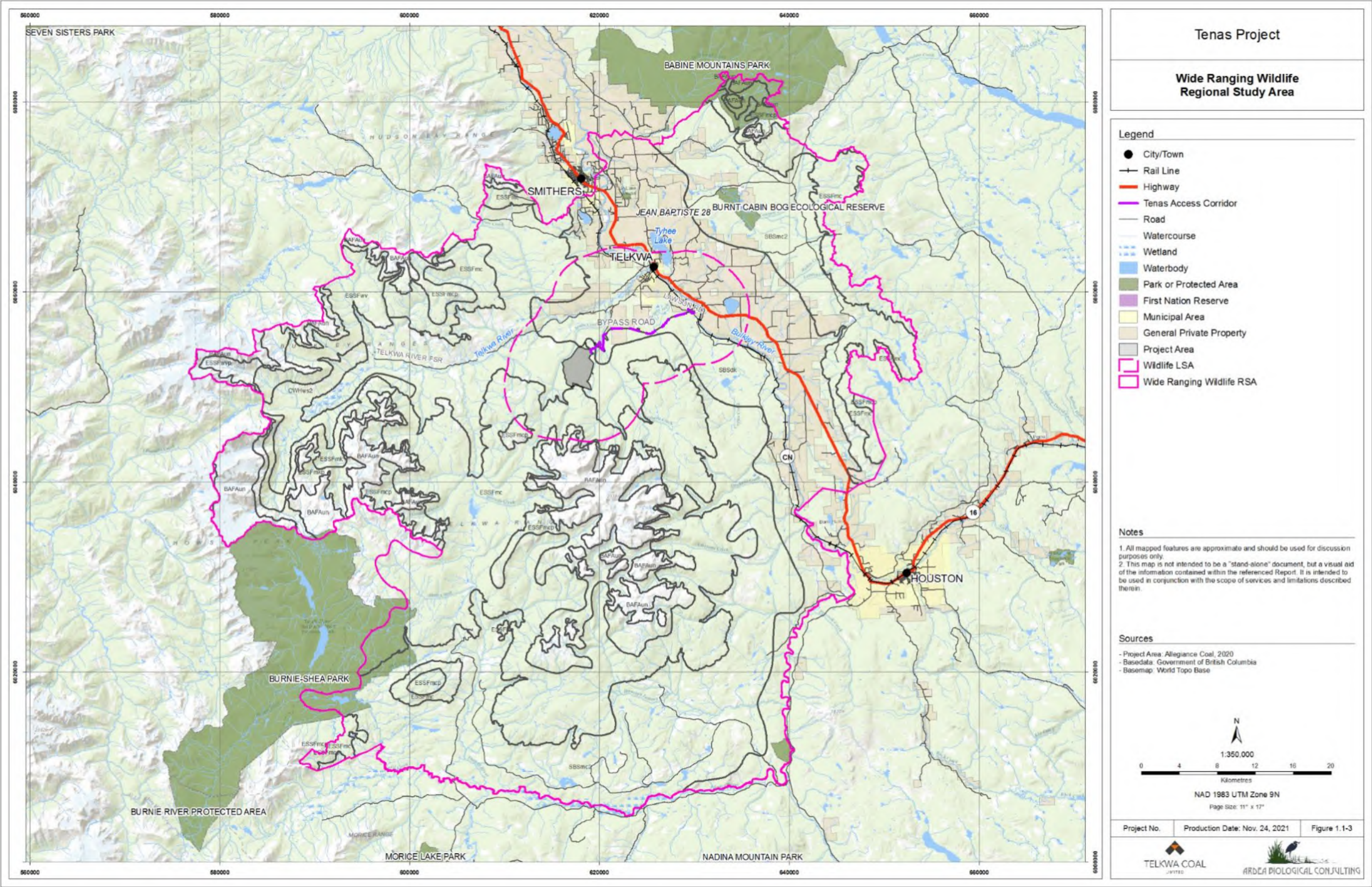
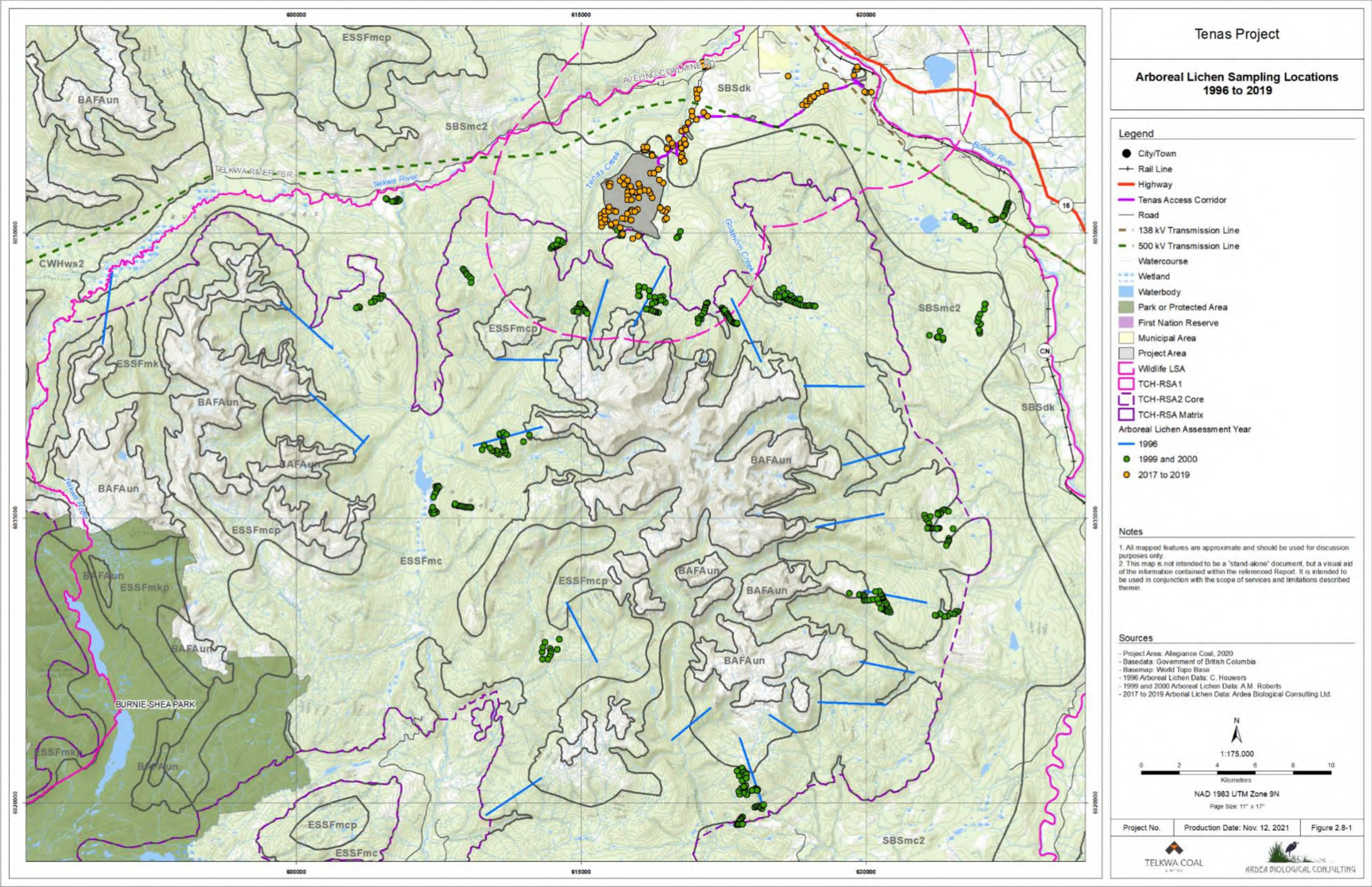


Figure 1.1-3: Local and regional study area boundaries for wide ranging wildlife species.



1.2 Ecological Overview

The Project is located within the Bulkley Basin (BUB) and Bulkley Ranges (BUR) ecosections of northwestern BC. The BUB ecosection occurs at lower elevations and spans a broad lowland area in the rainshadow of the Kitimat and Nass ranges of the Coast Mountains (Demarchi 2011). This ecosection contains many lakes (Demarchi 2011), including Tyhee Lake, Round Lake, Seymour Lake, and Coffin Lake within the Project W-RSA. Major drainages in the BUB ecosection that intersect the Project Area include the Bulkley and Telkwa rivers and Goathorn and Tenas creeks. The BUR ecosection occurs at higher elevations and spans a narrow, rounded range of mountains on the leeward side of the Kitimat Ranges (Demarchi 2011); mountains/mountain ranges that overlap the W-LSA include parts of the Telkwa Mountain Range and Hudson's Bay Mountain. Many small lakes occur across this upland area and the ecosection is drained by numerous small streams that flow into larger streams and rivers such as the Telkwa and Morice rivers (Demarchi 2011).

The Biogeoclimatic Ecosystem Classification (BEC) system is used in BC to classify ecosystems (Pojar et al. 1987, MacKenzie and Meidinger 2017). The BEC system uses a hierarchical system to classify the land into ecosystems using the dominant vegetation, climate and site conditions (MacKenzie and Meidinger 2017). The BEC system allows the classification of vegetation at different levels from the regional to the site specific.

The Project is located within the SBS Moist Cold (SBSmc2) biogeoclimatic (BGC) subzone and the SBS Dry Cool (SBSdk), with the W-LSA containing the Engelmann Spruce - Subalpine Fir Moist Cold (ESSFmc), the Engelmann Spruce - Subalpine Fir Moist Cold Parkland (ESSFmcp) and small portions of the Boreal Altai Fescue Alpine Undifferentiated (BAFAun) subzones (Figure 1.1-1). The SBSdk occurs at lower elevations and transitions into the SBSmc2, which transitions into the ESSFmc as elevation increases (Banner et al. 1993). Elevation ranges from 700 to 1,050 m in the SBSdk, from 850 to 1,350 m in the SBSmc2, and from 950 to 1,500 m in the ESSFmc (Banner et al. 1993).

Fires have historically been the main stand replacing event within lower elevations, with historic fires in the SBSdk and SBSmc2 subzones commonly burning most stands every 100 years and few stands older than 300 years (Banner et al. 1993, Steventon 2001 *In* Wong et al. 2003). In the ESSFmc, fires are less frequent with stand replacing events estimated at 200 years (Steventon 2001 *In* Wong et al. 2003).

In the SBSdk, the main conifer tree species are hybrid white spruce and lodgepole pine, with lesser amounts of subalpine fir, but there is a significant presence of deciduous tree species with deciduous and seral ecosystems containing trembling aspen, black cottonwood, and paper birch. Douglas maple and Rocky Mountain juniper occur in moist and dry habitats respectively. The SBSdk is known for the diversity of its shrub and herb layers that are typically well developed (Banner et al. 1993). This diversity of plant species has led to a high diversity of ecosystems in its coniferous and deciduous forests, floodplains, wetlands and non-forested shrublands. As outlined above, fires have been the greatest historic influence on the distribution of vegetation within the SBSdk, with agricultural development, forest harvesting and cattle grazing more recently affecting the distribution of forested ecosystem within this subzone.

Deciduous forests are relatively uncommon in the SBSmc2, with hybrid white spruce, lodgepole pine and subalpine fir being the dominant tree species. These coniferous stands may have a component of trembling aspen, black cottonwood or paper birch. The shrub and herb layers are not as well-developed or diverse as the SBSdk, and moss layer is better developed and may be dominant (Banner et al. 1993). Old forests are relatively common in areas that have escaped historic fires, although recent forest harvesting has been extensive in this subzone in the project area.

The higher elevation ESSFmc contains subalpine fir, Hybrid white spruce and lodgepole pine as the dominant tree species, with western hemlock, whitebark pine, and deciduous tree species being uncommon (Banner et al. 1993). The ESSFmc is split into forested (ESSFmc), woodland (ESSFmcw) and parkland

(ESSFmcp) subzones as forests get progressively more open at higher elevations before the BAFA zone begins and forests are unable to grow. In the ESSFmcw subzone, forests have low productivity and are relatively open. The lower boundary of the ESSFmcw subzone usually represents the upper limit of forest harvesting operability (Trowbridge and Banner 2002). The ESSFmcp subzone is characterized by clumps of trees that are separated by areas of heath, meadow, and grassland (Banner *et al.* 1993).

The BAFA has long cold winters and short cool summers. The snowpack is usually thin and windblown, but may be deeper in some areas. The vegetation can be diverse, with a mosaic of krummholz tree patches, heather, meadows, and tundra. Dwarf willows, grasses, sedges, and lichens can be common (Mackenzie 2006).

The regional climate of the area is reflected in the BEC classification, with the SBS zone having a mostly continental climate, with some coastal influences in the Bulkley Valley (Banner *et al.* 1993). Winters in the SBS are snowy and severe, with short summers that warm and moist. The closest weather station is at the Smithers Airport, 25 km to the north, in the SBSdk subzone (ECCC 2019) and show that from 1981 to 2010, the mean annual precipitation (MAP) was 508 mm, with 367 mm as rainfall and 182 mm as snow. The wettest month is October with 65 mm and the driest month is March with 21 mm. The mean annual temperature (MAT) is 4.2°C, with July being the warmest month with an average temperature of 15.2°C, and January being the coldest month at -7.2°C (ECCC 2019). The ClimateBC program (Wang *et al.* 2016), shows that SBSmc2 has a MAP of 631 mm with November being the wettest month at 75 mm and the driest month being April with 32 mm. The MAT is 2.2°C, with July being the warmest month with an average temperature of 12.4°C, and January being the coldest month at -7.6°C.

The valley bottom, which contains the SBSdk, has a longer growing season than higher elevation areas containing the SBSmc2 due to being drier and warmer in summer, and has a much thinner snowpack that is present for a shorter duration. Winter temperatures in the SBSdk may not be colder than those in the SBSmc2. Wildfire, which is climate driven and is more frequent in the SBSdk than the SBSmc2, has contributed to the development of deciduous stands in the valley bottoms (Banner *et al.* 1993, Williams *et al.* 2001, Pojar 1995).

2. METHODOLOGY

2.1 Existing Information Review

The desktop review included an examination of available published and unpublished scientific data, citizen science data, Indigenous knowledge and local knowledge, as well as a review of federal and provincial legislation, regulations, strategies, guidelines, plans, best management practices (BMPs), and land use plans applicable to wildlife within the Project region. Baseline information from previous environmental assessments conducted near the Project were also reviewed and assessed for use for this Project.

The online resources outlined in Table 2.1-1 were used to help identify the information on wildlife species at risk, available research and monitoring, as well as any additional baseline information from projects involved in environmental assessments or other ecological studies related to wildlife.

Table 2.1-1: Data sources used to identify available baseline information for the Project.

Title	Content	Reference
BC Conservation Data Centre (BC CDC)	Provides status reports and designations for at risk wildlife species in BC.	(BC CDC 2018b)
Species at Risk Act (SARA) Registry	Provides status reports and designations for at risk wildlife species in BC.	(ECCC 2018)
Canadian Impact Assessment Registry	Provides status and available documents for projects undergoing an environmental assessment with the Impact Assessment Agency of Canada. Projects initiated but suspended or completed prior to 2016 are in the CEA Archive.	(IAAC 2020, CEAA 2018)
Canadian Environmental Assessment Archive		
EcoCat: The Ecological Reports Catalogue	Map application and catalogue to identify available ecological reports completed in BC.	(BC MOE 2018)
Electronic Atlas of the Fauna of BC (eFauna)a	Provides descriptions and distribution maps of wildlife species in BC.	(Klinkenberg 2019)
Environmental Assessment Project Information Centre (EPIC)	Provides status and available documents for projects undergoing an environmental assessment with the BC Environmental Assessment Office	(BC EAO 2019)
iMap Incident Mapping Application	Provides locations for listed wildlife species in BC.	(BC CDC 2018a)
Species Inventory Web Explorer	Provides reports, data files, digital data from wildlife species inventories	(BC MOE 2020)
DataBC	Search tool for BC Government spatial and aspatial digital data products	(Government of BC 2020)

Information obtained through the searches of the data sources outlined in Table 2.1-1 were reviewed and are summarized under the appropriate wildlife species or species group identified within the baseline program (see Section 2.2). For baseline information that may be used for a variety of species, e.g. conservation status and harvesting statistics, the methods used to develop and use that information is outlined below rather than be repeated for each species or species group.

2.1.1 Conservation Status

The conservation status of terrestrial wildlife species of provincial or federal conservation interest that potentially occur within the Project area was obtained by using the *BC Species and Ecosystems Explorer* online search function of the BC Conservation Data Centre (BC CDC) (BC CDC 2018a) and the Species at Risk Act (SARA) Public Registry online search function (ECCC 2018). The primary source of information was the BC CDC, which outlines the status for the Province of BC as well as provides the results of reviews

from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which evaluates species for potential SARA listing, as well as providing the status of the species under SARA.

The query of the BC CDC online search engine included criteria for any provincially or federally listed species within the Skeena Stikine, Bulkley and Nadina Forest Districts as well as the BC Ministry of Environment and Climate Change Strategy (BC MECCS) Skeena and Omineca Management Regions. For some species, refinements to the searches to only include BGC subzones within the RSAs were done to reduce the species list to only those species likely to be found within the various RSAs. A summary of the conservation status for provincial and federal species at risk is provided in Table 2.1-2 and is used for all descriptions for the conservation status discussions within this report.

Table 2.1-2: Conservation status definitions for provincial and federal species at risk.

Designating Agency	Status	Definition
BC Conservation Data Centre (BC CDC)	Red	Indigenous species or subspecies that have been designated, or are candidates for, Extirpated, Endangered, or Threatened status in BC.
	Blue	Indigenous species or subspecies considered to be of Special Concern in BC.
	Yellow	Indigenous species that are apparently secure and not at risk of extinction in BC. Yellow-listed species may have red- or blue-listed subspecies.
Committee on the Status of Endangered Wildlife in Canada (COSEWIC)	Endangered	A species facing imminent extirpation or extinction.
	Threatened	A species that is likely to become endangered if limiting factors are not reversed.
Species at Risk Act (SARA)	Special Concern	A species of special concern because of characteristics that make it is particularly sensitive to human activities or natural events.

2.2 Baseline Field Assessments

Baseline field assessments and surveys for wildlife were conducted within the W-LSA and various RSAs between 2017 and 2019 and included a range of surveys and habitat use assessments (Table 2.2-1) for focal species of interest. Focal species identified for the wildlife baseline studies include those species that have potential to interact with the Project and are either species of conservation concern or species with distinct social, cultural, or economic values. Consideration for the selection of focal species or species groups included:

- ▶ Species occurrence or habitat overlap with the W-LSA or various RSAs;
- ▶ Species of conservation concern including federal and provincial listings;
- ▶ Species of interest to Indigenous, regulatory agencies or the Public; and
- ▶ Species raised as a concern during Project consultation.

Where possible, historic data from available sources was included in the review of baseline and current conditions, along with any research, studies or assessments completed to support the Project or other nearby projects.

Table 2.2-1: Wildlife species and species groups included in the wildlife baseline programs.

Focal Species / Species Groups	Rationale for Selection	Baseline Program(s)
Terrestrial Invertebrates	Various invertebrate species likely to occur within the W-LSA have been listed by the BC CDC or COSEWIC as a conservation concern.	Invertebrate field surveys including passive (e.g. malaise, vane and bowl traps), and active (e.g. sweep and beating nets) surveys; potential habitat identification
Amphibians and Reptiles	Several amphibian and reptile species have been confirmed to live within the W-RSA. Western Toad and Coastal Frog are listed as Special Concern with COSEWIC and Yellow-listed by BC CDC.	Amphibian aquatic, terrestrial, and eDNA surveys, wildlife habitat assessments, western toad habitat suitability modelling Reptile hibernacula and terrestrial surveys
Bats	Several bat species have been confirmed to live within the W-RSA, with several listed species including the listed Northern Myotis and Little Brown Myotis (Endangered under COSEWIC, Schedule 1 of SARA) and Blue-listed (Special Concern) (BC CDC 2019). These listed forest bat species are of particular concern due to the potential for the Project to affect their habitats.	Ultrasonic monitoring surveys, bat call classification, forest bat roost assessments and forest bat (little brown and northern myotis) habitat suitability modelling.
Furbearers	Several furbearer species have been confirmed to live within the W-RSA and WRW-RSA. Furbearers are economically important to trappers and have biological importance as an indicator species. Focal species of interest in the baseline studies were American marten, which are not listed by COSEWIC or SARA and Yellow-listed (Secure) in BC CDC; Fisher, which are not listed under COSEWIC or SARA and Blue-listed (Special Concern) in BC CDC; and Wolverine, which are of Special Concern under COSEWIC and Blue-listed (Special Concern) in BC CDC.	Review of harvest data, wildlife camera traps, snow track surveys, wildlife habitat assessments, wildlife trail assessments and American marten habitat suitability modelling.
Black Bear	Found within the W-RSA, not listed by COSEWIC, SARA or BC CDC, important to public and Indigenous communities, and managed for hunting purposes. Have the potential for human/bear conflicts resulting in bears being destroyed.	Review of harvest data, wildlife camera traps, wildlife trail assessments.
Grizzly bear	Found within WRW-RSA, listed as Special Concern under COSEWIC, SARA Schedule 1, and Blue-listed (Special Concern) by the BC CDC. Important to public and Indigenous communities.	Review of harvest data, wildlife camera traps, wildlife habitat assessments, wildlife trail assessments, grizzly bear habitat suitability modelling.
Caribou (Northern mountain population)	Found within the TCH-RSAs. Listed as Threatened under COSEWIC and Schedule 1 of SARA, and Blue-listed (Special Concern) in BC CDC. Project area is within Environment Canada and Climate Change Critical Habitat area and BC Wildlife Habitat Area for caribou.	Caribou collar data analyses for habitat selection, movement and mortality analyses; disturbed habitat analysis, wildlife camera traps, snow track surveys, wildlife habitat assessments, wildlife trail assessments, and arboreal and terrestrial lichen assessments.

Focal Species / Species Groups	Rationale for Selection	Baseline Program(s)
Moose	Found within the WRW-RSA, not listed by COSEWIC, SARA or BC CDC, important to public and Indigenous communities, and managed for hunting purposes.	Moose collar data analyses for habitat selection, distribution and movement analyses, wildlife camera traps, snow track surveys, review of population survey and harvest data, wildlife habitat assessments, wildlife trail assessments and moose habitat suitability modelling.
Other Ungulate Species Rocky Mountain Elk Mule Deer and White-tailed Deer Mountain Goat	Found within the W-RSA, not listed by COSEWIC, SARA; mountain goat Blue-listed by BC CDC, all other species Yellow-listed. Important to public and Indigenous communities, and managed for hunting purposes.	Review of population survey and harvest data, Rocky mountain elk collar data analyses for distribution analysis, wildlife camera traps, snow track surveys, wildlife habitat assessments, and wildlife trail assessments.

Assessments, surveys and mapping completed under the Baseline programs were conducted in accordance with provincial and other accepted standards and guidebooks including:

- ▶ *A Field Guide to Site Identification and Interpretation for the Prince Rupert Forest Region* (Banner et al. 1993).
- ▶ *British Columbia Wildlife Habitat Rating Standards, Version 2.0* (RIC 1999c).
- ▶ *Environmental DNA Protocol for Freshwater Aquatic Ecosystems. Version 2.2.* (Hobbs and Goldberg 2017).
- ▶ *Field Manual for Describing Terrestrial Ecosystems, 2nd edition* (BC MOFR and BC MOE 2010)
- ▶ *Ground-based Inventory Methods for Selected Ungulates: Moose, Elk and Deer. Standards for Components of British Columbia's Biodiversity No. 33. Version 2.0.* (RIC 1998a).
- ▶ *Inventory Methods for Bats. Standards for Components of British Columbia's Biodiversity No. 20. Version 2.0* (RIC 1998b).
- ▶ *Inventory Methods for Marten and Weasels. Standards for Components of British Columbia's Biodiversity No. 24. Version 2.0.* (RIC 1998c).
- ▶ *Inventory Methods for Medium-sized Terrestrial Carnivores: Coyote, Red Fox, Lynx, Bobcat, Wolverine, Fisher & Badger. Standards for Components of British Columbia's Biodiversity No.25. Version 2.0* (RIC 1999a).
- ▶ *Inventory Methods for Plethodontid Salamanders. Standards for Components of British Columbia's Biodiversity No. 36. Version 2.0* (RIC 1999b).
- ▶ *Inventory Methods for Pond-breeding Amphibians and Painted Turtle. Standards for Components of British Columbia's Diversity No. 37. Version 2.0.* (RIC 1998d)
- ▶ *Inventory Methods for Terrestrial Arthropods. Standards for Components of British Columbia's Biodiversity No. 40. Version 2.0.* (RIC 1998f)
- ▶ *Live Animal Capture and Handling Guidelines for Wild Mammals, Birds, Amphibians and Reptiles. Standards for Components of British Columbia's Biodiversity No. 3. Version 2.0.* (RIC 1998g).
- ▶ *Standard Operating Procedures: Hygiene Protocols for Amphibian Fieldwork.* (BC MELP 2008).
- ▶ *Terrestrial Arthropod Diversity; Planning a Study and Recommended Sampling Techniques.* (BSC 1994).

- ▶ *The Very Handy Manual: How to Catch and Identify Bees and Manage a Collection.* (Droege 2015).

Incidental observations of wildlife species were obtained opportunistically when suitable wildlife species were encountered during the baseline program surveys. As well, additional wildlife information was recorded during most avian, vegetation or terrain and soils related baseline surveys; and followed the same standards for gathering ecosystem and wildlife information (*i.e.* BC MOFR and BC MOE 2010).

Georeferenced field maps were created for all aspects of the wildlife baseline program assessments and surveys using ArcMap and consisted of ortho-images, overlaid with available road atlas, proposed Project infrastructure, and appropriate additional information, depending on the assessment of survey being completed (e.g. preliminary TEM polygons, or known wetlands). The field maps were loaded on to global positioning satellite (GPS) activated tablets that were used for navigation and data collection in the field. During the baseline surveys, all survey points and tracks were recorded on the tablets and a handheld Garmin GPS unit was used to provide additional locations for post-field mapping as well as in-field back-up. Photos were taken of survey locations and any observed animals and habitat features were recorded with field notes outlining habitat characteristics.

Habitat Suitability Modelling

Habitat suitability models were developed for selected focal species that were identified during the baseline studies as potentially interacting with the Project (Telkwa Coal 2019 and 2020). Models were developed using the standards outlined in RIC (1999c) and included western toad, forest bats (little brown myotis and northern myotis), grizzly bear and moose. A habitat suitability model for American marten model was developed using methods developed by Steventon (2014) to identify suitable habitats as well as identify potential female marten home ranges, which can provide potential population density estimates. All models were based on life history information and used a combination of spatial datasets that included ecosystems, forest attributes, and anthropogenic features to identify suitable habitat. The western toad, forest bats and marten models were developed using a four-class rating system as a predictor of habitat quality and included high, moderate, low, and nil suitability (RIC 1999c). The grizzly bear and moose models used a six-class rating system as a predictor of habitat quality and included high, moderately-high, moderate, low, very low and nil suitability (RIC 1999c). Additional information on the habitat suitability models is provided under the appropriate species sections, with the detailed model methodologies provided in the Appendices.

2.3 Terrestrial Invertebrates

Baseline conditions for terrestrial invertebrates were determined using a combination of a review of the available literature and existing provincial data, along with conducting baseline invertebrate field assessments and a simple assessment of potential invertebrate habitats. Methodologies for the terrestrial invertebrate field assessments are provided in the following sections.

2.3.1 Baseline Field Assessments

Invertebrate Field Surveys

Terrestrial invertebrate surveys were conducted in the W-LSA during the periods July 24 to 27, 2017 and July 16 to 18 and 23 to 27, 2018. The late July timing was chosen both years because it is the time of year when bumble bee populations are typically highest, and beetles, butterflies, and adult dragonflies would also typically be active and present in greater numbers. Bumble bees were of particular interest both years, as they were anticipated to be terrestrial insect group of interest that was most likely to occur in higher numbers in the W-LSA. Weather conditions were suitable (warm, sunny or partial sun, and dry) for insect sampling and insects were active on all sampling dates in 2017 and 2018; on days when rain showers occurred (e.g., July 17 and 18, 2018), the area was surveyed a second time when weather conditions were suitable. The terrestrial invertebrate surveys conducted within the W-LSA focussed on habitats containing

flowering plants, the majority of which were located in open meadows, recent cutblocks (e.g., less than ~15 years old), along BC Hydro's transmission line right-of-way, and forestry roadsides. Some of the seed mixes used in forestry road reclamation in BC contain plant species (e.g., red clover, birdsfoot trefoil, and alfalfa) that provide nectar and pollen resources attractive to bees and butterflies. Fireweed, another plant that is attractive to bumble bees when in bloom, may also be abundant in disturbed areas along roads and within recent cutblocks. Disturbed sites also tend to support the growth of invasive plants such as yellow hawkweed and thistles, which are also used by bees and some butterflies as forage plants. Forestry roads often provide good foraging areas for bumble bees and other insects because these sites support more flowering plants than sites located in adjacent forested areas.

Terrestrial invertebrate sampling was conducted using accepted methods described in relevant sampling standards documents (Droege 2015, RIC 1998f, BSC 1994). Two types of invertebrate sampling techniques were used: passive (sampling sites) and active sampling (walking transects). Passive sampling involved using three types of stationary traps:

- ▶ Malaise traps (large, mesh fabric flight-interception trap that collects flying insects when they contact a vertical central panel and move up a sloping roof into a collection container);
- ▶ blue vane traps (consist of two plastic cross vanes and a collection container with soapy water or propylene glycol, into which insects fall when they fly into the vanes); and
- ▶ bowl traps (coloured bowls placed on the ground and filled with soapy water and especially attractive to bees, butterflies and other pollinating insects (Droege 2015) (Appendix A: Plates A-1, A-3, and A-4).

Active sampling involved walking and using sweep or beating nets to obtain invertebrates. Sweep net sampling involved using a net on a pole and sweeping it through vegetation or actively attempting to capture flying insects. Beating nets were used by placing a net under vegetation and the branch or plant is tapped with a stick, causing invertebrates to fall into the net (Appendix A: Plate A-2). Direct capture from vegetation or from the ground was also used where appropriate to sample invertebrates. Active sampling was conducted while walking along forestry roads, farm/field access roads, along the BC Hydro transmission rights-of-way, and within open areas or cutblocks in the forest, as these were the areas that had the most flowers in bloom and typically had higher insect activity. Wetland sites due to their greater abundance of blooming plants and associated insect activity, were also targeted for active sampling by walking the edges. All sampling transects were marked using a GPS and identified as sampling tracks within the W-LSA. The locations of the sampling sites and walking transects are outlined in Figure 2.3-1, with sampling sites labelled as S1, S2, etc, and walking transects labelled as T1, T2, etc. and described in Table 2.3-1 and Appendix A: Table A-2 and Table A-3.

Invertebrate Sample Processing and Identification

Terrestrial Invertebrate samples collected during the July 2017 and 2018 surveys were preserved in the field and held in 85% ethanol until processed in January/February and August-December 2018. More delicate, specimens such as individual butterflies were transferred to glassine envelopes and held in a freezer until identified. Each sample was sorted, and wherever possible, invertebrates that were not potential species of conservation concern were identified to family level. Identification below Order level was not possible in the case of some immature specimens because they lacked the necessary features for more refined identification. Collected specimens that belonged to insect groups of conservation concern (i.e., lady beetles, bumble bees, butterflies, and dragonflies) were identified to species level where possible. Bumble bee specimens were washed of any ethanol and dried, to ensure that hair colours and banding patterns were fully visible, then pinned and sent for final identification. Lincoln Best (Calgary, Alberta), a specialist on the native bees of BC, was used to identify bumble bee specimens to species level (and subspecies in the case of two western bumble bee specimens). Western bumble bee specimens were also reviewed by Cory Sheffield, primary author on the paper describing biogeography of western bumble bee

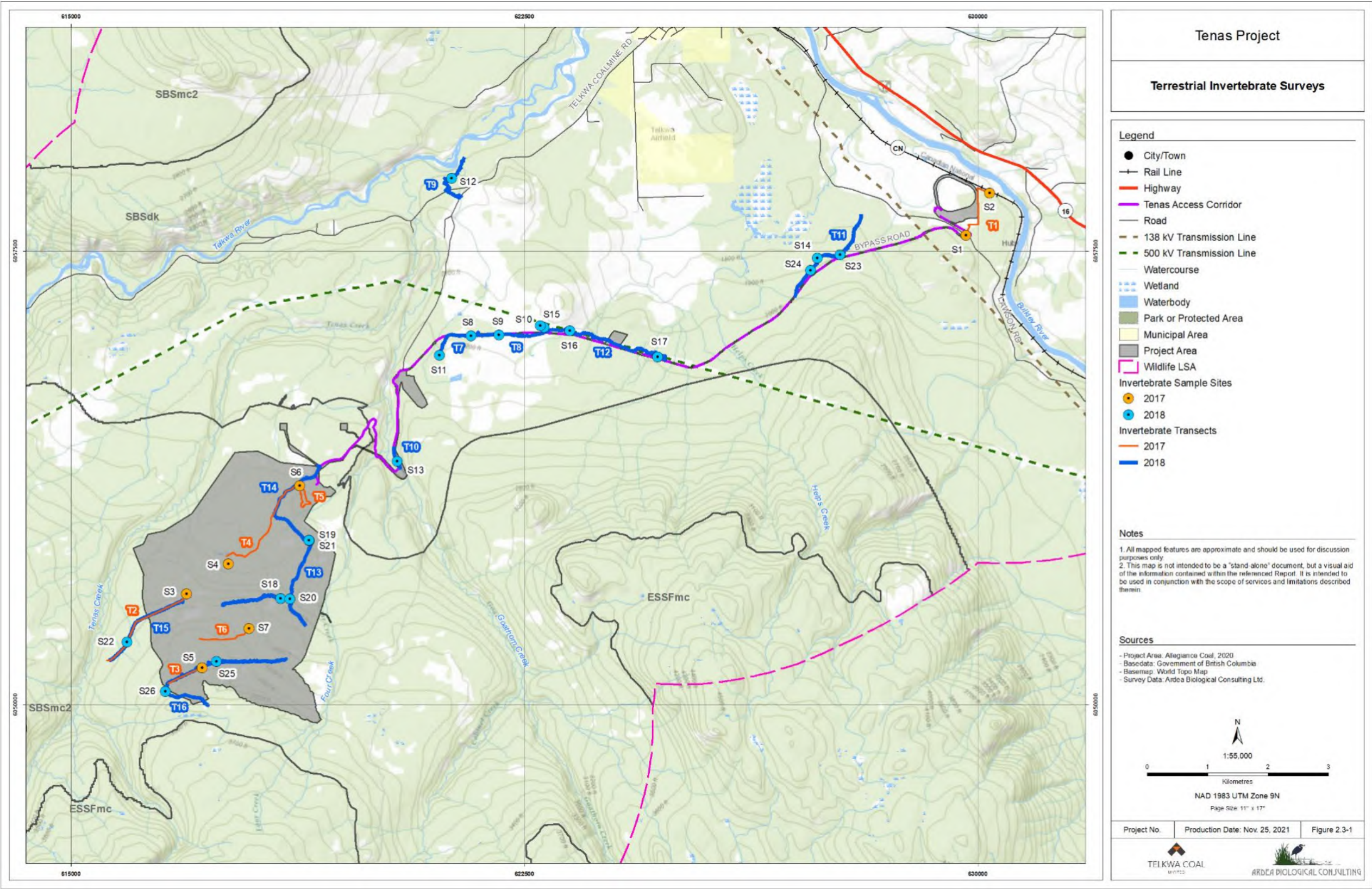


Figure 2.3-1: Locations of terrestrial invertebrate sampling sites and walking transects sites in the W-LSA in 2017 and 2018.

subspecies in western Canada (Sheffield et al. 2015). All remaining invertebrate specimens collected during the July 2017 and 2018 surveys were retained in vials and preserved in 85% ethanol. Several terrestrial invertebrate identification resources and dichotomous keys were used when processing the samples: Marshall (2006) (lady beetles); Williams *et al.* (2014) (bumble bees); Guppy and Shepard (2001) (butterflies); Cannings (2002) (dragonflies); Bland and Jaques (1978) (remaining insect families).

Table 2.3-1: Summary of invertebrate survey locations and habitat descriptions.

Sites and Transect Labels	Date	General Area	Description
2017 Terrestrial Invertebrate Surveys			
Site 1 (S1)	July 24	Rail Infrastructure	Open meadow along Lawson Road (Appendix A: Plate A1)
Site 2 (S2)			Loadout site (Appendix A: Plates A2 & A3)
Track 1 (T1)			Invertebrate reconnaissance survey Access Corridor (as defined during the 2017 sampling season) between Rail Loadout site and Lawson Road
Site 3 (S3)	July 25	Minesite	Sampled within the main mine area as defined during the 2017 field season. Sampling focused on roadside habitat, riparian habitats, and 10+-year-old cutblock habitat.
Site 4 (S4)			
Track 2 (T2)			
Site 5 (S5)	July 26		Sampling focused within one kilometer of the minesite area, primarily along roadside habitat and within some 10+-year-old cutblock habitat (Appendix A: Plates A9, A10, and A11).
Track 3 (T3)			
Site 6 (S6)	July 27		Sampling conducted in a variety of habitats, including 10-year-old cutblocks, mature forest, and roadsides; the majority of sampling was conducted along roadside habitat, as this was where the majority of blooming plants were found and insect activity was concentrated (Appendix A: Plates A12, A13, and A14).
Track 4 (T4)			
Track 5 (T5)			
Site 7 (S7)			
Track 6 (T6)			
2018 Terrestrial Invertebrate Surveys			
Site 8 (S8)	July 16	Access Corridor	Much of the sampling was done along an existing access corridor leading to agricultural fields (Appendix A: Plate A15).
Site 9 (S9)			Focussed on large patch of cow parsnip situated along a fence line between two agricultural fields.
Site 10 (S10)			Wetland site (this wetland was surveyed again as S15 on July 23; Appendix A: Plate A17)
Site 11 (S11)			
Track 7 (T7)			Tracks connected the four sites surveyed on July 16.
Track 8 (T8)			
Site 12 (S12)	July 17	Goathorn Creek	The habitat sampled at S12 and T9 consisted of flowering plants, which were abundant along both sides of the road allowance. The habitat adjacent to the road allowance was less suitable for the terrestrial invertebrate species of interest, as it consisted of 30+-year-old pine and aspen forest
Track 9 (T9)			

Sites and Transect Labels	Date	General Area	Description
Site 13 (S13) Track 10 (T10)	July 17	Goathorn Creek	Site was resurveyed on July 26 due to rain showers on July 17. Sampling track T10 was conducted in roadside habitat containing flowering plants along Goathorn Road
Site 14 (S14) Track 11 (T11)	July 18	Access Corridor	Minimal sampling was done on July 18 due to rain showers, which resulted in low terrestrial insect activity. Followed a trail that led to a cleared area within mature forest. This area was resampled on July
Site 15 (S15) Site 16 (S16) Site 17 (S17) Track 12 (T12)	July 23		Near wetland Constructed pond was situated at Site 16 (Appendix A: Plate A20) Covers the agricultural access road on the Kerr Property starting at Site 15 and followed the BC Hydro transmission line right-of-way to the track end point at Site 17.
Site 18 (S18) Site 19 (S19) Site 20 (S20) Track 13 (T13)	July 24	Minesite	Situated along a forestry road through an approximately 30+-year-old replanted cutblock (Appendix A: Plates A21, A22, and A23). Follows the road connecting Sites 18-20
Site 21 (S21) Track 14 (T14)	July 25		Small water body adjacent to sampling site Starts at Site 21 and follows a forestry road (Appendix A: Plate A24)
Site 22 (S22) Track 15 (T15)			Located on a forestry road that passed through mature forest (Appendix A: Plate A25) Follows forestry road starting at Site 22
Site 23 (S23) Site 24 (S24)	July 26	Access Corridor	Primarily mature aspen/spruce forest with some large patches of blooming snowberry Wetland
Site 25 (S25) Site 26 (S26) Track 16 (T16)	July 27	Minesite	Located along forestry roads

Invertebrate Habitat Identification

A review of the habitat requirements of the listed terrestrial invertebrates was conducted and compared to the available ecosystems found within the Terrestrial Ecosystem Mapping (TEM) described in Ardea (2021a). A list of potential ecosystems that matched the habitat requirements of the invertebrate species was developed for use in potential assessment of effects to those habitats and in support of assessing the availability of suitable habitat for terrestrial invertebrate species of conservation concern within the W-LSA.

2.4 Amphibian and Reptiles

2.4.1 Baseline Field Assessments

Baseline conditions for amphibians and reptiles were determined using a combination of a review of the available literature and existing provincial data, along with conducting baseline field assessments such as terrestrial and aquatic surveys, eDNA sampling, wildlife habitat assessments, and through the development of a western toad habitat suitability model. Methodologies for the amphibian and reptile field assessments are provided in the following sections, as well as those outlined in the wildlife habitat assessment methodology outlined in Section 2.11.

Amphibian Terrestrial and Aquatic Surveys

Terrestrial area-based surveys were completed to assess potential habitat use and occupancy time constrained searches conducted in larger wetlands and systematic searches conducted depending on area size and complexity. In general, surveys consist of walking transects along the edges of the wetted portions of ponds searching for egg masses, tadpoles, and adult amphibians. Surveys also consist of transects and area-based searches in adjacent upland areas that provide suitable terrestrial living and overwintering habitats as well as migration corridors for congregating breeding adults and dispersing metamorphs.

Aquatic surveys that involved dip netting and area-based observation surveys that were time constrained and/or systematically conducted depending on area size and complexity were completed in appropriate aquatic habitats to document amphibian species use. In general, surveys involve setting/checking traps, walking along the edge of the wetted portion of aquatic environments (ponds, lakes, streams, etc.) and using a dip net to search for egg masses, tadpoles, and adult amphibians.

Non-systematic visual searches for amphibians were completed in both aquatic and terrestrial habitats as a preliminary method to help delineate more intensive surveys or as a reconnaissance level survey to re-visit sites or areas previously studied to document seasonal and annual changes in populations or species use. Opportunistic searches when traveling between aquatic habitats or when conducting other wildlife surveys were undertaken in both terrestrial and aquatic habitats as amphibians or their habitat were encountered.

The locations of the surveys described in the following sections are shown in Figure 2.4-1.

eDNA Amphibian Sampling

Water samples were collected from potential amphibian aquatic habitats (Figure 2.4-1) and analysed for eDNA presence and concentration using methods outlined in Hobbs and Goldberg (2017). Samples obtained in 2017 were analyzed with known DNA markers for coastal tailed frog and western toad; while samples in 2018 were analyzed for coastal tailed frog, western toad, Columbia spotted frog and wood frog. Water samples (two replicate litres) were collected from each sample site in sterilised Nalgene bottles and stored on ice in a cooler to prevent degradation of DNA until processed. Thirteen sites were sampled in 2017 and 29 sites in 2018.

Samples were processed within 24 hrs of collection as per Hobbs and Goldberg (2017) by filtering the water through a 0.45 µm pore diameter cellulose nitrate membrane held in a sterile polypropylene funnel. Each sample was then filtered through using a peristaltic pump and the filter papers preserved in 2 ml sterile polypropylene cryogenic vials with 95% molecular-grade ethanol. One control sample, using distilled water, was processed both prior to and after processing the samples daily, following the same filtration protocol as the site water to serve as a contamination test of the filtration and analysis processes. All the preserved samples (i.e. filter papers) were then shipped to the laboratory at the University of Northern British Columbia (UNBC) for subsequent extraction and analysis.

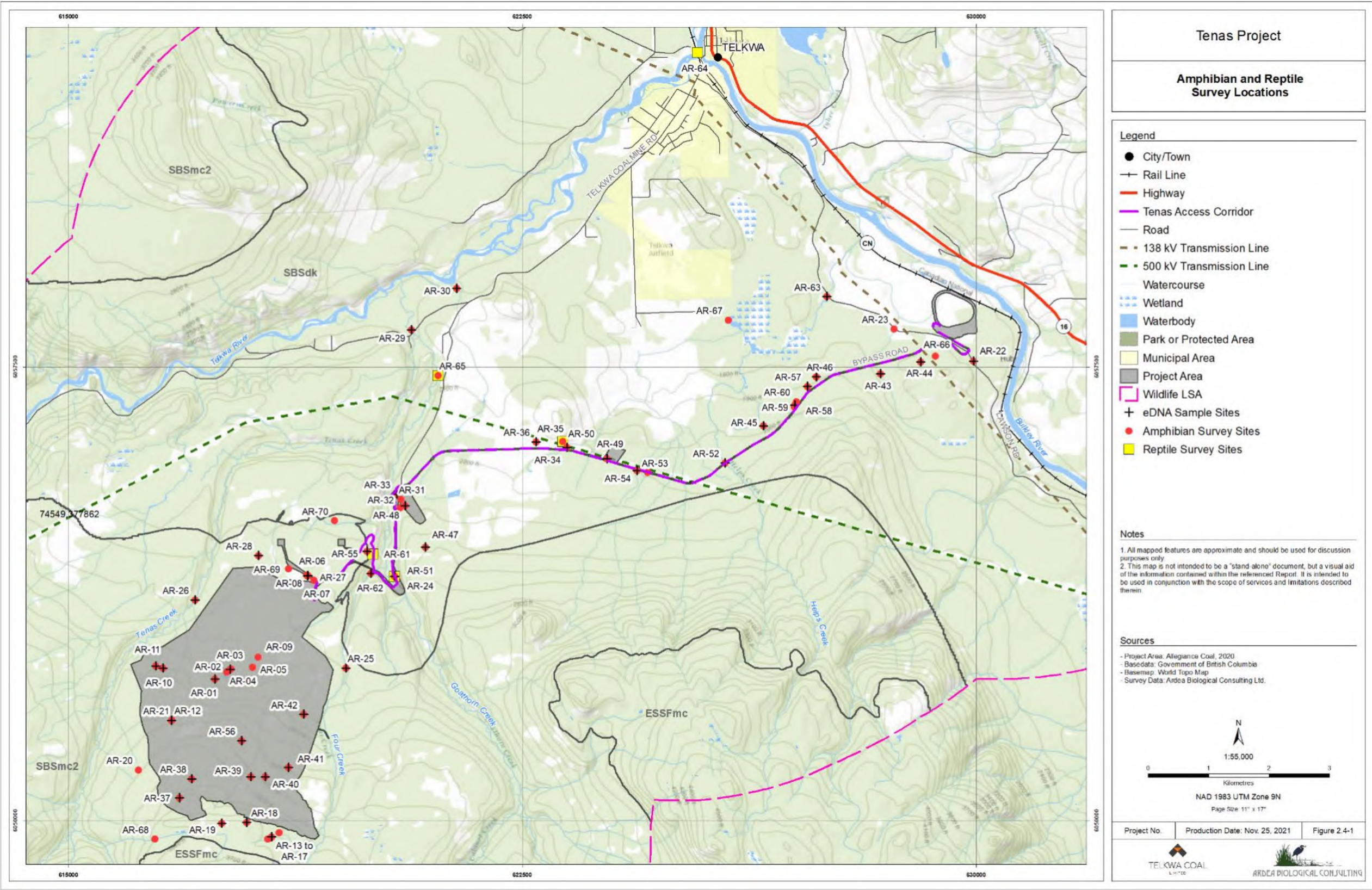


Figure 2.4-1: Locations of amphibian and reptile survey sites in the W-LSA in 2017 and 2018.

Analyses of the eDNA samples was completed at the Genetics Lab at UNBC using quantitative polymerase chain reaction (qPCR) techniques to amplify the DNA from the samples. The methods used for the analyses follows, with the more detailed methodology provided in Appendix B1: *eDNA Lab Analysis Report*. Samples were processed to amplify the DNA and an initial “A” elute and second “B” elute drawn from the column. Analysis of the “A” elute was conducted in triplicate using species specific primers for the presence of the target species, along with a positive control lambda DNA that was added to the initial elute to detect failed amplification. If the control lambda DNA sample yielded a negative result, the assays were conducted again using the “B” elute.

Reptile Hibernacula and Terrestrial Surveys

In suitable potential hibernacula sites, area-based surveys that were time constrained and/or systematically conducted depending on area size and complexity were completed (Figure 2.4-1). Surveys consisted of transects and spot searches looking into crevices and in voids within potential habitats such as bedrock, boulder, talus and rocky outcroppings.

Terrestrial area-based surveys that were time constrained and/or systematically conducted depending on area size and complexity were also completed for reptiles. In general, surveys consisted of looking for basking and/or hunting snakes by walking transects through potential habitats within forests, woodlands, fields and grasslands near wetlands, streams, or ponds.

Non-systematic visual searches were conducted for reptiles to help delineate more intensive surveys or as a reconnaissance level survey to re-visit sites or areas previously studied to document seasonal or annual changes in species use. Opportunistic searches were also undertaken in terrestrial habitats as reptiles or their habitat were encountered.

Western Toad Habitat Suitability Modelling

The habitat suitability model for western toad identifies suitable habitat for three life requisites and associated seasons. The **Reproduction (Spring/Summer)** model outlines the aquatic breeding habitats used for egg laying, tadpole feeding and security during the spring and summer seasons. The **Living (Growing)** model provides mapping of upland habitats for feeding and security during the spring to fall periods while the **Hibernating (Winter)** model shows potential hibernating habitat during the winter months. Habitat suitability ratings obtained from the wildlife habitat assessments were used to test and refine the models, with adjustments made to the model ratings based on the field data. The detailed methods used in the modelling are outlined in Appendix B2: *Western Toad Species Account and Habitat Model*.

2.5 Bats

2.5.1 Baseline Field Assessments

Baseline conditions for bats were determined using a combination of a review of the available literature and existing provincial data, along with conducting baseline field assessments such as ultrasonic monitoring, forest bat roost assessments, wildlife habitat assessments, and through the development of a forest bat habitat suitability model.

Ultrasonic Monitoring

Ultrasonic recordings of bat species were collected from 2017 to 2019 in nine locations throughout the W-LSA. Three to four full spectrum bioacoustic and ultrasonic recorders (model SM3BAT), manufactured by Wildlife Acoustics, Inc. were deployed to collect ultrasonic bat calls. These Automated Recording Units (ARUs) were capable of 16-bit digital high-speed sampling and each was outfitted with a single ultrasonic microphone (Wildlife Acoustics 2018a). Sampling parameters varied between, and in some cases within years, to provide opportunities to capture different species calls, identify seasonal and daily bat activity

levels as well as attempt to determine optimal recording strategies to maximize battery life and memory storage. Sampling was planned for the spring to fall periods as there were concerns about ARU security during the hunting season and ARU reliability below 20° C (Wildlife Acoustics Inc. 2018a) The recording parameters for the ARUs are provided in Table 2.5-1. ARU sampling locations were chosen to include representative open foraging habitats wetland habitats or cutblocks within the W-LSA where potential feeding and roosting habitats would be available (e.g. older forests, mixed forests), with many sites used over multiple years (Figure 2.5-1 and Table 2.5-1).

The ultrasonic recorders recorded full spectrum bat echolocation calls, which allows for more advanced digital signal processing, including echo cancellation, noise reduction, filtering and other signal enhancement techniques to improve the reliability of the survey results (Wildlife Acoustics Inc. 2014). Batteries and SD memory cards were replaced approximately monthly, with the data downloaded and stored separately for each unit and sampling session. The downloaded data underwent a preliminary review periodically to identify any issues with recording parameters or the ARU operation and allow corrections or repairs to be made.

Table 2.5-1: Ultrasonic monitoring operating dates and recording parameters 2017 to 2019

Year	ARU ID	Operating Dates ¹	Parameters ²
2017	17-ARU 1-1	May 28 to July 20	Starting at sunset, record 15 minutes per hour for 3 hours; providing 45 minutes of ultrasonic bat recordings per night.
	17-ARU 1-2	July 27 to September 17	
	17-ARU 2-1	May 28 to September 17	
	17-ARU 3-1	May 28 to August 25	
	17-ARU 4-1	June 2 to September 3	
2018	18-ARU 1-1	May 18 to September 11 ³	Starting at sunset, record in 10-minute intervals when triggered by an ultrasonic sound for 3 hours; providing maximum of 180 minutes of recordings each night.
	18-ARU 2-1	June 2 to June 10 ³	
	18-ARU 2-1	June 18 to September 9	Starting 75 minutes after sunset, record in 10-minute intervals when triggered by ultrasonic sounds for 2 hours; providing maximum of 120 minutes of recordings every third night.
	18-ARU 3-1	July 28 to September 25	
	18-ARU 4-1	July 31 to September 5	
2019	19-ARU 2-1	April 24 to May 23 ⁴	Starting at sunset, record in 15-minute intervals when for 2 hours, providing maximum of 120 minutes of recordings each night.
	19-ARU 3-1	April 24 to May 23	
	19-ARU 4-1	April 24 to May 20	
	19-ARU 2-1	May 24 to September 15	Starting at 25 minutes after sunset, record for 30 minutes every 55 minutes for 3 consecutive hours; providing maximum of 90 minutes of recordings each night.
	19-ARU 3-1	May 24 to September 21	
	19-ARU 4-1	May 31 to September 27	

Note: 1) Operating dates based on methods outlined in RIC (1998b) and Skalak et al. (2012).

2) Recording parameters programmed using the SM3 Configurator as per the methods outlined in the Wildlife Acoustics SM3BAT Bioacoustic Recorder User Guide (Wildlife Acoustics Inc. 2018b).

3) ARU malfunctioned and no recordings obtained.

4) Card error, some data loss

5) Microphone error, no data collected

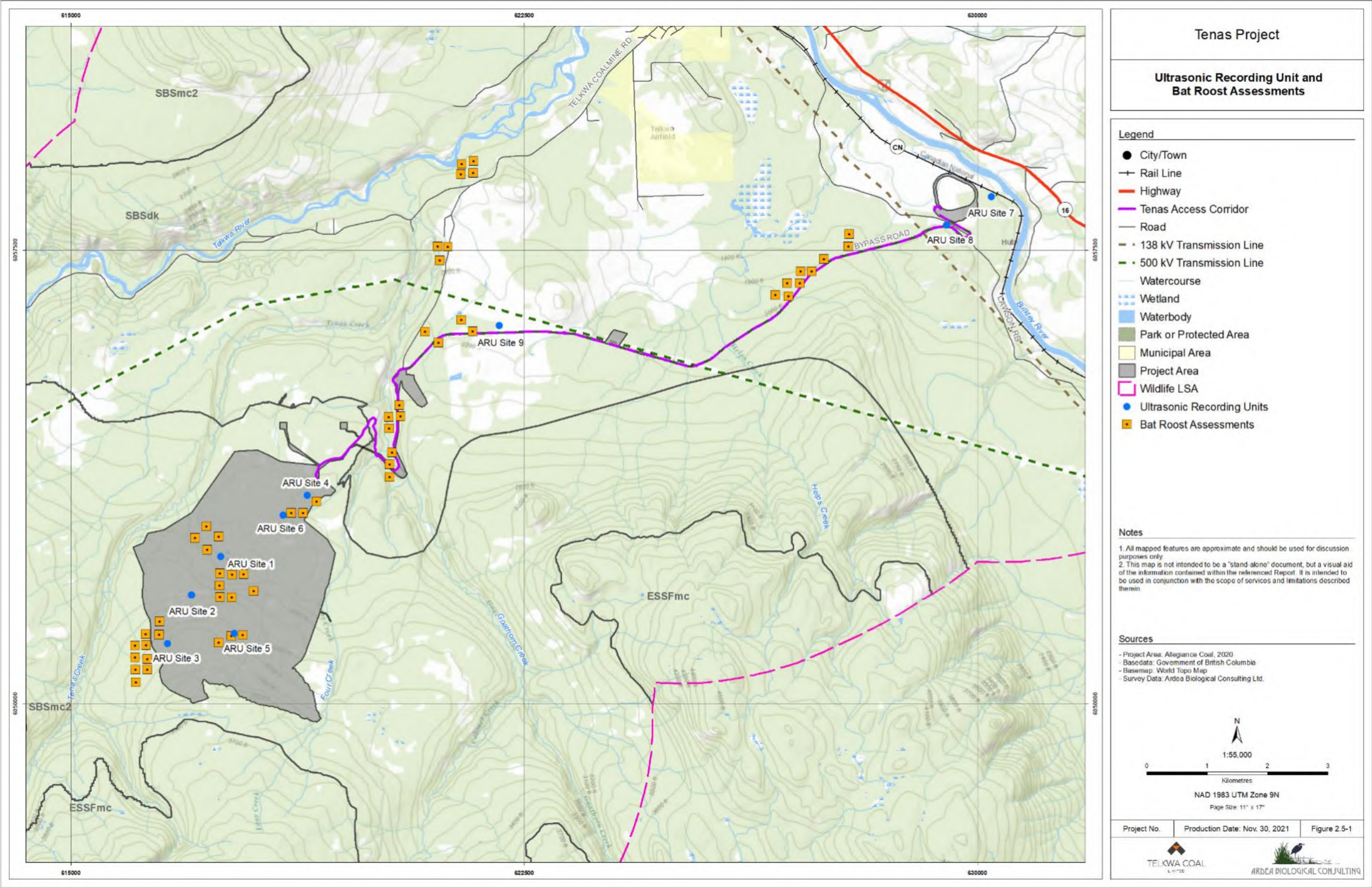


Figure 2.5-1: Locations of bat ultrasonic recording stations and bat roost assessments within the W-LSA from 2017 to 2019.

Table 2.5-2: Locations names and site descriptions for ultrasonic monitoring stations deployed from 2017 to 2019.

ARU Map ID	ARU ID	General Area	Habitat Description
ARU Site 1	17-ARU 1-1	Minesite	Mature spruce forest on edge of black spruce bog wetland
ARU Site 2	17-ARU 2-1 19-ARU 3-1	Minesite	Regenerating 30-year-old pine forest
ARU Site 3	17-ARU 3-1	Minesite	Mature spruce forest 50 meters from 10-year-old cutblock
ARU Site 4	17-ARU 1-2	Minesite	Mature spruce forest on edge of approximately 10-year-old cutblock
ARU Site 5	18-ARU 1-1	Minesite	Mature spruce forest on edge of exploration trail
ARU Site 6	18-ARU 2-1 19-ARU 2-1	Minesite	Mature spruce forest on edge of 10-year-old cutblock
ARU Site 7	17-ARU 4-1	Rail infrastructure	Mature pine forest on edge of 10-year-old partial harvest cutblock east of rail infrastructure area
ARU Site 8	18-ARU 3-1 19-ARU-4-1	Access corridor	Mature mixed forest adjacent to pasture, overlooking rail infrastructure area
ARU Site 9	18-ARU 4-1	Access corridor	Young mixed forest adjacent to cultivated field

Bat Call Classification and Analysis

Identification of bat species based on echolocation calls can be challenging because of the potential for wide variation in bat calls between and within species (Barclay 1999, Lemen et al. 2015, Reichert et al. 2018, Nocera et al. 2019, Fraser et al. 2020). Wildlife Acoustics Inc. has developed a software program, Kaleidoscope™ Pro version 5.1.6, (referred to as the software), that processes ultrasonic recordings and was designed to be used with their ultrasonic recorders. The software eliminates noise, deletes echoes, and uses band-pass filters to detect, extract, and enhance the narrow-band signal of bat echolocation calls. After the recorded files have been “scrubbed,” the software uses an algorithm based on a Hidden Markov Model to model bat echolocation calls. This produces species-level identification of the calls and calculation of a probabilistic statement in the form of a presence p-value regarding the certainty of the identification (Wildlife Acoustics Inc. 2018b). The software provides a rapid method for classifying bat echolocation calls recorded under variable field conditions (Agranat 2012).

The analysis of the ARU recordings underwent an iterative process to obtain the best potential classification of the data to identify bat species. As more data was collected, we increased our understanding of the data and potential species present, as well were able to use upgrades in the classifiers provide by Wildlife Acoustics Inc. The main steps for this process are outlined below.

Initial Analysis of 2017 Data

For the original analysis of the 2017 data, nine bat species were chosen to be classified after a preliminary literature review of species of bats likely to occur within the W-LSA. In addition to bat species suspected to be in the area, California myotis (*Myotis californicus*), and Yuma myotis (*Myotis yumanensis*) were selected due to California myotis being identified on the western borders of the Skeena Region (BC CDC 2010e), while the range of Yuma myotis is unknown within the province.

Due to the 15-minute (900 seconds) recordings per hour, each file was processed into 30 second sub-files, to filter out non-call periods and allow for a smaller set of files for classification. The results of the initial pre-processing is provided in Table 2.5-3. The pre-processing resulted in an average reduction of 98.7% (range 97.3% to 99.6%) in the number of files to classify.

Table 2.5-3: Summary of results of file pre-processing of 2017 ARU data to split files into 30 second analysis files.

ARU Map ID	ARU ID	Total 900 Second Files Recorded	Total Recording Minutes	Total 30 Second Noise Files	Total 30 Second Analysis Files
ARU Site 1	17-ARU 1-1	180	2,700	5,339	61
ARU Site 2	17-ARU 2-1	339	5,085	4,643	127
ARU Site 3	17-ARU 3-1	318	4,770	9,931	239
ARU Site 4	17-ARU 1-2	159	2,385	9,503	37
ARU Site 7	17-ARU 4-1	294	4,385	8,718	54
Totals		1,290	19,325	38,134	518

Both the *Noise* and analysis sets of files were then processed using the following software parameters: echolocation call signal-of-interest frequency range was set to 8 to 120 kHz and the call duration range of 2 to 500 milliseconds. The sensitivity level was set to zero, which balances the frequency of false negative and false positive species classification rates (Agranat 2012).

The re-processing of the set of *Noise* files did not classify any identified pulses, while the set of analysis files resulted in the identification of some additional *Noise* files, which had ultra-sonic sounds that were likely due to ambient background noise such as wind, rain, mechanical or insect activity. A second set of sub-files were classified *NOID*, which contained more than two potential bat identifications, or had insufficient data to match the reference classifiers. All other files had bat species detected by the software during the file processing stage, with the software calculating summary that provided a presence p-value for each species at each site based on a Maximum Likelihood Estimator (Wildlife Acoustics Inc. 2018b). A p-value of approaching zero is the best possible outcome, indicating that a given species is most likely present. P-values of one, or approaching one, indicate that it is not possible to state with statistical confidence the presence of a given species of bat based on the available data. Wildlife Acoustics (2018b) suggests that a P-value < 0.05 with 5 or more classified pulses indicates that the species is *Likely* present and all other P-values indicates that they are only *Possibly* present.

Following the software classification, an initial manual classification/visual review of approximately 10% of the call files was conducted to compare the call signatures to the reference calls available in the software. This manual review identified that calls for bats that emit lower frequency calls (i.e. call frequencies below 30 kHz), such as hoary bat (*Lasiurus cinereus*) and Eastern red bat (*Lasiurus borealis*) did not appear to be effectively classified.

Analysis of 2018 Data

The 2018 data was classified using the same parameters as the 2017 data with the same group of bat species as 2017, but without the need to process into 30 second sub-files as they only recorded for a maximum of 15 seconds.

Based on the results of the 2017 software classification and the initial manual classification review process of the 2017 data in 2018, we also processed the 2017 and 2018 data for the presence of low frequency calling bats (e.g. hoary bat and Eastern red bat). Pallid bats were also selected for inclusion in the low frequency analysis as a small number of calls in the 2017 data were identified during manual classification as potentially pallid bat (*Antrozous pallidus*), a species that is not known to be found outside of the Okanagan (BC CDC 2019). To accomplish the low frequency analysis, we processed all of the 2017 and 2018 data files using a low frequency setting that ranged from 8 to 50 kHz and a call duration time range of 2 to 500 milliseconds. The three species of interest; Eastern red bat, hoary bat and pallid bat, were added to the original classifier list for the software to classify, providing a final listing of eleven bat species analyzed by the software (Table 2.5-4).

Table 2.5-4: List of bat species analyzed by the Kaleidoscope™ Pro classification software.

Common Name	Scientific Name	Common Name	Scientific Name
Big Brown Bat ¹	<i>Eptesicus fuscus</i>	Long-legged Myotis ¹	<i>Myotis volans</i>
California Myotis ¹	<i>Myotis californicus</i>	Northern Myotis ¹	<i>Myotis septentrionalis</i>
Eastern Red Bat ²	<i>Lasiurus borealis</i>	Pallid Bat ²	<i>Antrozous pallidus</i>
Hoary Bat ^{1,2}	<i>Lasiurus cinereus</i>	Silver-haired Bat ¹	<i>Lasionycteris noctivagans</i>
Little Brown Myotis ¹	<i>Myotis lucifugus</i>	Yuma Myotis ¹	<i>Myotis yumanensis</i>
Long-eared Myotis ¹	<i>Myotis evotis</i>		

Note: 1) Initial bat species list for software classifications

2) Species targeted for low frequency analysis after review of 2017 results in early 2018

Manual Classification of Data

Once the 2017 and 2018 data were classified, using the full frequency and low frequency processing methods, a manual classification of approximately 22% of all call files was undertaken. This manual review included files that had been classified as listed bat species (e.g. little brown myotis) or species that were known to have limited ranges or abundance (e.g. big brown bat, northern myotis). The manual classification review was completed using the Kaleidoscope software and comparing the signals to known call signatures provided in the software following methods outlined in Maxell et al. (2015) and Wildlife Acoustics Inc. (2018b). Files were also randomly chosen for manual review that represented a variety of recording times, dates and locations; files classified as NOID and Noise were included in the manual classification review to determine if they contained any identifiable bat calls for the species of interest. A sub-set of the files used for the manual classification that had bat pulses that were difficult to classify or outside of their normal range

were sent for review to biologists experienced in bat classification for BC bat species; Jennifer Prive of EDI, and Mike Sarell of Ophiuchus Consulting. For each species identified within the file that was manually reviewed, a final decision that identified the species as *Likely* or *Possibly* present was determined based on the weight of evidence of the software analysis (and manual reviews for that set of pulses).

Bat Roost Assessments

Bat roost assessments were performed in August of 2018 and were designed in an effort to understand the prevalence of potential bat roost sites within the W-LSA. Prior to starting field work, a 200m x 200m cardinal direction UTM plot grid was created and applied to GIS maps within the minesite, the access corridor and the rail infrastructure areas. Grid points that fell within old growth or mature forest (>121 years from the VRI data) were selected to be assessed for suitable bat roost trees. A list of these points was created for use in the field with the Avenza™ app on a GPS enabled tablet.

Surveyors used the mapping on the field tablet to navigate to the point and then identified the closest tree to become the physical centre of the plot. All trees over 15 cm diameter at breast height (DBH) within 8 m of plot centre were then individually measured and assessed using the tree attributes for wildlife form (FS 882 (6) HRE 98/5, BC MOFR and BC MOE 2010). Information collected on each tree within the 200 m² plot included species, DBH (measured or estimated), % remaining bark, estimated height, crown class, height to live crown, and wildlife attributes (appearance rank, crown rank, bark rank, wood, lichen, wildlife use). For Day/Night roosting, each tree was then rated from 0 to 5 for bat day/night roosting potential, with 0 = no potential, 1 = potential for 1 to 5 bats, 2 = potential for 6 to 20 bats, 3 = 21 to 50 bats, 4 = 51 to 100 bats, 5 = 101 to 200 bats). Maternal roosting was classified as *Yes* or *No*, depending on the rating for the number of potential bat roosting, the diameter of the tree being greater than 30 cm, evidence of cavities or internal rot and accessibility for the bats to the cavity/interior of the tree.

Field data was entered into an Excel spreadsheet to track the field attributes assigned for maternal and day/night roost sites as well as obtaining TEM and VRI attribute data of the plot sites for use in the

development of the suitability modeling. An overall site rating for Day/Night roosting trees was calculated by translating the roost ratings of the individual trees to the mid-point of the range for the rating and then adding up the values. An overall rating for the site was then made based on the original rating system for the total number of bats potentially able to roost at the site.

Forest Bat Habitat Suitability Modelling

A habitat suitability model was developed for the two SARA Schedule 1 red-listed myotis species, little brown myotis and northern myotis. Four life requisites were assessed: **Food (Growing)** which models the foraging habitats for these bats during the spring, summer and fall; **Security/Thermal (Growing)**, which models the day/night roosting habitats during the spring, summer and fall seasons; **Reproducing (Growing)**, which modelled maternal roosting sites from May to September; and **Hibernation (Winter)**, which modelled potential hibernation sites during the winter (October to April). Habitat suitability ratings obtained from the wildlife habitat assessments as well as the bat roost assessments were used to test and refine the models, with adjustments made to the model ratings based on the field data. The detailed methods used in the modelling are outlined in Appendix C1: *Forest Bat Species Account and Habitat Model*.

2.6 Furbearers

Baseline conditions for furbearers were determined using a combination of a review of the available literature, analyses of the provincial trapper harvest and big game harvest data and conducting baseline field assessments including snow track surveys, wildlife camera traps, wildlife habitat assessments, wildlife trail assessments and through the development of a marten habitat suitability model.

2.6.1 Baseline Analyses

Trapper Harvest Data

The available BC trapper harvest data was obtained from BC MFLRORD for the period 1975 to 2017. To analyse the trapper harvesting within the last 20 years, the data for the period from 1998 to 2017 was extracted for analysis and summarization. Traplines were identified within the W-LSA and W-RSA using ArcGIS and data obtained from DataBC (Government of BC 2020). Summary data on species and amounts harvested over the last 20 years was presented in graphs.

Big Game Harvest Data

Big game harvest statistics were obtained from DataBC for the period 1976 to 2018 (BC MFLNRORD 2021). To analyse the big game harvest data within the last 20 years, the data for the period 1998 to 2018 was extracted for analysis and summarization for wolves as that is the only furbearer species tracked within this database. Summary statistics for the management units (e.g. MU 6-08 and MU 6-09) that are contained within the W-RSA for the wolves harvested in the last 20 years was presented in graphs.

2.6.2 Baseline Field Assessments

General wildlife methodologies used for collecting baseline data for furbearers included wildlife camera traps, wildlife habitat assessments and wildlife trail assessment. The methodologies for these assessments are provided in Section 2.11.

Snow Track Surveys

To determine winter habitat use by furbearer species, ungulates and potentially birds such as grouse; snow track transects were conducted from mid January to early March, 2018 within the W-LSA. Surveys were conducted in the minesite, rail infrastructure and Goathorn Creek areas (Figure 2.6-1), as per snow tracking

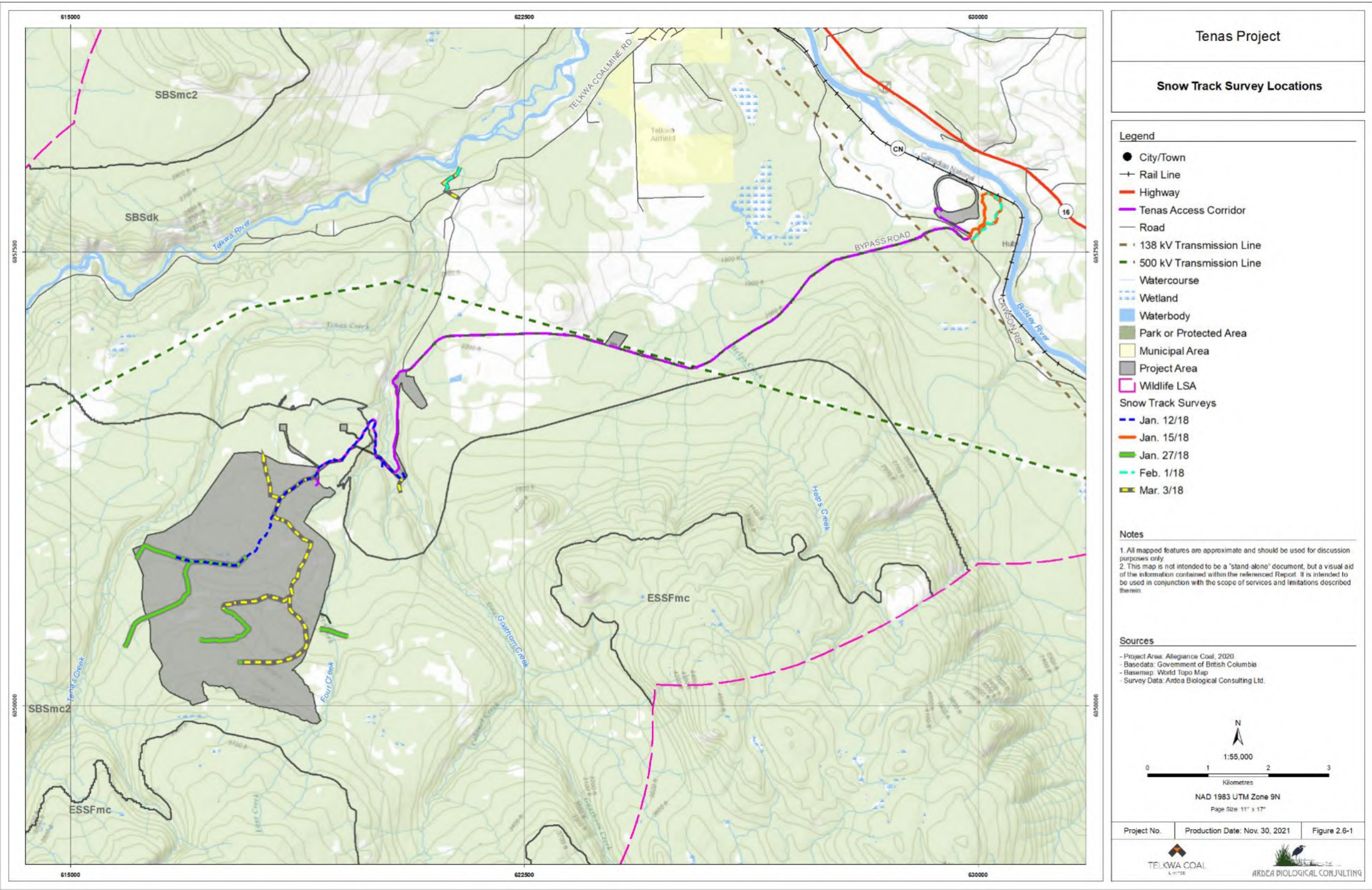


Figure 2.6-1: Locations of snow track surveys within the W-LSA in 2018.

methodologies recommended in RIC (1998a and 1998c). A total of 26,887 m of snow track surveys were completed (Table 2.6-1), with the majority (76%) of the transects completed within the minesite area.

Track transects were conducted 24-48 hours after snow, recording the date, time, all the tracks that bisected and within 2 m of the transect line, the habitat in which each track was located, snow conditions (depth), and current weather conditions. Habitat was classified as Mixed (M) (neither conifer or deciduous > 75%), or Coniferous (C) (>75% coniferous) (RIC 1998h), or Riparian (R) (rich sites influenced by proximity to water). No habitat polygons were encountered that were classed as Deciduous (>75% deciduous) (RIC 1998h). Habitats adjacent to the transects were also classified based on their structural stage (BC MOFR and BC MOE 2010) (Table 2.6-2) based on field observations along the length of the transect, with a habitat change recorded when there was a significant change to the forest structure. Edge habitats were identified when the forest structure was open on one side and young to mature on the other side.

Marten Habitat Suitability Modelling

The habitat suitability model for American marten identifies suitable habitat for the **Living** life requisite during the **Winter** season. The Living life requisite uses a combination of forage and denning habitat ratings to obtain an overall Living rating from ecosystem and other attributes available from digital data. The model also predicts the potential number of available female territories based on average territory sizes from the literature. The detailed methods used in the modelling are outlined in Appendix D: *Marten Habitat and Territory Analyses Summary Report*.

2.7 Black and Grizzly Bear

Baseline conditions for black and grizzly bear were determined using a combination of a review of the available literature, analyses of the provincial trapper harvest and big game harvest data and conducting baseline field assessments including wildlife camera traps, wildlife habitat assessments, wildlife trail assessments, and through the development of a grizzly bear habitat suitability model.

2.7.1 Baseline Analysis

Trapper Harvest Data

The BC trapper harvest data obtained from BC MFLRORD for the period 1998 to 2017 was reviewed as black bear gall bladders and paws are tracked within this data set. Summary data on the traplines that obtained gall bladders or paws over the last 20 years was compiled.

Table 2.6-1: Location and date of snow track transects.

General Survey Location	Date Surveyed (d/m/y)	Distance Surveyed (m)	Total Distance (m)
Minesite	12/1/2018	4,824	20,389
	27/01/2018	8,573	
	03/03/2018	6,992	
Rail Infrastructure	15/01/2018	2,307	3,554
	01/02/2018	1,247	
Goathorn Creek	12/1/2018	1,357	2,944
	01/02/2018	544	
	03/03/2018	1,043	
Total			26,887

Table 2.6-2: Forest structure descriptions used during the snow track surveys.

Forest Structure	Approximate Age
Open	15 to 30 years
Young	30 to 60 years
Mature	60 to 120+ years
Edge	Open adjacent to Young/Mature

Big Game Harvest Data

Big game harvest statistics were obtained from DataBC (BC MFLNRORD 2021) and the data for the period 1998 to 2018 was reviewed for grizzly bear and black bear harvested in management units 6-08 and 6-09.

2.7.2 Baseline Field Assessments

General wildlife methodologies used for collecting baseline data for black and grizzly bear included wildlife camera traps, wildlife habitat assessments and wildlife trail assessment. The methodologies for these surveys and assessments are provided in Section 2.11.

Grizzly Bear Habitat Suitability Modelling

The habitat suitability model for grizzly bears identifies suitable habitat for the **Living** life requisite during the **Spring**, **Summer** and **Fall** seasons. The Living life requisite uses a combination of Forage and Security/Thermal habitat ratings to obtain an overall Living rating from ecosystem and other attributes available from digital data. Habitat suitability ratings obtained from the wildlife habitat assessments as well as the bat roost assessments were used to test and refine the model, with adjustments made to the model ratings based on the field data. The detailed methods used in the modelling are outlined Appendix E: *Grizzly Bear Species Account and Habitat Model*.

2.8 Caribou

Baseline conditions for the Telkwa Caribou Herd were determined through the completion of a literature review and a compilation and analyses of existing data which is provided in Appendix F: *Assessment of Disturbance in the Telkwa Caribou Herd Range*. A technical Caribou Sub-working Group consisting of BC MECCS and Federal ECCC representatives guided compilation of the most current government-sourced data and provided input to the methodology to analyze these existing data. A substantial amount of information was compiled during the desktop assessment, including several local habitat studies, academic studies, annual survey reports from the Ministry of Environment, a caribou management plan, two caribou recovery plans, three land use plans, and a comprehensive status and background summary, other published literature and available Telkwa caribou collar locations.

2.8.1 Baseline Analyses

Following review of the existing information and based on the available caribou collar locations, baseline analyses were designed to support the completion of an effects assessment for the Project. The resulting data of the baseline analyses will be used to assess the effects of the Project on caribou: alteration and/or loss of habitat (i.e., direct and indirect effect through sensory disturbance), change in mortality (including the mechanisms of apparent competition and facilitated predation), and change in movement patterns. Therefore, three types of data analyses were conducted to enhance the understanding of baseline conditions of the Telkwa Caribou Herd, as follows.

- ▶ analyses of caribou collar data to characterize the annual and seasonal distribution, movement patterns and habitat selection;
- ▶ analysis of caribou collar data to characterize spatial patterns of caribou mortality; and
- ▶ quantification of disturbed habitat, following the criteria in the 2014 Recovery Strategy (Environment Canada 2014).

Analyses describing caribou distribution, movement, habitat selection, and mortality were completed base on caribou collar data. Background on the collar data is provided below, followed by descriptions of the methodologies for each analysis.

Collar Data

The Province of British Columbia provided a dataset of telemetry collar locations for the Telkwa Caribou Herd on the conditions that a confidentiality agreement was signed by all persons who viewed these data. The data are summarized here at a level of detail that does not require a confidentiality agreement to be signed by each reader. The dataset includes 33,024 locations from GPS and very high frequency (VHF) collars with a temporal extent of May 7, 1994, to July 7, 2018. The collar data represent the locations of 82 caribou, recorded from 15 GPS and 70 VHF collars. Both collar types were deployed on three caribou.

The available VHF caribou locations started in 1994 and continued to be collected until 2012. VHF collar locations were collected at approximately monthly intervals during this period, consequently, the data reflect caribou locations across all seasons. The VHF collar locations were concentrated in years during and after the implementation of a program to augment caribou numbers through the transplant of caribou from the Chase-Sustut Caribou Herd (between 1997 and 1999; Stronen 2000). The locations of translocated VHF collared caribou were collected from 1997 to 2007. Prior to the translocation program, all caribou were residents of the Telkwa Caribou Herd. The numbers of collared resident caribou were relatively low (range: 1 to 7 collars) until 2005 when the number increased to 17 VHF collared resident caribou. As of 2012, all VHF collars on resident caribou had failed or the caribou had died.

Resident caribou locations were collected using GPS collars from 2001 to 2004, then again from 2013 to 2018. GPS collars acquired locations at much higher rates than the VHF collars and, therefore, are disproportionately represented within the dataset. The time interval between GPS locations indicates that the collars were set to acquire location fixes every 4 to 12 hours during the 2013 to 2018 sampling period. The majority (approximately 70%) of the GPS fixes from the earlier sampling period did not have a timestamp and the number of fixes suggests that the fix rate was close to 8-hour intervals.

Residency of caribou and collar type was considered an important factor for some analyses. Translocated caribou (with only VHF collars) exhibited a different distribution and movement compared to the resident caribou fitted with both collar types (Grant 2017). In addition, VHF collars are known to have greater location error as they are recorded from an aircraft or estimated by triangulation (Frair et al. 2010). Stronen et al. (2007) reported an average accuracy of ± 300 m for the Telkwa caribou VHF collar locations during 1997 to 2000. The location error of GPS collars is generally less than 30 m (D'Eon et al. 2006). VHF collars do not provide locations at a temporal resolution that allows reasonable movement analyses. The differences in collar type and caribou residency are acknowledged in the relevant analyses.

Distribution

The purpose of the distribution analysis was to quantify the annual and seasonal distribution of the collared caribou, which can be used to assess the degree of spatial overlap of the Telkwa Caribou Herd with the Project. The distribution was assessed using the historic collar locations in two ways: (1) the relative occurrence of locations across BGC variants groups and (2) using utilization distributions.

Relative Occurrence of Locations

A habitat-based approach was chosen for the analysis, using BGC variants groups (Table 2.8-1) as a broad habitat layer, for two primary reasons. First, broad patterns of vegetative and climatic conditions vary across BGC variants in ways that are known to affect the seasonal distribution of caribou (e.g., forage production, vegetative cover, and snow depth). Second, the locations of the Project components can be associated to different BGC variants; for example, the open pit occurs within the SBSmc2, and the access corridor and rail infrastructure area occur in the SBSdk.

Telkwa caribou habitat selection was quantified while considering the following data limitations:

1. Caribou collar locations showed that Telkwa caribou almost exclusively use the alpine and subalpine habitats. Base data that differentiate habitat within the alpine and subalpine are not

available, and the creation of new data would have poor habitat specificity and, therefore, provide limited use for modelling. Terrain metrics on their own would not inform habitat selection.

2. Telkwa caribou use of forested habitat was so limited that detailed modelling of habitat selection in those areas would not be informative.
3. Discussions with the Project's Caribou Sub-working Group indicated that reviewers agreed with a simpler modelling approach.

To quantify habitat selection within the caribou study areas the proportion of collar locations within BGC variants was compared to the availability of BGC variants within each study area. Collar data were available for resident Telkwa caribou and for caribou that were translocated from the Chase-Sustut caribou herd to the Telkwa Caribou Herd from 1997 to 1999 (Stronen 2000). The VHF and GPS collar data were grouped. To reduce some of the pseudo-replication associated with the high fix rates of the GPS collars only the first locations of each day were included.

A seasonal comparison of proportional use to availability of BGC variants in the study areas was completed for spring (April 16 to May 24), calving (May 25 to June 24), summer (June 25 to September 14), fall (September 15 to October 31), and winter (November 1 to April 15) seasons. The comparison of annual habitat selection was limited by the number of locations within a season, so the annual analysis focussed on winter (the longest season) and only included years with more than 50 collar locations.

For each analysis, BGC variants were extracted for caribou collar locations that occurred within the study areas (i.e., locations outside a study area were not considered). The availability of the each BGC variant within the study area was calculated using a spatial overlay to estimate the area and percentage of each BGC variant (Table 2.8-1 and Table 2.8-2). A selection ratio was used of the difference between the proportion of caribou collar locations in a given BGC variant and the proportion of the available BGC variant, compared to the proportion of the available BGC variant in the study areas (Manly et al. 2002). The selection ratio theoretically ranges from -1 to infinity. Positive selection ratio values indicate the caribou collar locations were within a given BGC variant more often than if they were distributed according to availability (i.e., randomly), while negative values indicate collar locations were within the BGC variant less often than expected. A value of zero indicates that the collar locations were within the BGC variant at an equal proportion to the availability of the BGC variant.

To standardize the scale for easier comparison, the selection ratio was transformed using the following criteria:

$$f(x) = \begin{cases} \frac{-1}{1+x}, & x < 0 \\ 0, & x = 0 \\ 1+x, & x > 0 \end{cases} \quad \text{where } x \text{ is the selection ratio.}$$

The value of the standardized selection ratio provides the relative strength of selection and quantifies how much more or less a BGC variant is used compared to availability. For example, a selection value of 3.0 indicates that caribou collar locations were located within a BGC variant three times as often as expected, a value of -2.0 indicates that the collar locations were located within the BGC variants half as often as expected, values close to 1 or -1 indicate they were used about as often as expected.

The direction and strength of habitat selection is influenced by numbers of collar locations within a specific BGC variant polygon, the BGC variants availability within the study area, and the relationship between the factors. When too few collar locations occur within a BGC variant or a BGC variant is not sufficiently represented within a study area, then the selection index becomes much more uncertain, making interpretations of results futile. Consequently, the Project Area and W-LSA were excluded in the analysis because they are too small an area relative to the Telkwa caribou range and contained too few collar locations.

Table 2.8-1: Description of BGC variant groups that occur within the Telkwa Caribou Herd Study Areas.

BGC Group	BGC Variants	Description
Alpine	BAFAun, CMAun	High elevation, mountainous areas dominated by dwarf shrubs, heaths, herb and grassland tundra, mosses, and lichen. May contain a mosaic of krummholz tree patches at lower elevations. The climate is severe with a short frost-free period and low growing season temperatures. Snowpack exists from October-May, generally >1m; however, wind scouring can greatly reduce depth on some sites. Human activity in the area is limited to moderate levels of human recreation that occurs year-round, including a designated snowmobile area and limited ATV access in summer
Engelmann spruce - subalpine fir parkland	ESSFmcp, ESSFmkp, ESSFwvp	High elevation, subalpine parkland with clumps of stunted Engelmann spruce and subalpine fir that are separated by areas of heath, meadow, and grassland. The climate is slightly milder than alpine but cold still limits tree growth. Snowpack is generally >1m and lacks local scouring that occurs in the Alpine. Human development is similar to alpine.
Engelmann spruce - subalpine fir forest	ESSFmc, ESSFmk, ESSFwv	Mid-high elevation, forest dominated by subalpine fir and Engelmann spruce. The climate in summer is moderated enough to support productive tree growth. Winter snowpack generally exceeds 70 cm. Forestry roads and cutblocks are developed though most of the zone.
Sub-boreal spruce - moist cold	SBSmc2	Productive, mid elevation forest zone dominated by interior spruce, subalpine fir, and lodgepole pine. Cooler and moister summers than the SBSdk and longer winters with deeper snowpack, generally >50cm. Forestry development is extensive, with limited rural and recreational development.
Sub-boreal spruce - dry cool	SBSdk	The most productive and lowest elevation interior BGC variant. Occurs in the Bulkley Valley and lower portions of the Telkwa and Morice River valleys. The climate has relatively dry and warm summers and dry cold winters with generally <50cm snow. Mature forests are dominated by lodgepole pine and spruce but the zone also contain a significant component of seral deciduous and mixed forests with trembling aspen, black cottonwood, and paper birch. Human development is extensive, including forestry, agriculture, urban and rural development and a major transportation corridor.
Coastal BGCs	CWHws1, CWHws2, ICHmc, MHmmp	Coastal variants that are low to mid elevation, moist to wet, and include forests dominated by hemlock and cedar. The variants are characterized by short, cool, and wet growing season, and cool snowy winters. The MH zone is higher elevation and wetter than the other zones. Forestry roads and cutblocks are developed though most of the zone.

Table 2.8-2: Percentage of BGC variant groups within each of the Telkwa Caribou Herd Study Areas and the Project Area.

BGC Variant Group	TCH-RSA1 (2,625 km ²)	TCH-RSA2 Core (1,613 km ²)	TCH-RSA2 Matrix (5,434 km ²)	LSA (357 km ²)	Project Area (11 km ²)
Alpine	9.66	15.03	12.55	0.17	0.00
Engelmann Spruce - Subalpine Fir Parkland	13.35	22.70	4.69	1.25	0.00
Engelmann Spruce - Subalpine Fir Forest	35.91	59.30	13.84	15.91	0.18
Sub-boreal Spruce - Dry	9.80	0.00	15.87	52.53	7.08
Sub-boreal Spruce - Moist	30.45	2.34	33.97	30.13	92.74
Coastal BGCs	0.82	0.62	19.07	0.00	0.00

Utilization Distribution

A second question associated with distribution is whether there was evidence of concentrated Telkwa Caribou Herd seasonal use of the landscape in proximity to the Project Area. This was examined by creating kernel density estimates (KDE) to represent utilization distributions (UD), a common method of describing caribou range use (Fieberg and Kochanny 2005). The KDEs were used to visualize areas with high density point locations within the Telkwa Caribou Herd range. KDE input parameters were a one-kilometre search radius, quartic kernel shape, and a 100 m pixel resolution. One annual and five seasonal UD (spring, calving, summer, fall, winter) were created for the combined collar data (resident GPS/VHF and translocated VHF) using the Heatmap tool in QGIS (v3.14). Seasonal and annual areas of utilization distributions (e.g., area of 95% isopleths) were not quantified.

Movement

Caribou are wide-ranging species and some herds make regular movements through specific areas (movement corridors). Potential movement corridors were identified through a spatial analysis that combined consecutive collar points to model caribou movement across the landscape, followed by mapping those movements within the study areas to qualitatively assess potential movement corridors. The objective was to determine areas within the Telkwa Caribou Herd's range that were more likely to be used for movement between seasonal ranges.

Only GPS collar locations were included in the analysis. The GPS locations were filtered to include only the first location for each day. Reducing the number of locations was required because a large portion of the collar data did not have a timestamp and could not be sorted by a date-time field. VHF collar data were excluded from the analysis because the collar locations do not provide the temporal resolution required for this analysis. A spatial layer of caribou steps (path segments) was created for spatial analysis and visualizing caribou movements. First, movement paths were created by sorting collar locations by date and collar identifier, then by connecting the consecutive points. The paths were broken into segments, each representing a step between two points along the path. The time, distance, turning angle, and velocity of was estimated for each step using the *adehabitatLT* package in R (Calenge 2006). The movement attributes were merged to the caribou step spatial layer using a spatial join. Potential movements between seasonal ranges were distinguished from foraging behaviour by selecting parts of caribou paths that represented higher velocity movements.

To differentiate steps that might be indicative of seasonal movements as opposed to foraging behaviour, we selected the fastest 5% of caribou movements were selected for the analysis. The faster movements were selected as an indicator of seasonal movements because paths of animals moving between seasonal ranges tend to be longer (i.e., faster) than other movements (Fahrig 2007). The selection of the fastest 5% of movements as the cut-off was arbitrary, but reasonable as it is equivalent to about 18 days (5% of the year) which should capture movements between seasonal ranges.

Mortality

The date and locations of caribou mortalities from the telemetry dataset were used to quantify mortality rates across the BGC variant groups. GPS collars were excluded from this analysis because there were only two known mortality locations for GPS collared caribou and the inclusion of GPS collar data would have biased the analysis as the majority total locations would be the GPS collar locations. The lack of mortality locations of GPS collared caribou is due to the shorter operational life of GPS collars, not lower mortality rates of these caribou. GPS collars are programmed or remotely triggered to release from the caribou before the collars lose power, allowing recovery of the collars without recapturing the caribou.

The data were filtered to include only caribou that had documented mortality associated with a spatial location. The filter excluded caribou with final locations that were not associated with mortality; for example, some caribou were recaptured to replace collars or the collar's batteries failed. The dataset included 34 locations where caribou died and 2,330 locations representing the distribution of those 34 caribou when they were alive. Caribou mortalities included in this analysis occurred between 1996 and 2012.

Mortality was calculated as the ratio of mortality locations to total locations within each BGC variant group. As such, the resulting values provided a relative index of mortality across BGC variants, not absolute mortality rates. To facilitate easier comparison, the raw index values were standardized to 1 for the BGC variants with the lowest mortality rate.

Disturbed Habitat Analysis

The amount of disturbed habitat was estimated for each of the caribou study areas following guidance from the *Recovery Strategy for the Woodland Caribou, Southern Mountain population (Rangifer tarandus caribou) in Canada* (Environment Canada 2014) and the Caribou Sub-working Group. The total area of human disturbance was estimated using a spatial analysis of vector data. The analysis included buffering spatial layers of human disturbance and conducting a spatial overlay of the features with the study areas and BGC variant groups. The final spatial layer included the current total area of the human disturbance footprints (e.g., roads, railway, cutblocks, and agricultural lands), a 500 m buffer around the human disturbance footprints, and the unbuffered footprint of forest fires up to 40 years old. The proportion of disturbed habitat within each caribou study area was compared to the 35% total disturbance threshold identified in the Recovery Strategy (Environment Canada 2014). In addition to the total disturbance estimate, human disturbance features were summarized by type and predicted intensity of disturbance allowing analyses to estimate the extent of each anthropogenic disturbance type within each study area and BGC variant group.

The complete disturbance habitat analysis methods are provided in Appendix F: *Assessment of Disturbances in the Telkwa Caribou Herd Range*.

2.8.2 Baseline Field Assessments

Baseline field assessments such as snow track survey, arboreal and terrestrial lichen assessments, wildlife camera traps, the wildlife habitat assessments and wildlife trail assessments were conducted to identify any evidence of caribou habitat use patterns. The methodology for the snow track surveys is outlined in the Furbearer section (Section 0), the methodologies for the wildlife camera traps, wildlife habitat assessments and wildlife trail assessments are provided in Section 2.11, while the arboreal and terrestrial lichen assessment methods are provided below.

Arboreal and Terrestrial Lichen Assessments

Arboreal and terrestrial lichen abundance in the caribou study areas was initially assessed through a review of available previous studies to determine the distribution and abundance of arboreal and terrestrial lichens in the area (Houwers 1996, Edie 1998b, Roberts 2000). Arboreal lichen surveys were conducted during the bat roost assessments as well as in TEM plots, following methods outlined in Armeleder et al. (1992). The biomass of arboreal lichens (kg/ha) was calculated using the methods outlined in Stevenson et al. (1998) to provide an estimate of the amount of arboreal lichen per hectare. The locations of 376 historic arboreal lichen assessments that contained sufficient location information and 125 plots used to conduct lichen assessments during the current baseline program are outlined in Figure 2.8-1, for a total of 501 arboreal lichen assessment locations.

Terrestrial lichen abundance was assessed using historic sources (Edie 1998b, Roberts 2000), as well as from TEM plot data obtained from the current baseline program (Ardea 2021a). The plot data were reviewed to identify the percent cover of terrestrial lichen species important to caribou, which included species within from the genera *Cladina*, *Cetraria*, *Cladonia*, *Stereocaulon*, and *Peltigera* (Roberts 2000 and 2001, Cichowski 2014). The percent cover for the terrestrial lichens was summed and the biomass (kg/ha) calculated using a conversion factor of $10.418 \text{ g/m}^2 \times \text{percent cover}$ identified by Roberts (2000). A total of 572 terrestrial lichen assessment locations included in this assessment are outlined in Figure 2.8-2. A total of 383 locations were obtained from historic terrestrial assessments that contained sufficient location information, and 189 plots containing terrestrial lichen data completed during the current baseline program.

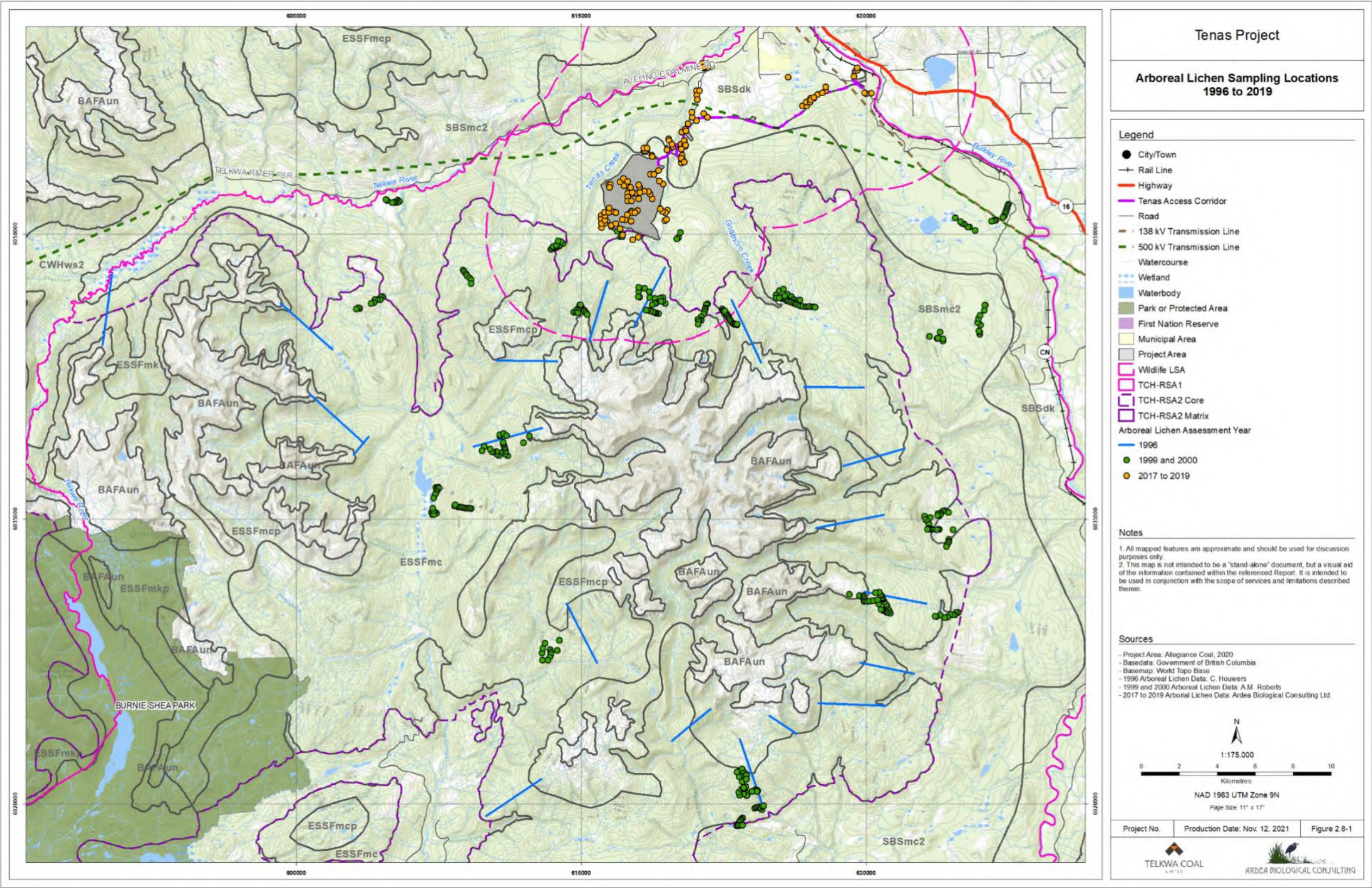


Figure 2.8-1: Locations of arboreal lichen plots and transects within the Telkwa caribou study areas.

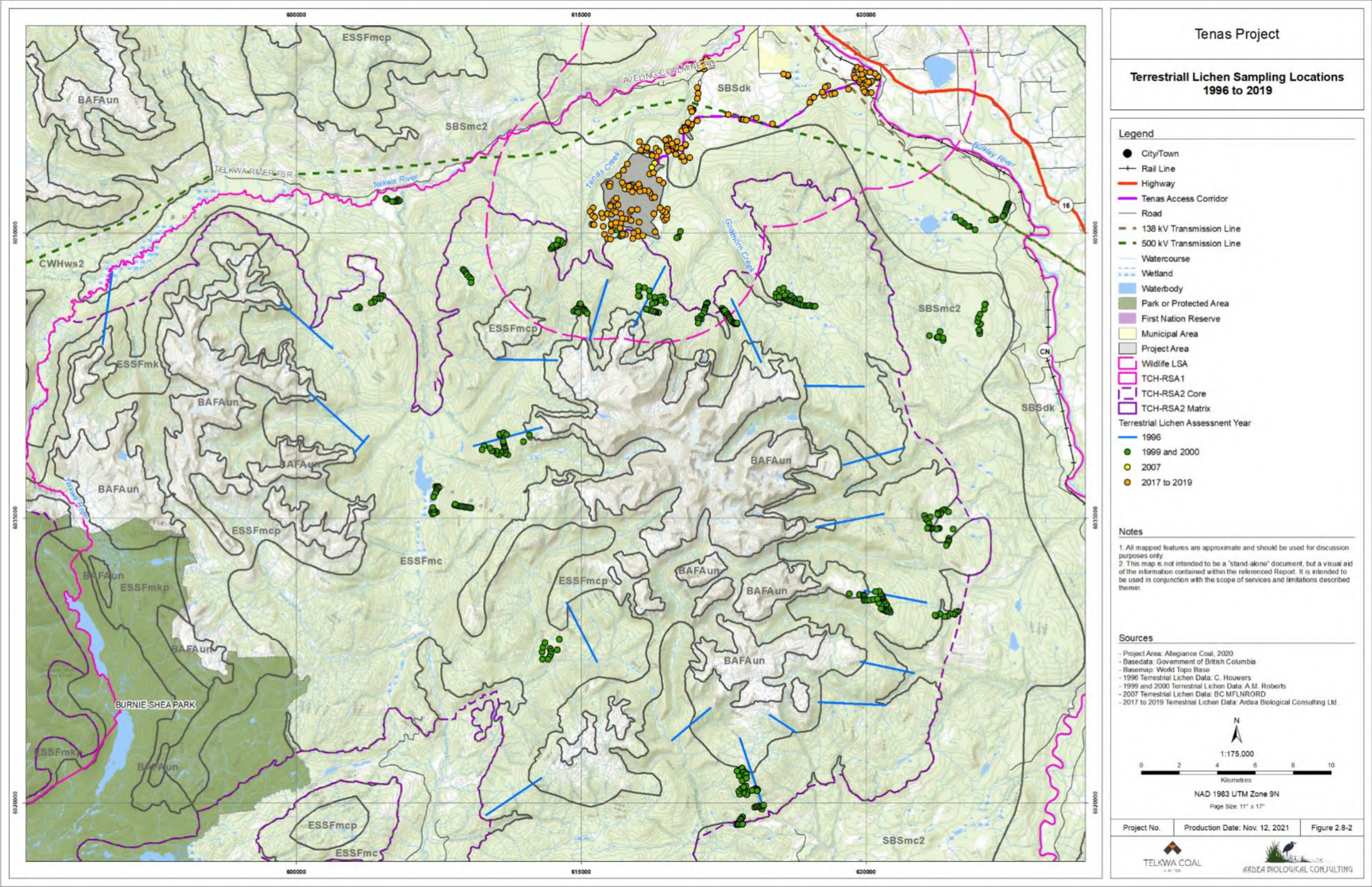


Figure 2.8-2: Locations of terrestrial lichen plots and transects within the Telkwa caribou study areas.

2.9 Moose

Baseline conditions for moose were determined using a combination of a review of the available literature and existing provincial data, including collar relocation data, population survey data and big game harvest data. Baseline field assessments such as wildlife camera traps, wildlife habitat assessments, wildlife trail assessments provided data within the W-LSA, while the development of a moose habitat suitability model provided information on potential habitat suitability within the W-LSA and the WRW-RSA.

2.9.1 Baseline Analyses

A substantial amount of information was compiled during the desktop review, including population survey data and reports, moose collar data, three land use plans, and several provincial status and summary reports. The baseline analyses for moose were designed to provide baseline information on moose distributions and movements using the moose collar data, with the population survey location data also providing some information on potential moose distributions. The moose collar data was used to better understand baseline conditions for moose related to annual and seasonal distributions, habitat use, and movement patterns of the collared animals. The moose population survey data also allowed for the characterization of seasonal winter distributions and habitat use patterns for a broader proportion of the population and longer time-frame.

Collar Data

Digital GPS telemetry collar locations for moose collared in the Project area was obtained from the Province of BC through a data request from the Species Inventory Web Explorer (BC MOE 2018) under a confidentiality agreement signed by all persons who viewed these data. The data is summarized here at a level of detail that does not require a confidentiality agreement to be signed by each reader. The dataset includes 23,300 locations from 12 GPS collars that were placed on 12 female moose with a temporal extent from March 24, 1998 to January 9, 2000 and January 12, 2003 to December 20, 2004.

GPS locations were collected from a single moose from March 1998 to January 2000 and three moose from January 2003 to January 2004. Five moose were collared in March 2003 and an additional three moose in March 2004, with these collars providing data until December 2004. Unfortunately, none of the GPS fixes had time-stamp information or location error data associated with the fixes and there were no associated reports or metadata that indicated the age of the moose or the programmed location fix rate. Based on a review of the number of daily fixes within the data, it appears that three of the collars (Jan. 2003 to Jan. 2004) had a fix rate of 6-hour intervals, while the remainder of the collars appeared to have been set at a 4-hour interval fix rate. Of the 23,300 locations obtained, 178 locations were removed from the data as they were related to activation prior to deployment (i.e. locations at the ministry office and researcher's residence), leaving a total of 23,122 useable fixes.

Population Survey Data

Digital population survey data for moose were also obtained from the Province of BC (BC MOE 2018) from surveys conducted on a periodic basis from 1992 to 2017. This data was collected for population density estimates using a stratified random block (SRB) survey design and composition estimates (sex and age ratios) using a transect design (Marshall 1993, 1997, 2004, 2010 and 2012; Schindler et al. 2019). Additional information on moose survey results without location data were also available from reports for surveys in 1983, 1988 and 2018 (van Drimmelen 1985, Steventon 1988, Schindler et al. 2019). Population density surveys (SRB design) were completed in 1983, 1988, 1992, 1997, 2004, 2012 and 2018, while composition estimates (transect design) were completed in 1984, 1990, 2001, 2003, 2010 and 2017 (Schindler et al. 2019). No population trend analyses of this data were completed during this baseline study as the work by Schindler et al. (2019) provided a comprehensive summary of the moose populations within

the moose study areas. The survey data was used in the evaluation and adjustments to the moose habitat suitability modeling (Appendix G: *Moose Species Account and Habitat Model*).

Big Game Harvest Data

Big game harvest statistics were obtained from DataBC (BC MFLNRORD 2021) and the data for the period 1998 to 2018 was reviewed and summarized for moose harvested in management units 6-08 and 6-09.

Distribution

Although the data from the collared moose are 16 to 22 years old, a preliminary review of the distribution and extent of the locations appeared to be representative of the habitat use observations obtained during the baseline studies as well as the authors' experience and understanding of moose habitat use in the area (Turney et al. 1999, Turney et al. 2006). For this analysis, the collared moose locations were used to quantify annual and seasonal use based on a simple ratio of the number of locations within a specific habitat and the amount of that habitat in a study area. A second analysis using the population survey animal location data was completed to provide a winter habitat use analysis for comparison to the collar location data as well as to show the pattern over the 20-year period available in the data. Although no analysis was completed with these locations to assess habitat use in this baseline assessment, the GPS location data was used in the evaluation and adjustments to the moose habitat suitability modeling (Appendix G: *Moose Species Account and Habitat Model*).

Relative Occurrence of Locations

For moose, a habitat-based approach was chosen for the analysis using BGC variant groups similar to what was used for caribou (see Section 2.8.1 above). The BGC variants provide a broad habitat layer that reflects vegetation and climatic patterns (e.g. forage species cover and production, plant phenology, snow depth, etc.), which influence seasonal moose use. As well, due to the collar data being 16-20 years old and the population survey data spanning 25 years, more detailed habitat use analysis would require that historic habitat patterns of harvested, agricultural and forested areas be created and used.

Using the moose collar and population data for the moose habitat use analysis had the following data limitations, benefits and assumptions:

1. Only 12 females of unknown age were collared, with data collected for a relatively short time (13 to 23 months). These animals likely do not represent male moose use of the WRW-RSA.
2. We did not know the reproductive status of the collared female moose and if any had calves with them or were without calves during the study. This may have influenced the distributions and use areas for the animals.
3. The collared moose locations have a close relationship with the regional study area, with 92% of the collar locations within the WRW-RSA and it is assumed that these collared moose are representative of female moose that use the WRW-RSA for most of their habitat requirements.

To reduce some of the pseudo-replication associated with the high fix rates of GPS collars and the lack of a time-stamp, we randomly selected one location for each day within the dataset for the analysis. A seasonal comparison of proportional use of the BGC variants in the study areas was completed using the same dates for the growing and winter seasons as was used in the moose habitat suitability mapping (Appendix G: *Moose Species Account and Habitat Model*). Growing season was defined as April 1st to October 31st and winter from November 1st to March 30th.

For each analysis, BGC variants were extracted for moose collar locations that occurred within the study areas only (see Section 1), with locations outside a study area not considered. The availability of each BGC variant within the study area was calculated using a spatial overlay to estimate the area and percentage of each BGC variant (Table 2.8-1). A selection ratio was used of the difference between the proportion of moose collar locations in a given BGC variant and the proportion of the available BGC variant, compared

to the proportion of the available BGC variant in the study areas (Manly et al. 2002). The selection ratio theoretically ranges from -1 to infinity. Positive selection ratio values indicate the caribou collar locations were within a given BGC variant more often than if they were distributed according to availability (i.e., randomly), while negative values indicate collar locations were within the BGC variant less often than expected. A value of zero indicates that the collar locations were within the BGC variant at an equal proportion to the availability of the BGC variant.

Table 2.9-1: Percentage of BGC variant groups within the WRW-RSA and W-LSA and the Project Area.

BGC Variant Group	WRW-RSA (3,576 km ²)	W-LSA (357 km ²)	Project Area (11 km ²)
Alpine	7.86	0.17	0.00
Engelmann Spruce - Subalpine Fir Parkland	9.23	1.25	0.00
Engelmann Spruce - Subalpine Fir Forest	28.76	15.91	0.18
Sub-boreal Spruce - Dry	18.13	52.53	7.08
Sub-boreal Spruce - Moist	34.37	30.13	92.74
Coastal BGCs	1.65	0.00	0.00

To standardize the scale for easier comparison, the selection ratio was transformed using the following criteria:

$$f(x) = \begin{cases} \frac{-1}{1+x}, & x < 0 \\ 0, & x = 0 \\ 1 + x, & x > 0 \end{cases} \quad \text{where } x \text{ is the selection ratio.}$$

The value of the standardized use ratio provides the relative strength of use and quantifies how much more or less a BGC variant is used compared to availability. For example, a use value of 3.0 indicates that collar locations were located within a BGC variant three times as often as expected, a value of -2.0 indicates that the collar locations were located within the BGC variants half as often as expected, and values close to 1 or -1 indicate they were used about as often as expected.

The direction and strength of habitat selection is influenced by the number of collar locations within a specific BGC variant polygon, the BGC variants availability within the study area, and the relationship between the factors. When too few collar locations occur within a BGC variant or a BGC variant is not sufficiently represented within a study area, then the selection index becomes much more uncertain, making interpretations of results unreliable.

Utilization Distribution

A second question associated with distribution is whether there was evidence of concentrated moose seasonal use of the landscape in proximity to the Project Area. This was examined by creating kernel density estimates (KDE) to represent utilization distributions (UD), a common method of describing animal range use (Seaman and Powell 1996, Powell 2000). The KDEs were used to visualize areas with high density point locations. An annual, growing and winter season UD were created for the combined GPS collar locations data using the Heatmap tool in QGIS (v3.14). KDE input parameters were a one-kilometre search radius, quartic kernel shape, and a 100 m pixel resolution.

Movement

Moose can be a wide-ranging species with animals making regular movements that follow the same paths, year after year (movement corridors) (Demarchi 2003). A spatial analysis of GPS telemetry collar locations to map individual moose movements across the landscape were used to qualitatively assess and identify

potential movement corridors. The objective was to determine areas within the Project area that moose may be more likely to be using for movement between seasonal ranges.

The moose GPS collar locations were filtered to include only one location for each day as none of the collar data had a time-stamp so it could not be sorted by a date-time field to allow for selection of a specific time of day. To create a spatial layer of moose steps (path segments) for spatial analysis, the GPS collar location data was sorted by collar identifier and then by date and a random selection from each collar and for each date was obtained using *Hawth's Analysis Tools for ArcGIS ver. 3.27* (Beyer 2004). Movement parameters were also calculated using Hawth's Tools to provide step length, turn angle, bearing and net displacement for the collared animal.

To differentiate steps that might be indicative of seasonal movements as opposed to movements related to foraging or other behaviour, we selected the longest 5% of moose movements for the analysis. The longest movements were selected as an indicator of seasonal movements because paths of animals moving between seasonal ranges tend to be longer than other movements (Fahrig 2007). The selection of the longest 5% of movements as the cut-off was arbitrary, but reasonable as it should capture movements between seasonal ranges.

2.9.2 Baseline Field Assessments

Baseline field assessments such as the snow track survey, wildlife camera traps, the wildlife habitat assessments, wildlife trail assessments and through the development of a moose habitat suitability model. The methodology for the snow track survey is outlined in the Furbearer section (Section 0), while the methodologies for the wildlife assessments are provided in Section 2.11.

Moose Habitat Suitability Modelling

The habitat suitability model for moose identifies suitable habitat for **Living (Winter)** life requisites as winter is considered a limiting season for this species. The suitability model will be based on the interactions between foraging habitat, security habitats for predator avoidance and thermal habitats where snow depth is reduced during the winter season. Habitat suitability ratings obtained from the wildlife habitat assessments were used to test and refine the model, with adjustments made to the model ratings based on the field data. The detailed methods used in the modeling are outlined in Appendix G: *Moose Species Account and Habitat Model*.

2.10 Other Ungulate Species

Several other ungulate species of interest are found within the W-LSA and the W-RSA including Rocky Mountain elk, mule deer, white-tailed deer and mountain goat. Baseline conditions for all of these species determined using a combination of a review of the available literature and existing provincial data, including available collar relocation data, population survey data and big game harvest data. These data provided information on habitat use for these species within both the W-LSA and W-RSA, while baseline field assessments such as wildlife camera traps, wildlife trail assessments and wildlife habitat assessments provided data on these species' habitat use within the W-LSA.

2.10.1 Baseline Analyses

Information on Rocky Mountain elk, mule deer, white-tailed deer and mountain goat was compiled during the desktop review, including population survey data and reports, some elk collar data, review of three land use plans, and several provincial status and summary reports. The baseline analyses for these ungulate species were designed to provide baseline information on distributions using the elk collar data. The elk collar data, although only from a few animals was used to identify elk seasonal distributions and general habitat use patterns of the collared animals.

Collar Data

Digital GPS telemetry collar locations for elk collared in the W-RSA was obtained from the Province of BC through a data request from the *Species Inventory Web Explorer* (BC MOE 2018) under a confidentiality agreement signed by all persons who viewed these data. The data is summarized here at a level of detail that does not require a confidentiality agreement to be signed by each reader. A dataset of 5,758 locations was obtained from three GPS collars that were placed on three female elk with a temporal extent from March 3rd, 2004 to April 6th, 2005.

All three elk were collared on March 3rd, 2004 and up to 8 relocations per day were recorded. One elk (Collar 891) had between five and eight relocations collected per day until April 2005, while the other two collars were more varied. One elk's collar (Collar 147) had several periods when no locations were collected, sometimes for several days, with the collar failing to collect any more locations in mid-February 2005. The third collar (Collar 149) collected data relatively effectively (between three and six relocations per day) until failing on January 19th, 2005.

Population Survey Data

Population data for Rocky Mountain elk, mule deer, white tailed deer and mountain goat were obtained from the Province of BC (BC MOE 2018). Regional population data for elk was obtained from surveys conducted in 2011, 2016, 2018 and 2020, using a transect design method over the known winter use area between Smithers and Houston, BC. (Schultz 2011, M. Wong pers. comm. 2020). No mule or white-tailed deer regional population data was available and only limited regional population information was available for mountain goat (Blythe and Kriss 2018).

BC Big Game Harvest Data

Big game harvest statistics were obtained from DataBC (BC MFLNRORD 2021) and the data for the period 1998 to 2018 was reviewed for Rocky Mountain elk, mule deer, white-tailed deer and mountain goat harvested in MU 6-08 and MU 6-09.

Distribution of Rocky Mountain Elk

Although the data from the collared elk was limited to three animals and for only the period 2004 to 2005, the distribution of elk within the Bulkley Valley has been relatively constant over the last 20 years (L. Turney, unpublished data). As elk are social animals and tend to be found in mixed groups of cows, calves and yearlings up to 20 animals (Blood 2000) it is expected that these animals are relatively representative of the greater population. We used the collared data to identify utilization distributions which can help identify potential interaction areas between the Project and elk. We used kernel density estimates (KDE) to represent utilization distributions (UD), a common method of describing habitat use (Ager et al. 2004). The KDEs were used to visualize areas with high density point locations. Growing and winter season UD's were created for the combined GPS collar locations data using the Heatmap tool in QGIS (v3.14). KDE input parameters were a one-kilometre search radius, quartic kernel shape, and a 100 m pixel resolution.

2.11 Baseline Field Assessments

Several wildlife field survey and assessment techniques were conducted to provide baseline wildlife use information on a variety of species within the Project area. These included wildlife camera traps, wildlife habitat assessments and wildlife trail assessments. The methods for each of these surveys and assessments are outlined below.

Wildlife Cameras

Wildlife cameras were deployed from the during 2017 and 2018 within the W-LSA to provide information on wildlife species use. Cameras were placed along roads and trails with known or expected wildlife use

within representative habitat types (e.g. mature and early seral forests). Cameras were positioned and orientated to ensure a clear view to capture images and avoid being detected by humans that may be using the area. Four to five Reconyx PC800 remote cameras were deployed and maintained each year to continuously monitor for wildlife using the following settings:

- ▶ Trigger sensor: On
- ▶ Sensitivity: High
- ▶ Number of pictures per series: 3
- ▶ Picture interval: 3 seconds
- ▶ Time lapse AM/PM: Off
- ▶ Resolution: 1080p
- ▶ Night Mode: Balanced
- ▶ Illumination: On
- ▶ Temperature: Celsius
- ▶ Label: CAM - number (1 to 5)

The camera locations are shown on Figure 2.11-1, with a summary of deployment dates, number of days the cameras were functioning and number of images obtained for each camera location by year is provided in Table 2.11-1.

Attribute information including the date and time of photo, temperature, image information and moon phase was obtained from the trail cameras using MapView Professional Image Management software (ver. 3.7.2.2) and stored in an Excel spreadsheet for analysis. The photographs from the wildlife cameras were reviewed to identify the species that was captured and where possible the age and sex of the species. Summaries of the species captured by the cameras were created for the species or species groups of interest and are reported within those species or species group sections. To allow for comparison of the relative numbers of images of a species between camera sites and between years, the number of images per 100 days of camera operation was calculated.

Wildlife Trail Assessments

Wildlife trails were assessed using encounter transect methods to identify trails that crossed or ran parallel to the access corridor (Figure 2.11-2). Surveys were conducted in July 2019 and recorded the physical characteristics of each trail, along with the species, sign of that species and a rating of use. This information was collected to determine baseline trail conditions as well as help in the assessment of potential effects and development of mitigation.

The methods used to assess wildlife use within the access corridor are listed below:

- ▶ Assessors walked along the access road alignment from the proposed rail infrastructure area to Goathorn Creek and marked the location of each trail within 20 m of the road centreline.
- ▶ Each trail was walked for approximately 50 m either side of the proposed road centreline to obtain data. Physical characteristics including slope (measured by clinometer in percent), direction (measured with compass in degrees), and distance (measured with a field tape in meters) was recorded at each change within the 50 m transect.
- ▶ Wildlife sign and use of the trails including was recorded using the WHA Evidence of Use form (BC MOFR & BC MOE 2010) with a rating of the level of trail use given based on the following criteria:
 - o High (H) was used for a trail that was well worn and little to no vegetation was growing on it due to a relatively high amount of wildlife use over time;
 - o Moderate (M) was used for trails that were worn, but had vegetation covering parts of the trail. Moderate use was assumed to show consistent seasonal use over time; and
 - o Low (L) was used for trails not worn but still had evidence of use.

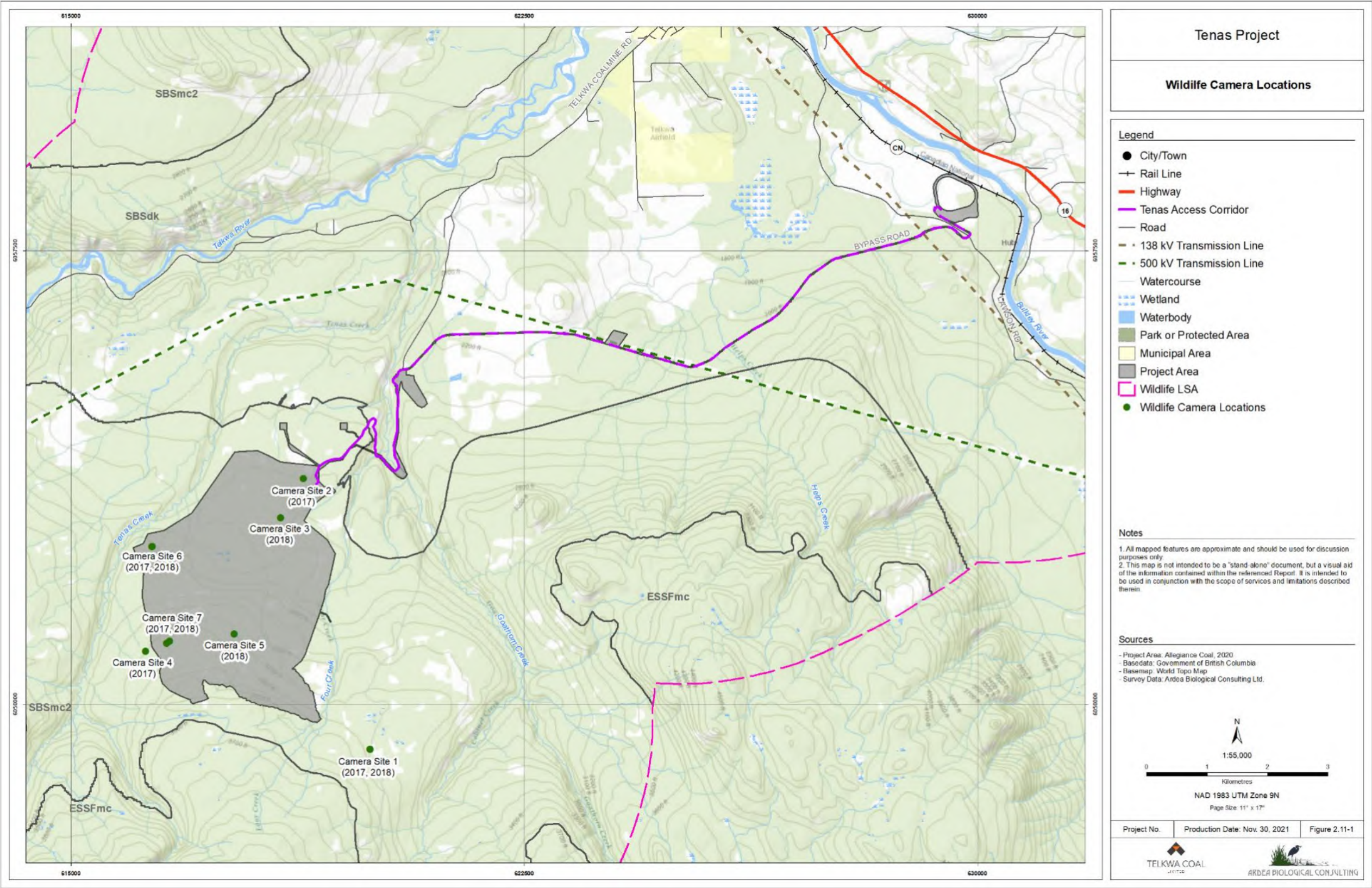


Figure 2.11-1: Locations of wildlife cameras within the W-LSA in 2017 and 2018.

Table 2.11-1: Summary of wildlife camera habitat, deployment dates and images obtained in 2017 and 2018 within the W-LSA.

Site Name	Habitat Description	Dates Deployed in 2017	Number of Days Operating in 2017	Number of Images Obtained in 2017	Number of Wildlife Images Obtained in 2017	Dates Deployed in 2018	Number of Days Operating in 2018	Number of Images Obtained in 2018	Number of Wildlife Images Obtained in 2018	Total Number of Images Obtained	Total Number of Wildlife Images Obtained
Camera Site 1	Beside road between old (~165-year-old) Sx/BI and 30-year-old PI/Sx harvested area.	Aug. 17 to Dec. 31	123	8,013 ¹	18	Jan. 1 to Jul. 7	116	21,349 ¹	75	29,362 ¹	93
Camera Site 2	Beside road near 35-year-old At/Sx harvested area, 15-year-old BI/PI harvested area and small unharvested old (~165-year-old) Sx/BI forest.	Aug. 17 to Sep. 26	0 ²	0	0	Not Deployed				0	0
Camera Site 3	Beside road near 45-year-old PI/At harvested area and 15-year-old BI/PI harvested area.	Not Deployed				May 18 to Sep. 12	117	756	390	756	390
Camera Site 4	Along wildlife trail at edge of old (~190-year-old) BI/Sx forest and 15-year-old BI/PI harvested area.	Jul. 10 to Jul. 17	17	44	42	Not Deployed				44	42
Camera Site 5	Along old exploration trail between old (~225-year-old) Sx/BI forest and old (~155-year-old) BI/Sx forest.	Not Deployed				May 18 to Jun. 28	41	246	162	246	162
Camera Site 6	Beside road in 45-year-old PI/At harvested area.	Apr. 11 to Sep. 26	149	567	382	May 18 to Sep. 12	118	159	129	726	511
Camera Site 7	Beside road between old (~175-year-old) BI/Sx forest and 15-year-old BI/PI harvested area.	May 28 to Sep. 26	122	731	695	May 18 to Sep. 12	118	278	261	1,009	956
Totals			411	9,355	1,137		510	22,788	1,017	32,143	2,154

Note: 1) Majority (94%) of photos were related to tree branch movements which caused almost continuous triggering of photos

2) Camera malfunction resulted in no photos obtained

Wildlife Habitat Assessments (WHA)

WHA forms (BC MOFR & BC MOE 2010) were completed at most plots associated with the TEM program (Ardea 2021a) when ecosystem information was gathered, as well as during the dedicated wildlife species surveys (e.g. bat roost assessments), and during other ground-based baseline surveys (e.g. wetland function, breeding bird counts, waterfowl surveys, etc.).

Habitat suitability ratings were completed at many sites/plots for the following species; western toad, marten, mule deer, fisher, forest bats, grizzly bear, moose and caribou (Figure 2.11-2). Evidence of use (e.g. sign or observed/heard species) information was collected at almost all sites for wildlife species of interest for the baseline program. Data collection methods and coding for the WHAs followed BC MOFR & BC MOE (2010).

WHA habitat suitability ratings were used to help test and refine the habitat suitability models for the species of interest (see Appendix B2: Western Toad; C1: Forest Bats; D: Marten; E: Grizzly Bear; and G: Moose), while the habitat use data provided information on species distributions and their habitat use in the Project area.

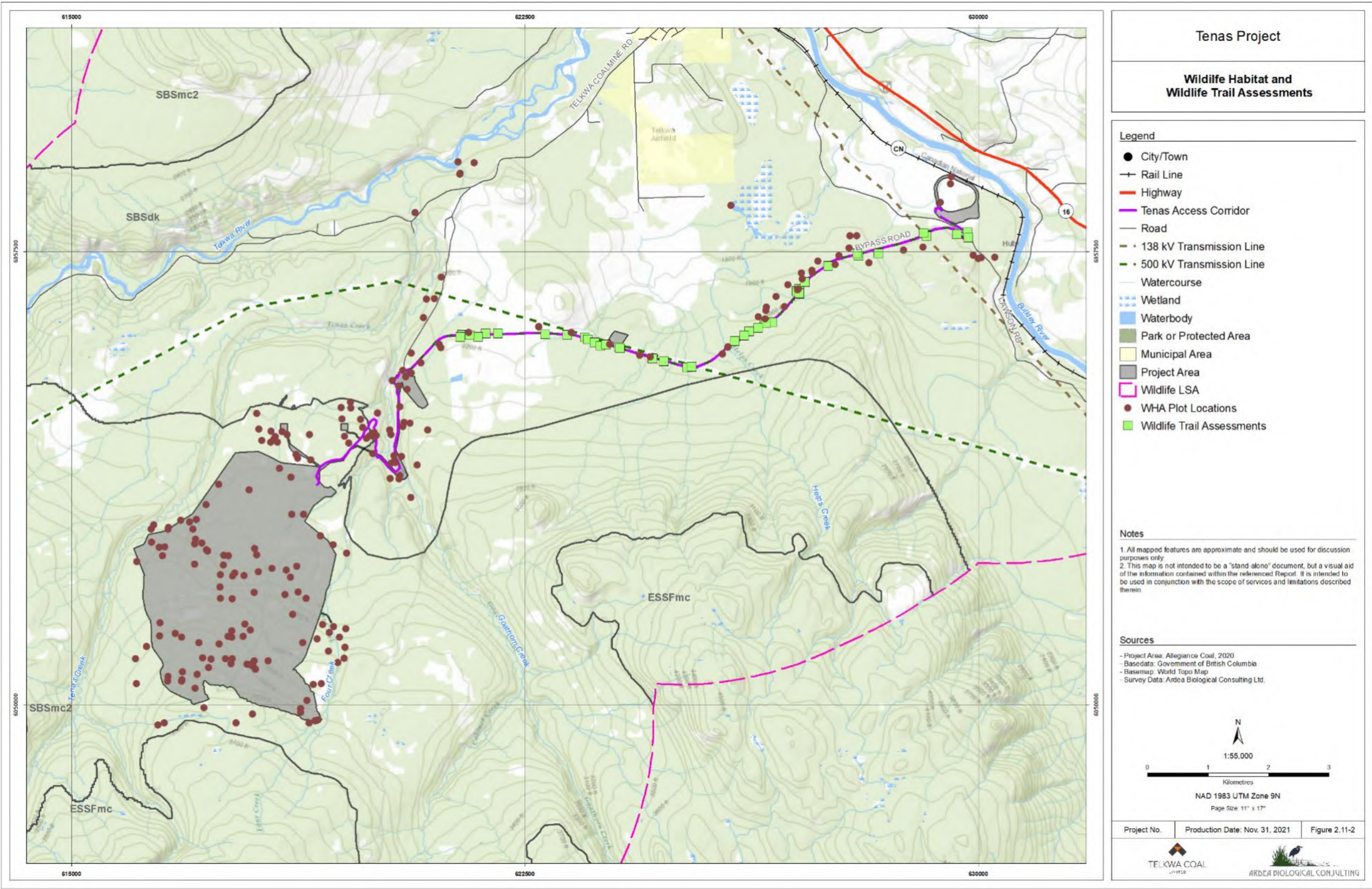


Figure 2.11-2: Locations of wildlife habitat and wildlife trail assessment plots within the W-LSA from 2017 to 2019.

3. RESULTS

3.1 Existing Information Review

3.1.1 Regulatory and Policy Context

When developing the baseline wildlife program, we considered applicable federal and provincial legislation, regulations, strategies, guidelines, plans, and best management practices (BMPs) relevant to the Wildlife VC, we also included available information provided by Indigenous groups. Applicable information from provincial land use plans and designations were also considered.

Federal and provincial legislation and regulations applicable to the Project and relevant to the wildlife are described in Table 3.1-1

Table 3.1-1: Applicable legislation and regulations related to wildlife.

Name	Year	Description
Canadian Environmental Protection Act	1999	The <i>Canadian Environmental Protection Act</i> focuses on protecting environmental and human health by preventing, controlling, and managing pollutants, wastes, and other toxic substances and contributing to sustainable development (ECCC 2019).
Species at Risk Act (SARA)	2002; amended 2019	SARA protects species listed on Schedule 1 as Extirpated, Endangered and Threatened, and affords species listed as Special Concern the benefits of management planning. Species included in Schedule 1 are established by the federal Cabinet and are based on recommendations by COSEWIC and consultation with government, Indigenous groups, and the public. SARA focuses on establishing and implementing plans to protect listed species and their critical habitat, reduce threats, and foster recovery.
BC Environmental Assessment Act	2002	The <i>Environmental Assessment Act</i> provides a mechanism for the Province of BC to review all major projects proposed in the province to assess for any potentially adverse environmental, economic, social, heritage, or health effects (Government of BC 2002). This Project requires an assessment of potential adverse environmental effects under the Reviewable Projects Regulations of the Act as the Project exceeds the production capacity of 75 thousand tonnes per year.
BC Forest and Range Practices Act	2002	The <i>Forest and Range Practices Act</i> outlines standards and requirements for how forest and range practices and natural resource activities should be conducted on Crown land in BC in a manner that safeguards protection of natural resources, including vegetation (Government of BC 2020). The Invasive Plants Regulation is a provision to section 47 the <i>Forest and Range Practices Act</i> , preventing the introduction or spread of invasive plants. This regulation specifies vegetation species recognized as invasive plants in BC. The <i>Forest and Range Practices Act</i> regulates forest clearing and applies protection to old growth forests and riparian areas. It also manages ecosystems as wildlife habitat through the Identified Wildlife Management Strategy.

Name	Year	Description
BC Mines Act	1996	The <i>Mines Act</i> describes how mines in BC are to be operated, including administration, permitting, acquisition, delegation of power, inspection, health and safety, penalties, abandonment, and enforcement. The BC Ministry of Energy and Mines requires completion of a vegetation assessment and development of an environmental management and reclamation plan to support the mitigation, decommissioning and closure of a Project.
BC Wildlife Act	1996 (updated 2019)	The <i>Wildlife Act</i> provides for regulations related to hunting and conservation of wildlife species and specific ecosystems and ecosystem components that provide habitat for wildlife species managed by the Ministry of Environment.

Strategies, Guidelines and Best Management Practices

Other strategies, guidelines, plans, and best management practices are also applicable to wildlife species (Table 3.1-2). These documents were considered when identifying how the species may interact with the Project, and will be used to develop appropriate mitigation measures, and characterize residual and cumulative effects during the Environmental Assessment.

Table 3.1-2: Summary of strategies, guidelines and best management practices applicable to wildlife.

Name	Year	Description
A Compendium of Wildlife Guidelines for Industrial Development Projects in the North Area, BC - Interim Guidance	2014	These guidelines provide direction for considering and mitigating threats to wildlife and wildlife habitat in the North Area (i.e., Peace, Omineca, and Skeena regions) during industrial activities (BC FLNRO 2014).
BC Conservation Framework: Conservation Priorities for Species and Ecosystems	2009	A science-based framework designed to prioritize species and ecosystems for conservation, select effective conservation actions, and co-ordinate management actions. Results can be used to advise conservation programs for a variety of stakeholders and organizations (Government of BC 2009).
Best Management Practices for Bats in British Columbia, Chapter 2: Mine Developments and Inactive Mine Habitats	2016	Outlines direction for assessment of bats during mine development and closure as well as providing potential mitigation and monitoring measures (Holroyd and Craig 2016)
Canadian Biodiversity Strategy	1995	The three objectives of the Canadian Biodiversity Strategy are the conservation of biodiversity, the sustainable use of biological resources, and the fair and equitable sharing of the benefits that result from the use of genetic resources (Government of Canada 1995).
Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia	2014	Provides guidelines for development from community planning to site level for a wide range of species and habitats within BC, including region specific direction (BC MFLNRO 2014b)
Environmental Assessment Best Practice Guide for Wildlife at Risk in Canada	2004	This best practice guide for considering plant and wildlife species at risk in environmental assessment provides best practice guidelines, key sources of information, policy commitments and laws and a discussion of the implications of the federal <i>Species at Risk Act</i> (ECCC 2004).
Guidelines for Amphibian and Reptile Conservation during Road Building and Maintenance Activities in British Columbia	2020	Provides guidance for mitigation the effects of roads on amphibians and reptiles (BC MECCS 2020).

Name	Year	Description
Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia	2014	Provides guidance for mitigation the effects of urban and rural land development on amphibians and reptiles (BC MFLNRO 2014)
Handbook for Mineral and Coal Exploration in BC	2008	This handbook compiles existing knowledge and recommended management practices for coal exploration and mining, including practices for water management and reclamation (AMEBC et al. 2008)
Identified Wildlife Management Strategy – Accounts and Measures for Managing Identified Wildlife: Northern Interior Forest Region	2006	The Accounts and Measures for Managing Identified Wildlife summarize the status, life history, distribution, and habitat requirements of identified species and plant communities; they also outline specific guidelines for habitat conservation and management (BC MWLAP 2004a).
Identified Wildlife Management Strategy – Procedures for Managing Identified Wildlife	2004	The Procedures for Managing Identified Wildlife describe the procedures for establishing, modifying, and rescinding a Wildlife Habitat Area (WHA), and for implementing strategic and landscape level planning recommendations (BC MWLAP 2004a).
Policy for Mitigating Impacts on Environmental Values	2014	The purpose of this policy is to improve the quality, transparency, and consistency of information to support provincial staff, decision makers, and proponents when there is an identified need for environmental mitigation under existing legislation. The policy applies to the identification of VCs, the assessment of potential effects, the development of mitigation measures, and the preparation of mitigation plans (BC MOE 2014).

Land and Resource Management Plans

The Project area and the W-LSA are located within the *Bulkley Land and Resource Management Plan* (Bulkley LRMP) (BVCRB and IRT 1998), with the various RSAs overlapping the Bulkley LRMP and the *Morice Land and Resource Management Plan* (Morice LRMP) (BC MAL 2007). The Bulkley and Morice LRMPs were developed to direct management of public land and resources within the planning regions by providing specific directions developed through local input. More detailed landscape unit plans have also been developed for landscape units that overlap the W-LSA; with land use planning objectives within the Telkwa Landscape Unit and the Bulkley Valley Landscape Unit governed by the *Telkwa Land Use Plan* (Telkwa LUP) (BCFD 1999) and the *Bulkley Valley Sustainable Resource Management Plan* (Bulkley SRMP) (BC MAL 2005), respectively. These plans provide management objectives and strategies for various wildlife species and their habitats. These objectives and strategies are summarized for species of interest within the appropriate section of this baseline report.

Previous Environmental Assessment Reports

Several environmental assessment reports that covered the Telkwa Coal project area and the Davidson project, a proposed molybdenum mine northwest of the project area, provided historic information related to wildlife species and habitat use (Table 3.1-3). Information from the studies that helped inform the baseline information for specific species was reviewed and summarized under those species in the appropriate section.

Table 3.1-3: List of environmental assessment reports reviewed for wildlife baseline information.

Report	Study Area	Content	Species covered
<i>Telkwa Project Vegetation, Forestry, Wildlife, EA Component</i> (TAESCO 1985)	Overlaps portions of the Tenas W-LSA	Snow tracking surveys	Marten, weasel, coyote, red fox, mink, fisher, lynx, wolf, river otter, red squirrel and snowshoe hare found during snow tracking. Marten and weasel most common tracks observed during surveys.
		Browse and pellet transects for ungulates conducted.	Moose, mule deer, white-tailed deer and elk use was observed. Moose more common in transects than deer species.
		Aerial surveys	Winter aerial surveys conducted in 1983 and 1984 for ungulates (moose, deer & elk).
		Incidental wildlife observations	Grizzly and black bear noted during surveys but no denning sites found.
<i>Wildlife North of the Telkwa River, A Stage II Assessment for the Proposed Telkwa Project</i> (Hatler 1990)	Portion of Tenas W-LSA north of Telkwa River	Aerial surveys and ground transects	Aerial surveys for ungulates conducted in February and March 1990, with primarily moose and small numbers of mule deer observed. Ground transects were conducted May 1990 to record sign and habitats. Moose, mule deer, snowshoe hare, red squirrel and small mammals were the major species observed. Limited black bear, grizzly bear, coyote, wolf and mustelid sign was observed.
<i>Moose Habitat Capability/ Suitability Mapping - Telkwa Coal Project</i> (Edie 1998a)	Overlaps portions of the Tenas W-LSA	Habitat Capability/ Suitability Mapping	Moose capability and suitability ratings from another study (Keystone 1997) used the Oikos TEM (Oikos 1999) to create moose habitat suitability and capability maps. No field sampling to verify the ratings was completed.
<i>Wildlife Assessment - Telkwa Coal Project</i> (Edie 1998b)		Review and effects assessment of various wildlife species.	Response to questions regarding pikas, wildlife and vehicle collisions, caribou, grizzly bear and listed species. Limited field work to look for pikas and lichen producing areas for caribou. Desktop review related to risks for vehicle mortalities and effects on listed species. A conceptual plan for moose habitat compensation and mitigation was developed for the proposed project to manage potential impacts to moose habitats and restore those areas affected.
<i>Wildlife Habitat Suitability Assessment and Vegetation Trace Metals Analysis for the Proposed Davidson Project</i> (Turney et al. 2006) <i>Davidson Project: Application for Environmental Assessment Certificate</i> (Rescan 2008a)	North of W-LSA on Hudson Bay Mtn.	Baseline and effects assessment of various wildlife species	Wildlife baseline information was collected for a variety of species, with habitat suitability mapping completed for moose, grizzly bear, black bear and marten. Effects assessments were completed for moose, black bear, marten, snowshoe hare, bats and Western toad.

3.1.2 Indigenous Knowledge

The Cultural Use Study (CUS) compiled a baseline inventory of cultural heritage resources pertaining to Wet'suwet'en communities by examining pre-existing cultural, social, historic, and economic data (Budhwa et al. 2020). The CUS and other relevant sources of Traditional Knowledge (TK) (Warner 1983, Rescan 2008, Ardea 2014) were reviewed for information relating to wildlife species. The review found limited information specific to wildlife. However, more broadly, recognition of the value of the natural environment, which extends to wildlife, is intrinsic throughout the available TK:

"The Wet'suwet'en continue to maintain a substantial connection to their hereditary lands by way of Yintah. For the Wet'suwet'en, Yintah is a central factor in their culture; it is the physical and spiritual connection that everything has to their territories (Morris et al. 2006:27; OW 2013a:14) ... [Yintah is] a concept in which all environmental components—from plants and animals to waterways and mountains—are all interconnected and linked with the human world (OW 2011:111)" (Budhwa et al. 2020).

Available information specific to wildlife is primarily related to harvest species and the importance of hunting and trapping and the feast system in Wet'suwet'en culture:

"The Wet'suwet'en maintain a special relationship with the wildlife that inhabit their territories. This relationship manifests in the traditional activities of hunting and trapping, as well as in the prominent use of wildlife in the feast system ... Respect for animals and territories is among the traditional values and methods of hunting that are integrated into oral histories and are part of the transmission of knowledge between elders and children (Jeness 1943:522)" (Budhwa et al. 2020).

"... the feast system is of paramount importance to Wet'suwet'en life-ways. Central to this system is the sharing of territorial foods at feasts, such as moose, bear, deer, and beaver. In addition, animal hides and hide goods from mink, marten, beaver, bear, moose, and other fur-bearing animals were distributed in the feast hall. For the Wet'suwet'en, the ability to gather these goods from house territories is vital to the continued authority of House Chiefs. As a result, the sharing of territorial foods and prestigious hides during feasts is just as important today as it was in the past ... (OW 2011:104)" (Budhwa et al. 2020).

"Hunting and trapping were—and continue to be—significant economic and subsistence activities in Wet'suwet'en culture ... The Wet'suwet'en can currently hunt and trap year-round, though most hunting and trapping takes place between April and December. In addition to supplying an important source of food and cultural goods, trapping of fur-bearing animals remains an economically viable activity (CSTC 2006:71)" (Budhwa et al. 2020).

Central to Wet'suwet'en values and methods of hunting are conservation measures that work to assure continued hunting and trapping success within their territories:

"Wet'suwet'en values and methods of hunting were traditionally integrated into their oral histories and were part of the transmission of knowledge between elders and children. Central to these teachings was the assurance of future success in hunting (Jeness 1943:541). The traditional management systems still in use today include conservatory measure, such as rotating hunting and trapping areas based on seasonality and population health of animals" (Budhwa et al. 2020).

The Wet'suwet'en use large and small game animals for food (e.g., meat, fat, and organs), cultural goods (e.g., furs, hides, and goods made from furs and hides), and food preservation (e.g., bear grease was commonly used to preserve huckleberries and blueberries) (Warner 1983, Rescan 2008, Ardea 2014, Budhwa et al. 2020). Large game animals harvested by the Wet'suwet'en for subsistence include, but are not limited to, black bears, caribou, coyotes, grizzly bears, moose, mountain goats, mule deer, and wolves, (Warner 1983, Rescan 2008, Ardea 2014, Budhwa et al. 2020). Smaller game animals harvested by the

Wet'suwet'en for subsistence include, but are not limited to, beavers, grouse (ruffed, spruce, and dusky/sooty), hoary marmots/groundhogs, lynx, marmots, martens, minks, muskrats, porcupines, snowshoe hares, squirrels, and weasels (Warner 1983, Rescan 2008, Ardea 2014, Budhwa et al. 2020). According to a country foods baseline assessment completed for the Davidson Project, the most frequently harvested and consumed wildlife species (i.e., mammals and birds) by the Wet'suwet'en for nutritional purposes are moose, snowshoe hare, and grouse (Rescan 2008).

The W-RSA includes several hunting areas important to the Wet'suwet'en, such as the Telkwa Pass. Caribou were historically an important source of food and cultural goods for the Wet'suwet'en (Budhwa et al. 2020). They once occurred throughout the Bulkley Valley in relatively large numbers and were known to gather in abundance in the Telkwa Pass:

“Wet'suwet'en elders describe herds of up to 150 caribou moving, wintering, and calving throughout the region (e.g., near present-day Smithers, Telkwa, and Witset). The Telkwa Pass in particular was known for its abundance of caribou (Morris et al. 2006)” (Budhwa et al. 2020).

The caribou population in the Bulkley Valley has experienced a significant decline in recent decades and the Telkwa herd is currently considered at risk (Budhwa et al. 2020). Grouse were also hunted in the Telkwa Pass (Budhwa et al. 2020).

3.2 Terrestrial Invertebrates

3.2.1 Existing Information on Invertebrates

Conservation Context

Terrestrial invertebrates are important key components of natural ecosystems and increasing numbers of invertebrate species are under threat as their critical habitats are degraded due to numerous factors. Some species face an uncertain future due to direct effects such as habitat degradation and fragmentation, and pesticide use. More invertebrate species are being reviewed and granted conservation status in BC and Canada to reduce the possibility of species being extirpated or becoming extinct altogether (Heron 2004, Venter et al. 2006).

A query using the BC CDC Species Explorer website (BC CDC 2014a) to search for any listed terrestrial invertebrate species likely to be found within the Skeena-Stikine Forest District, which contains the W-LSA was completed. The SARA Public Registry and associated documents (COSEWIC 2016a; SARPR 2017, 2018a) were also reviewed to determine if any additional federally-listed species could potentially occur in the W-LSA.

The results of this search were reviewed to refine the based on the potential habitat types that would be found within the W-LSA. Species accounts in Guppy and Shepard (2001) were reviewed to assist with final determinations of listed butterfly species potentially occurring in the W-LSA. Final determinations of listed bumble bee species were based on historical species' ranges (Williams *et al.* 2014), as well as collection and observation of the Western Bumble Bee and Yellow-Banded Bumble Bee in the Smithers-Hazelton area within similar habitats to those existing in the W-LSA (L. Westcott, unpublished data). Final determination of listed beetle species was based on historical distributions of those species, their habitat requirements, and known or anticipated availability of those habitat types within the W-LSA. Listed terrestrial gastropod species (snails and slugs) were searched for within the BC CDC Species Explorer and the SARA Public Registry, with a review of Forsyth (2004) and E-Fauna (Forsyth 2018), to determine if any listed gastropods were likely to be found within the habitats within the W-LSA. mollusc species were assessed to likely occur within habitat types currently existing in the W-LSA. Based on review of these sources, no red- or blue-listed land snails or slugs were expected to occur within habitat types existing within the W-LSA.

The final list of listed terrestrial invertebrate species likely to be found within the W-LSA is provided in Table 3.2-1. Listed terrestrial invertebrate habitat requirements, currently-known distributions for the listed species in northern BC, and the conservation status rationale is summarized in Appendix A: Table A-1.

Table 3.2-1: Conservation status of terrestrial invertebrates species that potentially occur in the W-LSA.

Species Name		Conservation Status ¹		
		Provincial	Federal	
Common	Scientific	BC CDC	COSEWIC	SARA Schedule 1
Nine-spotted lady beetle	<i>Coccinella novemnotata</i>	Not Listed	Endangered	Under review
Transverse lady beetle	<i>Coccinella transversoguttata</i>	Not Listed	Special Concern	Under review
Gypsy cuckoo bumble bee	<i>Bombus bohemicus</i>	Red	Endangered	Endangered
Western bumble bee, <i>mckayi</i> subspecies	<i>Bombus occidentalis mckayi</i>	Blue	Special Concern	Under review
Western bumble bee, <i>occidentalis</i> subspecies	<i>Bombus occidentalis occidentalis</i>	Blue	Threatened	Under review
Yellow-banded bumble bee	<i>Bombus terricola</i>	Blue	Special Concern	Special Concern
Western meadow fritillary, <i>sigridae</i> subspecies	<i>Boloria epithore sigridae</i>	Blue	Not Assessed	Not Assessed
Large marble, <i>ogilvia</i> subspecies	<i>Euchloe ausonides ogilvia</i>	Blue	Not Assessed	Not Assessed
Draco skipper	<i>Polites draco</i>	Blue	Not Assessed	Not Assessed
Kennedy's emerald dragonfly	<i>Somatochlora kennedyi</i>	Blue	Not Assessed	Not Assessed

Notes: 1) See Table 2.1-2 in Section 2.1.1 for status definitions.

No dedicated terrestrial invertebrate studies have not been undertaken for the previous coal production project assessments, and a literature search did not produce evidence of any other terrestrial invertebrate studies or sampling conducted within the boundaries of the W-LSA. Bumble bee records from sample sites near Smithers, BC and Telkwa, BC that may be geographically relevant to the Project area were reviewed for the purposes of this baseline study (L. Westcott, unpublished data).

Management Initiatives

Currently there are no federal or provincial recovery strategies or management plans available for the listed terrestrial invertebrates identified as potentially occurring or confirmed within the W-LSA. Very limited direction from existing strategies, guidelines or best management practices related to insects, except general recognition that insects are important components of the environment for some species (e.g. bats, birds), with riparian areas, coarse woody debris help maintain insect populations (BC MFLNRO 2014b). Management guidelines for terrestrial invertebrates were not included within the Bulkley LRMP (BVCRB and IRT 1998), the Telkwa LUP (BCFD 1999), or the Bulkley SRMP (BC MAL 2007) or in any of the previous environmental assessments completed near the Telkwa Coal project.

3.2.2 Assessment and Survey Results

Invertebrate Field Surveys

A total of 67 families of terrestrial invertebrates were collected or observed during baseline surveys conducted between July 24-27, 2017 and July 16-18 and 23-27, 2018. A complete summary of the

terrestrial invertebrates and their collection locations are provided in Appendix A (Table A-3 and Table A-4). No listed terrestrial invertebrate species were observed or collected during the July 2017 baseline surveys. In the 2018 surveys, two listed bumble bee species were collected, observed, or photographed at 10 survey sites within the W-LSA (Appendix A: Table A-4 and Figure 3.2-1). Thirteen yellow-banded bumble bee (*Bombus terricola*) specimens and two western bumble bee (*Bombus occidentalis*, subspecies *occidentalis*) specimens were collected during the July 2018 surveys. The *occidentalis* subspecies was identified by two independent taxonomists, L. Best and C. Sheffield, both well qualified to make the identifications. Plate 3.2-1 shows a yellow-banded bumble bee photographed at S16, where three specimens of that species were collected, while Plate 3.2-2 shows a western bumble bee photographed near Hazelton in 2014 as no photographs were obtained of western bumble bees in the W-LSA.



Plate 3.2-1: Yellow-banded bumble bee (*Bombus terricola*) photographed at S16. July 23, 2018.

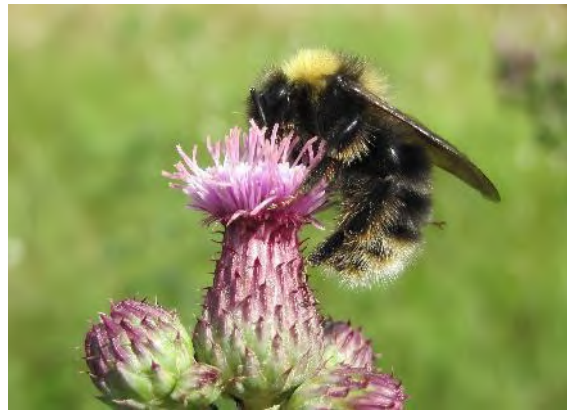


Plate 3.2-2: Western bumble bee (*Bombus occidentalis*), photographed near Hazelton, BC. July 2014.

Six of the yellow-banded bumble bee specimens were collected from wetland sites (S12, S15, S16, S23); the remaining seven yellow-banded bumble bee specimens and the two western bumble bee specimens were collected from sites located in roadside vegetation (S9, S14, S17, S19, S25) or recent cutblocks (S22) (Figure 3.2-1). Of the thirteen yellow-banded bumble bee specimens, ten were collected from sites located along the proposed access corridor; two yellow-banded bumble bees and the two western bumble bee specimens were collected from sites within the proposed minesite area; while the remaining yellow-banded bumble bee was collected near the Telkwa River, within the Goathorn Creek area. The majority of all other invertebrate specimens were collected in the three types of passive traps (i.e., Malaise trap; blue vane trap; bowl trap) that were set up at the survey sample sites (Appendix A: Table A-3 and Table A-4).

Invertebrate Habitat Identification

The habitat requirements of the listed terrestrial invertebrates range from dry grassland types at low elevations to meadows and wetlands, to forest openings, forest edges, and roadside habitats, depending on the species. The ecosystem mapping available from the TEM provides sufficient detail to allow for the identification of the habitat requirements to varying degrees, depending on the species. It is likely that an assessment of potential ecosystems and habitats will over-estimate the potential habitat for some species and under-estimate it for others due to the relatively broad descriptions of the potential habitats. Notwithstanding this limitation, it is still possible to identify if the habitats are present and their location in relation to the W-LSA. The summary of ecosystems that match the habitat requirements of the listed terrestrial invertebrates is outlined in Table 3.2-2, with an estimate of the potential habitat area available within the W-LSA and the W-RSA.

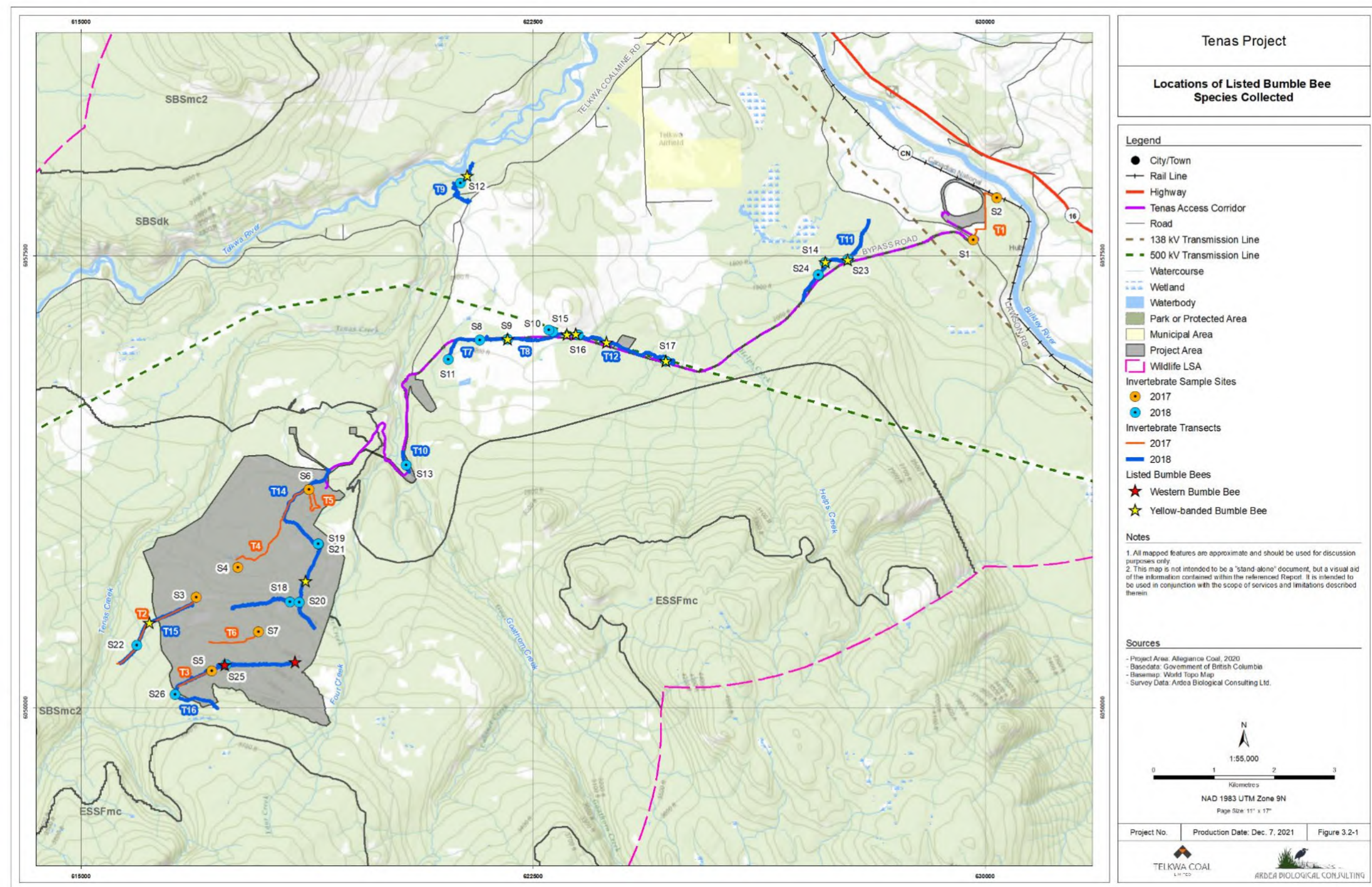


Table 3.2-2: Summary of potential habitats for listed terrestrial invertebrate species within the W-LSA.

Common Name	Habitat Requirements	Ecosystem Assumptions for Habitat Requirements	Ecosystems Within W-LSA / W-RSA with Habitat Requirements	Habitat Area (ha) and % of Total W-LSA	Habitat Area (ha) and % of Total W-RSA
<i>Beetles</i>					
Nine-spotted lady beetle	Broad-ranging habitat generalists from valley bottoms to alpine; found in coniferous forests, deciduous forests, grasslands, meadows, riparian areas wherever prey insects (e.g., aphids) prevalent	Most vegetated ecosystems potentially match habitat requirements. Likely higher probability within rich, wet ecosystems at lower elevations where plant densities are higher.	All ecosystems except open water, roads, railways and closed canopy coniferous forests (structural stage 4)	31,954 (89%)	170,935 (88%)
Transverse lady beetle	Broad-ranging habitat generalists from valley bottoms to alpine; found in coniferous forests, deciduous forests, grasslands, meadows, riparian areas wherever prey insects (e.g., aphids) prevalent	Most vegetated ecosystems potentially match habitat requirements. Likely higher probability within rich, wet ecosystems at lower elevations where plant densities are higher.	All ecosystems except open water, roads, railways and closed canopy coniferous forests (structural stage 4)	31,954 (89%)	170,935 (88%)
<i>Bees</i>					
Gypsy cuckoo bumble bee	Broad-range in a diversity of habitats including boreal forest, open meadows, and montane meadows; elevations from valley bottoms to alpine grasslands; foraging habitats with abundant sun exposure and forage plants blooming throughout growing season; favoured foraging and nesting sites are open meadows, flowering grasslands, and flowering plants on forest floor; forage within 1 to 1.5 km radius of nests, which are typically found in vacant rodent burrows, grass tussocks, or tree cavities	Most vegetated ecosystems potentially match habitat requirements. Likely higher probability within rich, wet ecosystems at lower elevations where flowering plant densities are higher.	All ecosystems except open water, roads, railways and closed canopy coniferous forests (structural stage 4)	31,315 (88%)	162,576 (84%)
Western bumble bee, <i>mckayi</i> and <i>occidentalis</i> subspecies	Broad-range of habitat types including open coniferous, deciduous, and mixed-wood forests; wet and dry meadows; meadows bordering riparian zones; montane meadows; subalpine habitats; along roadsides adjacent to wooded areas; and in isolated natural areas; found in habitat with abundant forage plants blooming throughout growing season; forage within 1 to 1.5 km radius of nests that are typically built in vacant rodent burrows, grass tussocks, or cavities in decaying wood.	Most vegetated ecosystems potentially match habitat requirements. Likely higher probability within rich, wet ecosystems at lower elevations where flowering plant densities are higher.	All ecosystems except open water, roads, railways and closed canopy coniferous forests (structural stage 4)	31,315 (88%)	162,576 (84%)
Yellow-banded bumble bee	Broad range of habitats, including mixed woodlands, farmlands, urban areas, montane meadows, prairie grasslands and boreal habitats; recorded foraging from a variety of plants; favoured habitats within or adjacent to wooded areas and wetlands.	Most vegetated habitats, deciduous forests and wetland ecosystems potentially match habitat requirements. Likely higher probability within rich, wet ecosystems at lower elevations where flowering plant densities are higher.	All ecosystems except open water, roads, railways and closed canopy coniferous forests (structural stage 4)	26,792 (75%)	118,437 (61%)

Common Name	Habitat Requirements	Ecosystem Assumptions for Habitat Requirements	Ecosystems Within W-LSA / W-RSA with Habitat Requirements	Habitat Area (ha) and % of Total W-LSA	Habitat Area (ha) and % of Total W-RSA
<i>Butterflies</i>					
Western meadow fritillary, <i>sigridae</i> subspecies	Coniferous and deciduous forests; mixed forests; grasslands/shrub/meadow habitats.	Most forested ecosystems potentially match habitat requirements along with open sites associated with farming and ranching. Likely higher probability within rich, wet ecosystems at lower elevations where flowering plant densities are higher.	Most non-alpine/subalpine ecosystems except open water, roads, railways, wetland or shrubland habitats and closed canopy coniferous forests (structural stage 4)	25,574 (72%)	101,436 (52%)
Large marble butterfly, <i>ogilvia</i> subspecies	Range of habitats including coniferous forest; grassland/shrub/meadow, from low to alpine elevations; <i>Arabis</i> (Family Brassicaceae) is the known host plant in BC.	Most forested and wetland ecosystems potentially match habitat requirements. Likely higher probability within rich, wet ecosystems at lower elevations where flowering plant densities are higher.	Most non-deciduous forests except open water, roads, railways, wetland or shrubland habitats and closed canopy coniferous forests (structural stage 4)	30,594 (80%)	161,415 (83%)
Draco skipper	Dry pine forests with abundant grasses; moist alpine meadows and valley bottoms; and dry mountain meadows and grassy hillsides; food plant(s) unknown.	Dry pine forests and dry grassland ecosystems, also moist meadows and grasslands from low elevation to alpine.	Mesic and dry pine forests, meadows, grasslands and open habitats from low elevation to alpine.	6,316 (18%)	38,668 (20%)
<i>Dragonflies and Damselflies</i>					
Kennedy's emerald	Sedge fens and marshes; females lay eggs in shallow, open pools with bottoms covered by aquatic mosses.	Fen, marsh and open water ecosystems at lower elevations.	Sedge marshes, swamps and fens, ponds, and shallow open water areas below the sub-alpine.	962 (3%)	3,212 (2%)

The lady beetle, bumble bee and several of the butterfly species have the potential to use a wide variety of ecosystems to obtain the required food and breeding requirements within the W-LSA and W-RSA. These species are able to use much of the W-LSA (72% to 89%) and W-RSA (52% to 88%), while other species such as the draco skipper butterfly and Kennedy's emerald dragonfly have more specialized habitat needs and can potentially use 3% to 18% of the W-LSA and 2% to 20% of the W-RSA (Table 3.2-2). Although there are large differences in the actual areas available, the proportions within the W-LSA and the W-RSA are similar, suggesting that the habitats have similar distributions and availabilities within the W-LSA and W-RSA.

3.3 Amphibians and Reptiles

3.3.1 Existing Information on Amphibians and Reptiles

Conservation Context

A query using the BC CDC *Species Explorer* website (BC CDC 2014a) to search for any listed amphibian or reptile species likely to be found within the Skeena-Stikine Forest District, which contains the W-RSA, was completed. As well, E-Fauna (Klinkenberg 2019) and Reptiles of BC (TRU & BC MOE 2019) websites were reviewed to identify species ranges. The resulting list of species and their conservation status in BC are provided in Table 3.2-1.

Table 3.3-1: Conservation status of amphibian and reptile species that potentially occur in the W-RSA.

Species Name		Conservation Status ¹		
		Provincial	Federal	
Common	Scientific	BC CDC	COSEWIC	SARA Schedule 1
<i>Amphibians</i>				
Coastal tailed frog	<i>Ascaphu truei</i>	Yellow	Special Concern	Special Concern
Columbia spotted frog	<i>Rana luteiventris</i>	Yellow	Not at Risk	Not Assessed
Long-toed salamander	<i>Ambystoma macrodactylum</i>	Yellow	Not at Risk	Not Assessed
Western toad	<i>Anaxyrus boreas</i>	Yellow	Special Concern	Special Concern
Wood frog	<i>Lithobates sylvatica</i>	Yellow	Not Assessed	Not Assessed
<i>Reptiles</i>				
Common garter snake	<i>Thamnophis sirtalis</i>	Yellow	Not Assessed	Not Assessed
Terrestrial garter snake	<i>Thamnophis elegans</i>	Yellow	Not Assessed	Not Assessed

Notes: 1) See Table 2.1-2 in Section 2.1.1 for status definitions.

Management Initiatives

Within BC, amphibians and reptiles are classified as wildlife under the *Wildlife Act* (Government of BC 1996) and are protected from hunting or harassment; as well as requiring permits for capture or salvage. The BC *Wildlife Act* and the Federal SARA provide protection for habitats of species that have been designated at risk, while the *Forest and Range Practices Act* (FRPA, Government of BC 2002) provides for the management of amphibians and reptiles that are classified as Identified Wildlife within the *Accounts and Measures for Managing Identified Wildlife: Northern Interior Forest Region* (BC WLAP 2004a) and through establishment of Wildlife Habitat Areas (WHAs) for species like tailed frog (BC WLAP 2004b). BC Ministry of Environment (MOE) and ECCC have developed management plans for Western toad (PWTWG 2014, ECCC 2016) and coastal tailed frog (BC MOE 2015, ECCC 2018).

The Bulkley LRMP (BVCRB and IRT 1998), Telkwa LUP (BCFD 1999) or the Bulkley SRMP (BC MAL 2005) do not provide any objectives or strategies related to amphibians or reptiles. The Bulkley LRMP and Bulkley SRMP do, however, provide for the protection of blue- or red-listed wildlife species, as well as providing a number of objectives and strategies for maintaining wetlands and wetland function that would potentially provide management for amphibian breeding habitats in general.

A number of best management practices (BMPs), guidelines and protocols for amphibian and reptile species have been developed to help to complete effective surveys/sampling (RIC 1998d, 1998e, 1998g and 1999b), reducing disease transfer during surveys/sampling (BC MOE 2008) and conducting effective salvage operations (BC MFLNRO 2016). There are also several guidelines related to industrial, rural and urban development that have been developed to reduce impacts to amphibian and reptile populations and their habitats including the *A Compendium of Wildlife Guidelines for Industrial Projects in the North Area, British Columbia* (BC MFLNRO 2014a) *Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia* (BC MFLNRO 2014b), *Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia* (BC MFLNRO 2014c) and *Guidelines for Amphibian and Reptile Conservation during Road Building and Maintenance Activities in British Columbia* (BC MECCS 2020).

Distribution and Abundance

Coastal Tailed Frog

Coastal tailed frogs are found throughout the coast mountains from the lower mainland to the Nass River on the North Coast within BC (Dupuis et al. 2000, COSEWIC 2011a). Records of coastal tailed frog on E-Fauna (Klinkenberg 2019) show the closest records occur in the Hazelton ranges near Terrace, BC. No coastal tailed frog observations have been located within the Telkwa River watershed or in the Bulkley River watershed (Klinkenberg 2019). Research sampling conducted within the upper Zymoetz (Copper) River and Pine Creek watersheds, on the west side of the Telkwa River, have observed Coastal tailed frog in the upper Zymoetz drainage (unpublished MFLNRO data 2015) approximately 7 km away from the Project area.

There are no population estimates for coastal tailed frog for B.C, though they are thought to be widespread; populations are remarkably discrete within streams. In 2000, it was estimated that coastal tailed frogs occurred in 46-54% of creeks surveyed on the southern and mid-coast of BC, but only in 15% of creeks surveyed in the north coast (Dupuis et al. 2000).

Western Toad

Western toads can be found throughout most of BC from the eastern slopes of the Rocky Mountains to the Pacific Ocean, from sea level to elevations greater than 3000 m, wherever they have a combination of breeding sites, suitable upland habitat, and overwintering areas (BC CDC 2016). They have not been found in the Teslin River basin in northwest BC or in the extreme northeast portion of BC (COSEWIC 2012). They are also absent in areas with extensive rural and urban development or where the habitats are relatively dry (e.g., south Okanagan) (BC CDC 2016). Within northern BC and the Yukon Cook (1977) suggested that permafrost-free valleys that receive early, high accumulations of snow that insulate the soil may be a factor in western toad distribution.

There are no population estimates for the province; however, populations have declined or become extirpated in parts of BC, notably in populated areas of Vancouver Island, the Gulf Islands, and the Lower Mainland (COSEWIC 2012).

Within the Bulkley Valley, locations of Western toad are not well documented although they are relatively common within the area (L. Rach, unpublished data). Two western toad observations are available in the provincial records for Telkwa and western toads have been observed in ecozones occurring within the W-LSA (Klinkenberg 2019).

Columbia Spotted Frog

The Columbia spotted frog is widespread within Canada, and in BC it is found throughout the province outside of the extreme northeast and southwest of the province (Green et al. 1997). They are rarely found far from water and are considered to be habitat generalists (Jones et al. 2005). Although their ability to adapt to different habitats makes them less affected by habitat change or loss, the Columbia spotted frog is a long-lived amphibian and takes a longer time to reach sexual maturity for reproduction and therefore can be more susceptible to population decline following disturbance.

Several observations of Columbia spotted frog were recorded in the Bulkley Valley, with an observation north of Smithers near Driftwood Creek in 1980 and a photograph from a bog in Smithers in 2010 (Klinkenberg 2019).

Long-toed Salamander

The long-toed salamander is a widespread species found throughout the BC from the Stikine and Taku Rivers in the northwest to the southern border (Corkran and Thoms 1996). They can be found in a wide range of elevations and habitats using a range of wetlands and ponds for breeding and upland forests, shrublands, riparian areas and agricultural lands (Graham and Powell 1999).

Within the W-LSA one historical record in 1981 was documented in the Town of Smithers although evidence of breeding has been observed in the area (Doyle and Turney 2018, L. Turney, unpublished data).

Wood frog

Wood frogs are small frogs with adults measuring up to 60 mm in length, and are found throughout BC in except the lower mainland and southern interior from 400 to 1800 m (BC MFLNRO 2014). They are found in a wide range of habitats such as marshes, wet meadows, moist woodlands and brush, and breed in shallow pond edges, seasonal pools, flooded meadows and slow-moving parts of streams (Jones et al. 2005).

There are no records of wood frog within the W-LSA available from the BC CDC iMap application (BC CDC 2020), although there are four incidental sighting records within the W-RSA. The records are all from prior to 1980 and were located: McDowell Lake (Jul. 16, 1974), southeast of Seymour Lake (Jul. 27, 1974), near Driftwood Canyon Provincial Park (Aug. 4, 1980), and along Highway 16, near Barret Hat Rd. (Aug. 5, 1980).

Common Garter Snake

Common garter snakes are the most common snake in Canada and found within the BC from the border with the US up to Prince Rupert to the west and Ft. St. John to the east and centrally almost to Ft. Nelson (TRU and BC MOE 2020). They are found near water and within riparian areas along streams, lakes, wet meadows and marshes where they feed on amphibians including fish, frogs, toads and salamanders (Fitch 1965).

The BC CDC iMap application (BC CDC 2020) shows an incidental sighting record for common garter snake northwest of the W-LSA obtained on Jul. 29, 2015. This species is locally common in the Smithers area, with several hibernacula known within south-facing rocky outcrops (L. Turney, unpublished data).

Terrestrial Garter Snake

In BC, terrestrial garter snakes are found throughout the southern portions, from low elevations to sub-alpine areas, using grasslands, shrublands, woodlands and open forests; and are commonly found closely associated with water (TRU and MOE 2020). They feed on a variety of species including slugs, fish, amphibians and small mammals, and will coil around their prey and bite, injecting a mild toxin to subdue their prey (Nussbaum et al. 1983).

No records of terrestrial garter snake are provided on either the E-Fauna (Klinkenberg 2019) or the CDC iMap (BC CDC 2020) applications within the W-RSA, but the BC Reptile website mapping (TRU and MOE 2020) indicates that they could be found within it.

Habitat Use and Movements

Amphibians require water for breeding and most species undertake seasonal movements from upland areas where they overwinter to permanent or seasonal watered areas such as stream backchannels, ponds and wetlands to breed. Once breeding has completed, they will move to riparian or upland areas to feed and return to their overwintering sites. Columbia spotted frogs are more closely tied to ponds and lakes, spending all seasons in or very close to water, with movements between breeding and overwintering ponds occurring. A summary of amphibian species habitat preferences and movement patterns is outlined in Table 3.3-2.

Both common and terrestrial garter snakes overwinter in hibernacula, leaving them in late April/early May with breeding occurring nearby as females leave the hibernacula. Dispersal occurs to hunting and breeding areas during the spring, with a return to the hibernacula in late September/early October (Table 3.3-2).

Table 3.3-2: Summary of habitat preferences and movement patterns for amphibians and reptiles potentially occurring within the W-LSA.

Species	Habitat Preferences ¹		Movement Patterns ¹	
	Terrestrial	Aquatic	Daily	Seasonal
Coastal Tailed Frog <i>Ascaphus truei</i>	Old-Mature moist forests	Cool, mobile non-ephemeral streams	Primarily nocturnal, may be active during the day during wet weather	Adults move from feeding/overwintering upland/riparian areas to lay eggs in streams, tadpoles leave streams 1 to 4 years after hatching.
Columbia Spotted Frog <i>Rana luteiventris</i>	Edges of ponds and lakes	Ponds and lakes in early spring; ~oligotrophic ponds and lakes for overwintering	Active near aquatic habitats during the day	Remain aquatic; may move over land in rainy periods to migrate to overwintering pond in fall
Long-toed Salamander <i>Ambystoma macrodactylum</i>	Moist forests with forest floor litter and woody debris	Warm sluggish aquatic habitats with ~vegetation	Primarily nocturnal, may be active during the day during wet weather	Migrate from overwintering upland sites to aquatic breeding habitats in early spring for a short period; disperse from breeding ponds summer to fall.
Western Toad <i>Anaxyrus boreas</i>	Moist forests with forest floor litter and woody debris	Small ponds and temporary or permanent pools	Primarily nocturnal, may be active during the day during wet weather	Migrate May to Jun. to water for breeding; adults move upland Jun to Sep.; juveniles disperse from ponds in Aug. to Sep; hibernation from Oct. to Apr.
Wood Frog <i>Lithobates sylvatica</i>	Moist forests, meadows and shrublands	Shallow clear ponds	Mainly Diurnal	Move to water for breeding Apr. to May for a few days
Common Garter Snake <i>Thamnophis sirtalis</i>	Warm aspect rocky habitats near wetlands and meadows	Wetlands and meadows that support prey species	Crepuscular or diurnal	Migrate from hibernacula in Apr./May to breeding and hunting grounds returning to hibernacula Sep. to Oct.

Species	Habitat Preferences ¹		Movement Patterns ¹	
	Terrestrial	Aquatic	Daily	Seasonal
Terrestrial Garter Snake <i>Thamnophis elegans</i>	Warm aspect rocky habitats near wetlands and meadows	Wetlands and meadows that support prey species	Crepuscular or diurnal	Migrate from hibernacula in Apr./May to breeding and hunting grounds returning to hibernacula Sep. to Oct.

Notes: ¹ from Jones et al. (2005) and Corkran and Thoms (2006)

3.3.2 Assessment and Survey Results

Amphibian and Reptile Field Surveys

Prior to conducting dedicated amphibian and reptile surveys, reconnaissance-level surveys were completed opportunistically within both assessment years while completing breeding bird work from June 8 to 12, 2017 and from June 4 to July 13, 2018 within the W-LSA. These searches were conducted at and between breeding bird point count plots with the goal of identifying suitable habitat and visually inspecting for amphibian use, noting the locations for future herptile surveys.

Using the information obtained during the reconnaissance-level surveys, more intensive surveys for amphibians and reptiles were conducted over three days from July 6 to 10, 2017 and over fourteen days from July 3 to September 28, 2018 within the W-LSA. A total of 70 amphibian and/or reptile surveys at 67 sites were completed (Figure 2.4-1), with Table 3.3-3 providing a summary of the habitat characteristics of the sites. A range of habitats were assessed including aquatic/wetland and upland habitats for amphibians and reptiles, while rocky outcroppings, talus and bedrock sites were searched primarily for reptiles. A total of 22 sites were surveyed in 2017 and 45 sites were assessed in 2018, with two locations assessed in 2017 being re-assessed in 2018. As well as the visual search methods used for amphibians, environmental DNA (eDNA) sampling was completed for amphibian at 42 (63%) of the survey sites; 13 in 2017 and 29 in 2018.

Incidental observations of amphibians and reptiles, along with potential breeding or overwintering habitats observed during other ecological field work conducted in the W-LSA in 2017, 2018 and 2019 were recorded and used to augment the survey data for this species group.

Table 3.3-3: Summary of amphibian and reptile survey methods and plot descriptions.

Location	Site ID	Survey Methods	Habitat Types	Water Nutrient Status*
Minesite	AR-01	Time Constrained/eDNA	Ditch-line ponding	Eutrophic
	AR-02	Time Constrained	Wetland - bog	Oligotrophic
	AR-03	Encounter/eDNA	Ditch-line ponding/Wetland bog	Oligotrophic
	AR-04	Time Constrained	Ditch-line ponding/Wetland bog	Oligotrophic
	AR-05	Encounter	Ditch-line ponding/Wetland bog	Oligotrophic
	AR-06	Time Constrained/eDNA	Ditch-line ponding/Wetland swamp	Eutrophic
	AR-07	Encounter	Ditch-line ponding/Wetland swamp	Eutrophic
	AR-08	Encounter	Ditch-line ponding/Wetland swamp	Eutrophic
	AR-09	Encounter	Ditch-line ponding	Eutrophic
	AR-10	Time Constrained/eDNA	Fluvial - Ephemeral stream	Oligotrophic
	AR-11	Time Constrained/eDNA	Fluvial - Ephemeral stream	Oligotrophic
	AR-12	Time Constrained	Ditch-line ponding	Eutrophic
	AR-13	Time Constrained	Fluvial - Ephemeral stream	Eutrophic

Location	Site ID	Survey Methods	Habitat Types	Water Nutrient Status*
Minesite	AR-14	Time Constrained	Fluvial - Ephemeral stream	Eutrophic
	AR-15	Time Constrained	Fluvial - Ephemeral stream	Eutrophic
	AR-16	Time Constrained/eDNA	Fluvial - Ephemeral stream	Eutrophic
	AR-17	Time Constrained	Fluvial - Ephemeral stream	Eutrophic
	AR-18	Time Constrained/eDNA	Ditch-line ponding	Eutrophic
	AR-19	Time Constrained/eDNA	Ditch-line ponding	Eutrophic
	AR-20	Time Constrained	Pond	Eutrophic
	AR-21	Time Constrained/eDNA	Ditch-line ponding	Eutrophic
	AR-25	Encounter/eDNA	River	Oligotrophic
	AR-26	Encounter/eDNA	River/Floodplain	Oligotrophic
	AR-27	Time Constrained/eDNA	Ditch-line ponding/Wetland swamp	Eutrophic
	AR-28	Time Constrained/eDNA	Wetland - swamp	Eutrophic
	AR-37	Time Constrained/eDNA	Fluvial - Ephemeral stream	Oligotrophic
	AR-38	Time Constrained/eDNA	Fluvial - Ephemeral stream	Eutrophic
	AR-39	Time Constrained/eDNA	Fluvial - Ephemeral stream	Oligotrophic
	AR-40	Time Constrained/eDNA	Ditch-line ponding	Eutrophic
	AR-41	Time Constrained/eDNA	Fluvial - Ephemeral stream	Oligotrophic
	AR-42	Time Constrained/eDNA	Fluvial - Ephemeral stream	Eutrophic
	AR-55	Time Constrained/eDNA	Pond	Eutrophic
	AR-56	Time Constrained/eDNA	Ditch-line ponding	Eutrophic
	AR-68	Encounter	Wetland - marsh/swamp	Eutrophic
	AR-69	Encounter	Wetland - bog	Eutrophic
	AR-70	Encounter	Pond	Eutrophic
Goathorn Creek	AR-24	Time Constrained/eDNA	Wetland - marsh/swamp	Oligotrophic
	AR-29	Encounter/eDNA	River	Oligotrophic
	AR-30	Time Constrained/eDNA	Floodplain	Eutrophic
	AR-31	Encounter	Riparian Floodplain	Oligotrophic
	AR-32	Time Constrained	Riparian Floodplain	Oligotrophic
	AR-33	Time Constrained/eDNA	Riparian Floodplain	Oligotrophic
	AR-48	Time Constrained/eDNA	Wetland - marsh	Eutrophic
	AR-51	Time Constrained/eDNA	Wetland - marsh/swamp	Oligotrophic
	AR-61	Time Constrained/	Rock Outcrop/Cliffs	N/A
	AR-62	Time Constrained/eDNA	Fluvial - River	Oligotrophic
	AR-65	Encounter	Rock Outcrop	N/A
Access Corridor	AR-34	Systematic/eDNA	Pond/Wetland - shallow water	Eutrophic
	AR-35	Encounter/eDNA	Pond/Wetland - bog/marsh	Eutrophic

Location	Site ID	Survey Methods	Habitat Types	Water Nutrient Status*
Access Corridor	AR-36	Time Constrained	Pond/Wetland - bog/marsh	Eutrophic
	AR-43	Encounter/eDNA	Fluvial - Ephemeral stream	Oligotrophic
	AR-44	Time Constrained	Wetland - marsh	Eutrophic
	AR-45	Time Constrained	Wetland - marsh	Eutrophic
	AR-46	Time Constrained	Pond	Eutrophic
	AR-49	Time Constrained	Pond	Eutrophic
	AR-50	Time Constrained	Rock Outcrop	N/A
	AR-52	Time Constrained	Fluvial - Ephemeral stream	Oligotrophic
	AR-53	Time Constrained	Fluvial - Ephemeral stream	Oligotrophic
	AR-54	Encounter	Fluvial - Ephemeral stream	Oligotrophic
	AR-57	Time Constrained/ Encounter	Wetland - marsh/swamp	Eutrophic
	AR-58	Time Constrained	Wetland - swamp	Eutrophic
	AR-59	Time Constrained	Wetland - swamp	Eutrophic
	AR-60	Time Constrained	Pond	Eutrophic
	AR-66	Encounter	Wetland - marsh	Eutrophic
Helps Creek Wetland	AR-63	Encounter/eDNA	Fluvial - Stream	Eutrophic
	AR-67	Encounter	Pond/Wetland - marsh	Eutrophic
Rail Infrastructure	AR-22	Time Constrained	Wetland - swamp	Eutrophic
W-LSA	AR-23	Time Constrained	Fluvial - Ephemeral stream	Oligotrophic
	AR-47	Time Constrained	Pond	Eutrophic
	AR-64	Encounter	Rock Outcrop	N/A

Notes: Oligotrophic water bodies contain a limited amount of available nutrients and minerals for uptake by living organisms; Eutrophic water bodies contain high to very high amounts of nutrients and minerals available for uptake by living organisms creating a productive habitat.

Amphibian and Reptile Habitats

A wide variety of habitats were surveyed within the W-LSA (Table 3.3-3), which were generalized to six general habitat associations as outlined in Figure 3.3-1. Streams (backchannels or riparian areas adjacent) were the most often surveyed habitat association (26%), followed by ditch-lines and associated ponding near wetlands (21%) and wetlands (20%).

The ditch-line ponding habitat association was only found within the minesite area and was associated with the historic logging that had occurred in that area. These sites ranged from 5 cm to 40 cm deep, with 4 of the 15 sites (27%) identified as amphibian breeding areas (Figure 3.3-2). Overall, 23 of 66 (35%) general habitat associations that contained water, were found to have evidence of amphibian breeding, with wetland and pond associated habitats making up 15 of the 23 (65%) water containing general habitat associations.

Four sites containing rock outcrop associated habitats were surveyed within the W-LSA, primarily for reptiles, but also in association to nearby stream or river/floodplain habitats where amphibians could be found (Table 3.3-3 and Figure 3.3-1). A site at the mouth of the Telkwa river is a known hibernacula and likely breeding site for common garter snake, while a pregnant common garter snake was observed at another site (Figure 3.3-6: Site AR-50) and is likely a breeding site and potential hibernacula as well. Appendix B3 provides additional habitat summary information.

Amphibian and Reptile Observations

A summary of the species observed during visual surveys and incidentally in 2017 and 2018 is provided in Table 3.3-4, with survey results provided in Appendix B3. Evidence of breeding was found for Columbia spotted frog, long-toed salamander and western toad based on observations of eggs, larval (tadpole) and metamorph stages within the W-LSA. Although no life stages were observed that confirmed breeding sites for wood frog, it was assumed that wood frog is also breeding in the W-LSA due to the observation of adults.

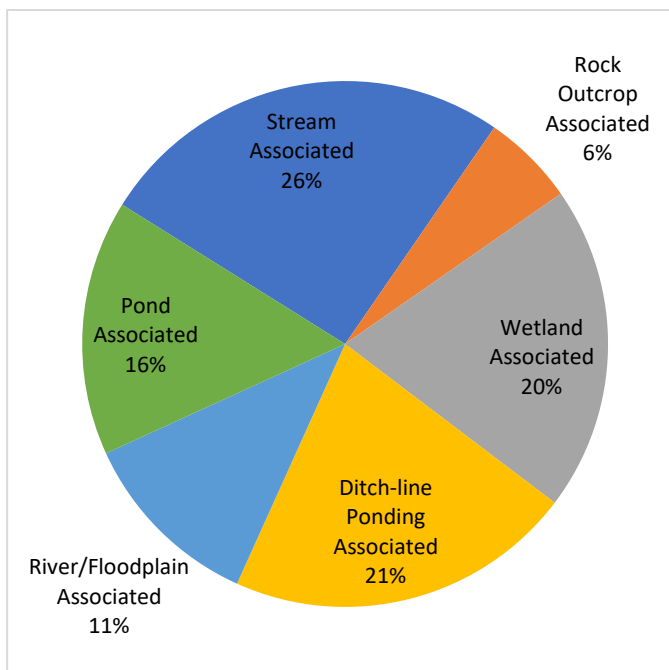


Figure 3.3-1: General amphibian and reptile habitat associations surveyed within the W-LSA.

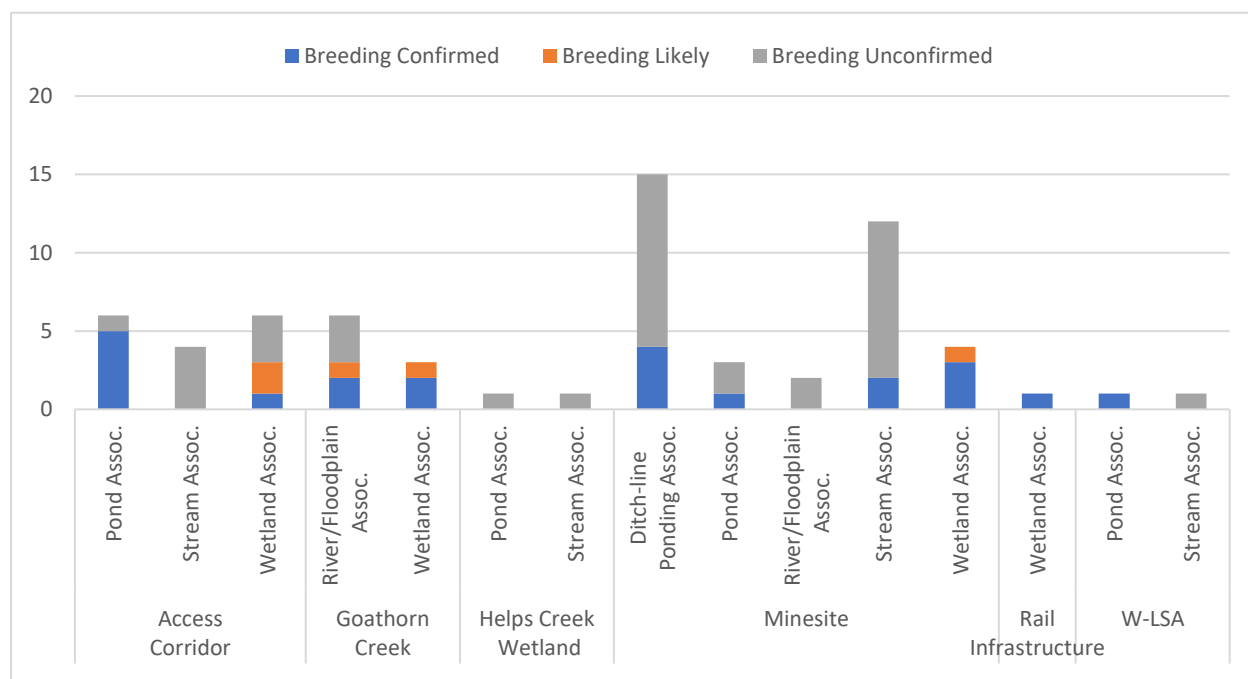


Figure 3.3-2: Distribution of general habitat associations with evidence of amphibian breeding within the W-LSA.

Table 3.3-4: Species identified in the W-LSA during visual surveys or incidental sightings.

Common Name	Scientific Name	Survey Year	Age Class ¹	Breeding in W-LSA
Columbia Spotted Frog	<i>Rana luteiventris</i>	2017 & 2018	E, L, J, A	Yes
Long-toed Salamander	<i>Ambystoma macrodactylum</i>	2017 & 2018	E, L, M	Yes
Western Toad	<i>Anaxyrus boreas</i>	2017 & 2018	E, L, M, J, A	Yes
Wood Frog	<i>Lithobates sylvatica</i>	2018	A, J	Likely
Common Garter Snake	<i>Thamnophis sirtalis</i>	2017 & 2018	A	Yes

Notes: 1) Age Class: E = egg/embryo; L = Larval; M = Metamorph; J = Juvenile (< 1 year); A = Adult (> 1 years)

During 2017 we obtained four samples that were tested for both coastal tailed frogs and western toads and nine samples that were tested for western toad only for a total of thirteen eDNA tests. In 2018 we collected a total of 29 samples, with 27 samples tested for western toad, 25 samples tested for Columbia spotted frog, 23 samples tested for wood frog and two samples tested for coastal tailed frog.

Comparing the species specific eDNA tests for sites where we had observed that same species, we found that the eDNA test provided a positive result 25% to 50% of the time. Where we had no observations of a species, the species specific eDNA test provided a positive result for 18% to 35% of the sites tested (Table 3.3-5). These findings correspond to others (e.g., Booker 2016), although sampling of amphibians in ponds using replicate samples from different parts of the same pond and repeat sampling over a season can provide much higher detection probabilities (Biggs et al. 2015).

Table 3.3-5: Results of eDNA sampling for selected amphibian species within the W-LSA.

Species Observed at Time of Sampling	Species Observed vs eDNA Species Test			No Species Observed vs eDNA Species Test		
	Positive	Negative	% Positive	Positive	Negative	% Positive
Coastal Tailed Frog ¹	-	-	-	0	6	0%
Columbia Spotted Frog	2	6	25%	3	14	18%
Western Toad	8	9	47%	8	15	35%
Wood Frog	1	1	50%	5	18	22%

Note: 1) No Coastal tailed frogs were observed within the W-LSA during the 2017 to 2018 surveys

The distribution of amphibian and reptiles observed during the surveys and eDNA results within the W-LSA are outlined in Figure 3.3-3 to Figure 3.3-6. A short summary of the breeding habitats and general distributions for each species within the W-LSA is outlined in the following paragraphs.

Coastal tailed frog was not identified during any of the time constrained, visual encounter or eDNA surveys, or observed incidentally within the W-LSA, despite intensive searches within typical habitats (e.g. cold, fast-running, steep streams) (COSEWIC 2011a) by personnel with extensive experience in coastal tailed frog search techniques and their ecology. Research conducted by Steventon (2009) and BC MFLNRO (2015 unpublished) identified that closest locations for this species was along the upper Zymoetz (Copper) River to approximately 7 km from the Telkwa River, but searches in 2015 by BC MFLNRO found no tailed frogs in streams that are tributaries to the Telkwa River. Based on the results of the field surveys and available literature, coastal tailed frog do not appear to occupy streams in the W-LSA.

Western toads were the most often observed amphibian within the W-LSA during the amphibian surveys. They were observed at 23 (35%) of the amphibian survey sites, with confirmed breeding observed in six sites; two within the minesite, and three along the access corridor (although two are overlapping in the

mapping) and one in the rail infrastructure area. Two likely breeding sites were identified in Goathorn Creek area and another two within the access corridor (Figure 3.3-3). Of the six confirmed breeding sites for western toad, three were pond associated sites, while ditch-line ponding, stream and wetland associated sites were confirmed breeding sites once each. Four sites were identified as likely breeding sites, based on observations of juvenile toads; included three wetland associated sites, one river/floodplain site. Western toad eDNA testing was relatively effective, with 47% of sample sites where western toad were observed having positive eDNA results, while eight additional locations where no observations of toads had occurred were positive (Table 3.3-5). The eDNA testing also identified that western toads were present upstream of the eDNA sample sites within Tenas and Helps creeks, providing evidence of their potential use of those watersheds.

Columbia spotted frogs were observed at 19 (29%) of the amphibian survey sites within the W-LSA, with confirmed breeding observed in seven sites and likely breeding identified at three sites (Figure 3.3-4). Three of the confirmed breeding sites were located within the minesite, two within the access corridor and one each in the rail infrastructure and Goathorn Creek areas. Two of the likely breeding sites were identified within Goathorn Creek and one in the minesite area. Confirmed breeding was identified at four wetland associated sites, two ditch-line ponding sites and one pond site; while likely breeding was identified at two wetland sites and one river/floodplain associated site. Although Columbia spotted frogs spend a significant amount of time in water (Jones et al. 2005), eDNA testing was positive in only 25% of the sites that had observations of spotted frogs (two of eight sites), with three additional sites identified from 17 tested sites (18%) where there were no observations of spotted frogs (Table 3.3-5). There was a positive eDNA sample at Helps Creek, below the Helps Creek wetland complex (Figure 3.3-4). This indicates that Columbia spotted frog is likely using the wetland complex and could potentially be breeding somewhere in the complex.

No adult long-toed salamanders were observed during the amphibian surveys, although evidence of breeding in the form of egg masses, larvae and metamorphs were observed at 16 (24%) of the amphibian survey sites (Figure 3.3-5). Breeding sites for long-toed salamanders were distributed across the W-LSA with five sites within the minesite and access corridor respectively, four sites in Goathorn Creek and one site each in the rail infrastructure and W-LSA. Pond associated habitats were the most common confirmed breeding site (7 or 44% of breeding sites), followed by wetlands (5 or 31% of breeding sites). Two sites were located in river/floodplain habitats and ditch-line pond and stream associated habitats had one site each. No primers or markers were available from UNBC at the time of the eDNA surveys to test for long-toed salamander, so no samples were taken to try to detect this species.

Wood frog were only observed three times within the W-LSA, with one site containing juveniles and two sites with adults found during the amphibian surveys (Figure 3.3-6). The site where the juvenile wood frogs were observed was identified as likely breeding sites located along the access corridor and the sites with the adults located within the access corridor and the minesite areas. All three sites were identified as wetland habitat associations. The eDNA sampling identified one of two sample locations where wood frogs were observed as positive for wood frog, with an additional five (22%) of 23 samples sites where no wood frogs were observed testing positive (Table 3.3-5). The positive eDNA result for Helps Creek (Figure 3.3-6), below the Helps Creek wetland complex suggests that wood frog is using the wetland complex and could potentially be breeding somewhere in the complex.

Adult common garter snakes were found at three of the four survey locations for reptiles within the W-LSA, with one site being a rocky outcrop that is a known hibernacula and likely breeding site at the confluence of the Telkwa and Bulkley rivers within the W-LSA where adult snakes were observed in August 2018. At two other rocky outcrop sites, surveyed in early July 2018, a pregnant adult female was found near the access corridor and this site was identified as a likely breeding site, while an adult was found along Goathorn Creek (Figure 3.3-6). There were no observations of terrestrial garter snakes within the W-LSA during the field work completed from 2017 to 2019.

Wildlife Trail Assessments and Incidental Observations

Western toads were observed at 31 incidental sighting locations, with 18 observed in the minesite, 10 along the access corridor, two in the Goathorn Creek area and one in the W-LSA. Two additional confirmed breeding sites were identified from the incidental observations, both along the access corridor (Figure 3.3-3). The site at the west end of the access route was also identified as a breeding site for Columbia spotted frog and wood frog (Figure 3.3-4 and Figure 3.3-6). Potential movement paths for Western toads were noted at two places near the access corridor in the W-LSA. The eastern site was found during the wildlife trail assessments in mid-July 2019, where toad tracks were observed along a well-defined wildlife trail that crossed the access corridor. A second observation of a potential movement route was found during invasive plant surveys in mid-September 2018, when several dozen toadlets were observed crossing an old road south of the proposed access corridor (Figure 3.3-3).

Incidental sightings of Columbia spotted frog included one additional confirmed breeding site within the access corridor, in a ditch-line pond habitat type, where western toad and wood frog were also found breeding (Figure 3.3-3, Figure 3.3-4 and Figure 3.3-6). There were three other incidental observations of adults; in the Goathorn Creek area in a ponded gravel pit area; in the minesite area along a road above a confirmed spotted frog breeding site and in the rail infrastructure area within a man-made pond along the existing railway line.

There was one incidental sighting of long-toed salamander spent egg masses in the Goathorn Creek area, within a ponded area near gravel pit, which was added to the list of confirmed breeding sites for this species.

Wood frog incidental observations included a confirmed breeding site along the access corridor, where both western toads and Columbia spotted frogs were also identified as breeding were also found breeding in a ditch-line pond habitat (Figure 3.3-3, Figure 3.3-4 and Figure 3.3-6). Two additional locations were also found along the access corridor that were identified as likely breeding sites due to the presence of juvenile frogs.

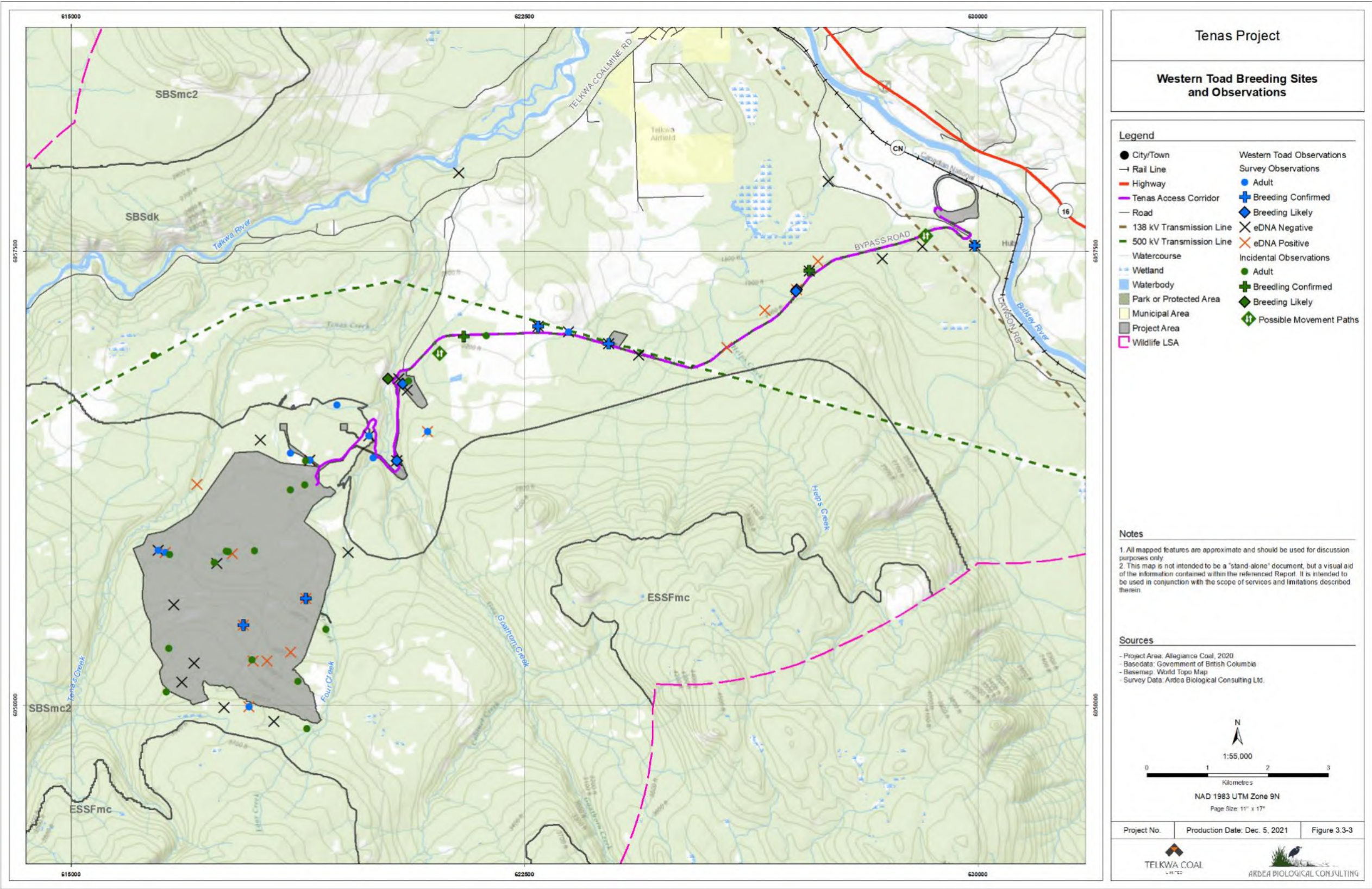
There were no incidental sightings of common or terrestrial garter snakes within the W-LSA during the field work completed from 2017 to 2019.

Wildlife Habitat Assessments

Habitat suitability ratings were collected for western toad within the W-LSA for use in the development of a wildlife habitat suitability model for the species. Ratings for western toad for food, security and thermal habitat attributes were collected at 118 locations within the W-LSA and are provided in Figure 3.3-7, while overall suitability ratings for Living and Denning habitats are provided in Figure 3.3-8.

Security, Food and Thermal habitat attributes were rated relatively the same within the SBSmc2 and the SBSdk, with slightly more sites rated High for Food and Thermal in the SBSmc2 than in the SBSdk, although these differences are more likely due to the ecosystems sampled rather than ecosystem distributions (Figure 3.3-7).

More sites were rated High, Moderate and Low for Reproduction habitats in the SBSdk than the SBSmc2 within the W-LSA, while sites within the SBSmc2 were more often rated higher for Living habitats than in the SBSdk (Figure 3.3-8).



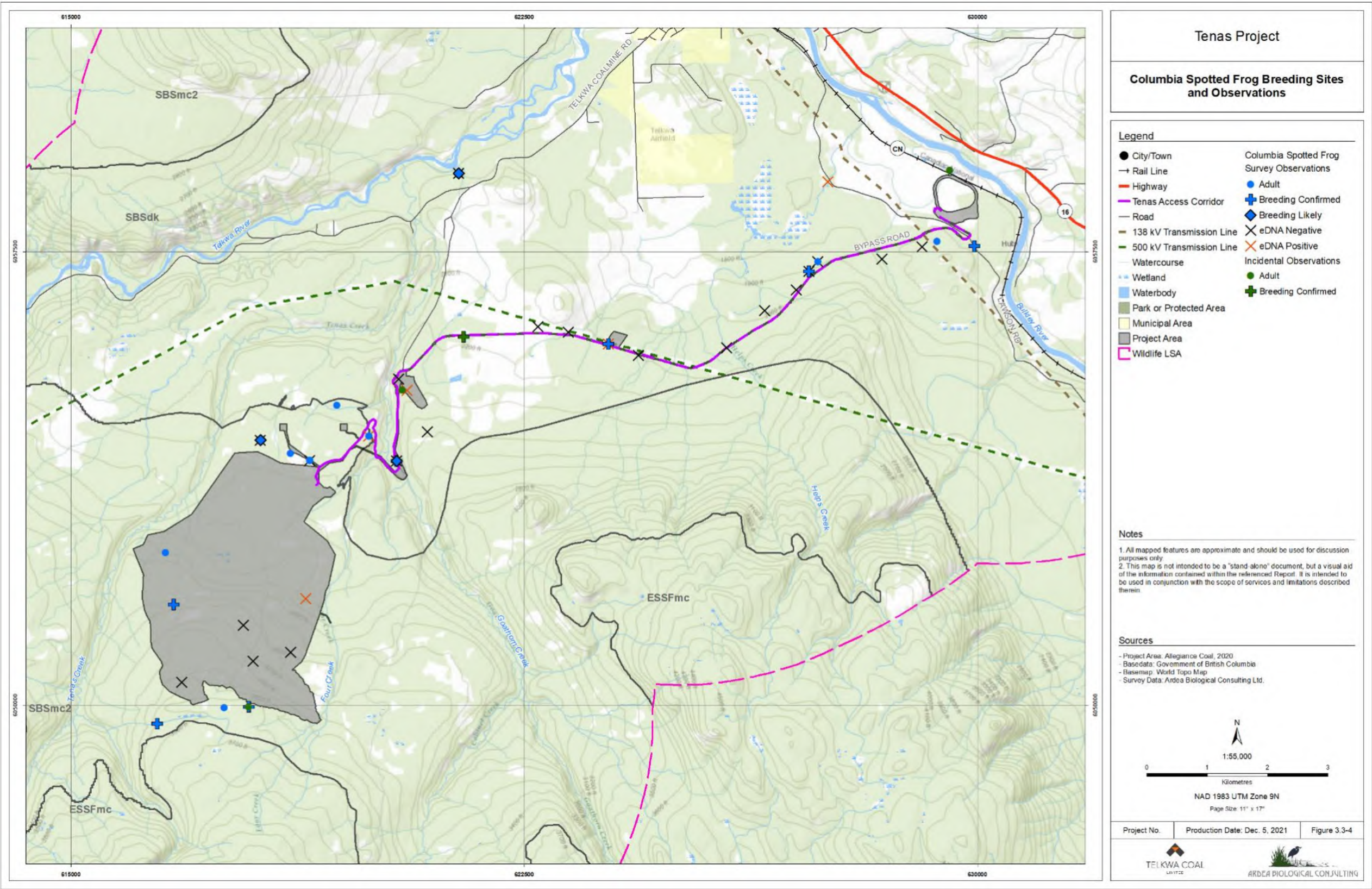


Figure 3.3-4: Columbia spotted frog observations and identified breeding sites in the W-LSA 2017 to 2019.

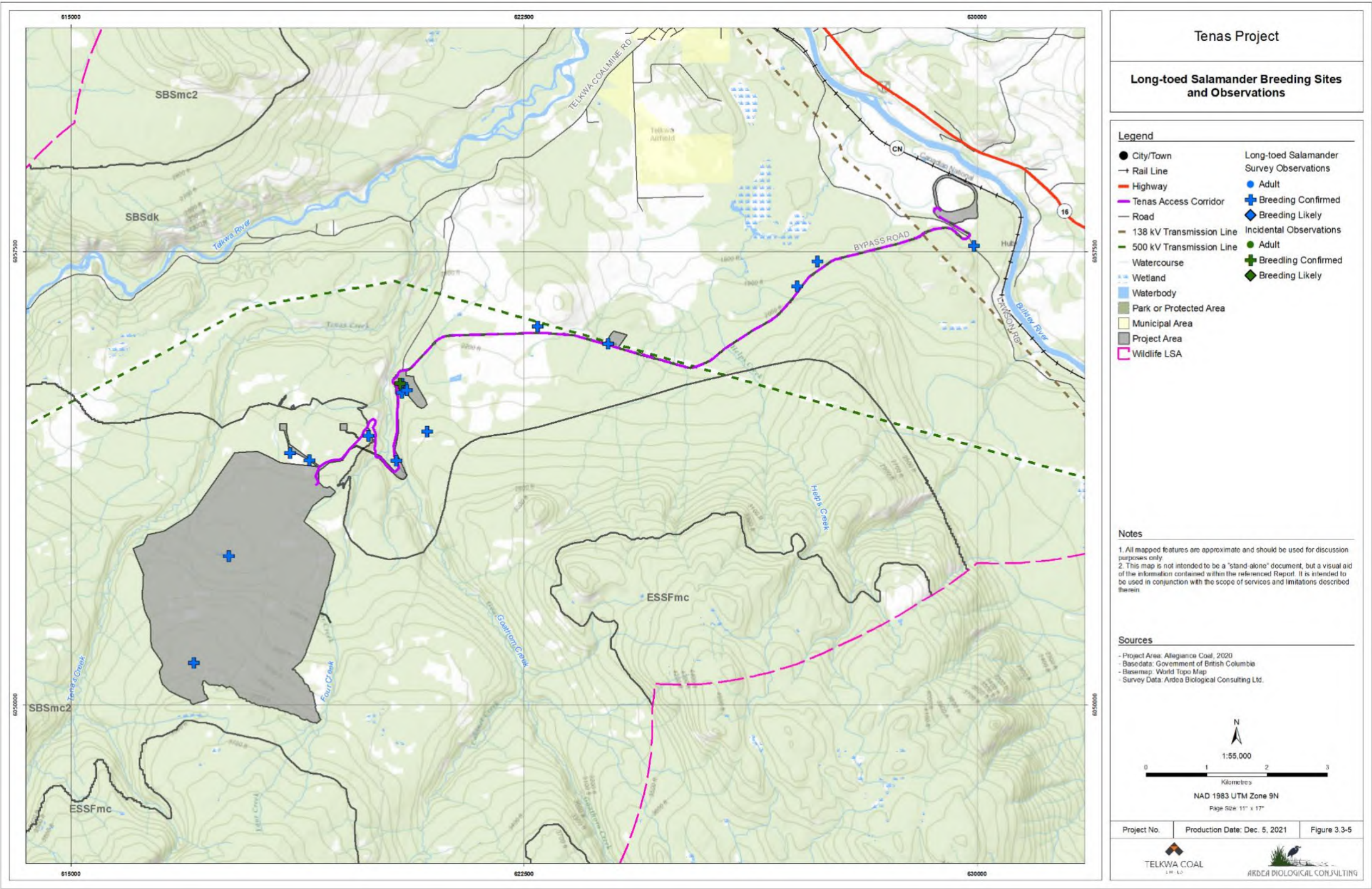


Figure 3.3-5: Long-toed salamander observations and identified breeding sites in the W-LSA 2017 to 2019.

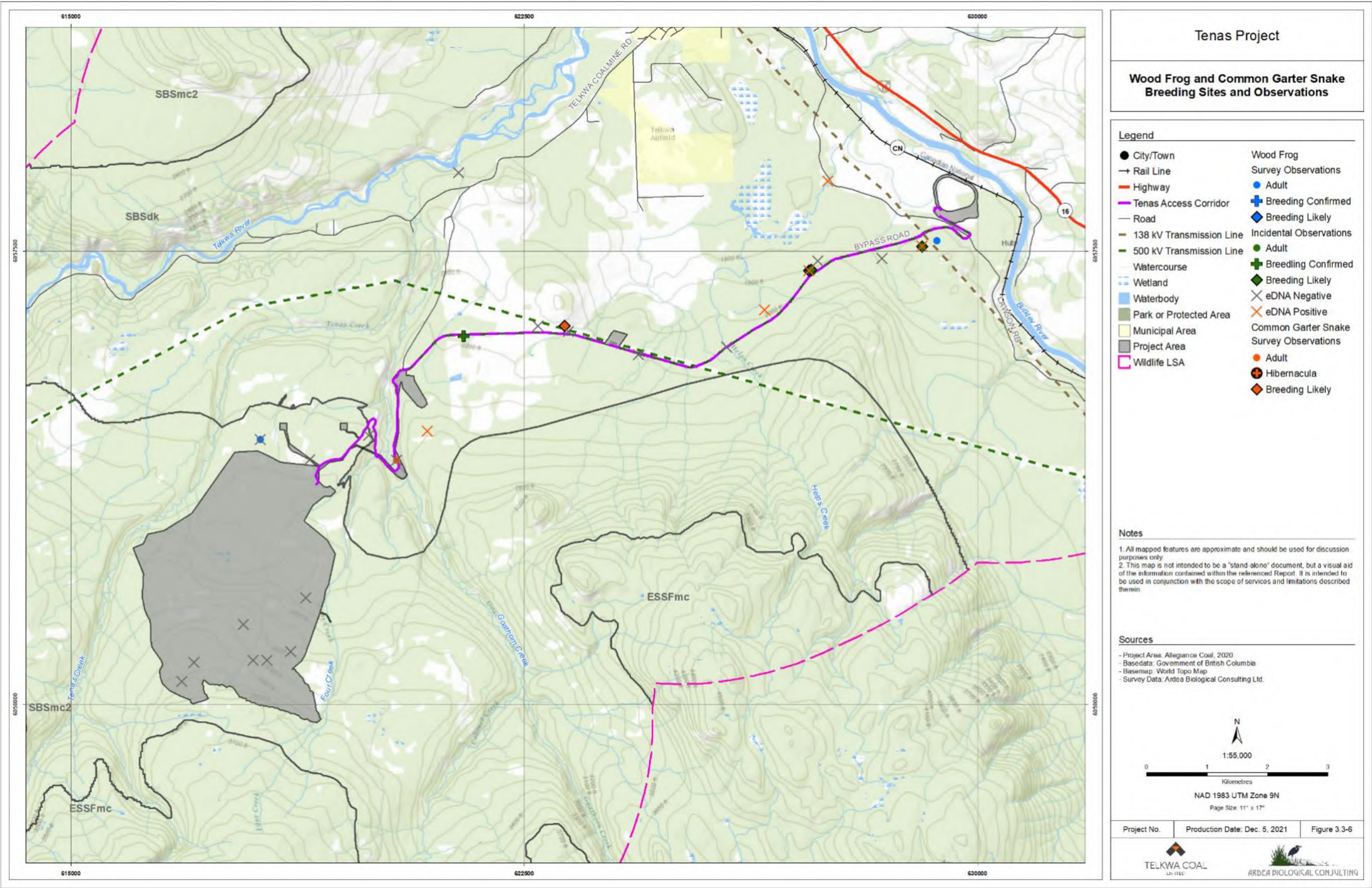


Figure 3.3-6: Wood frog and common garter snake observations and identified breeding sites in the W-LSA 2017 to 2019.

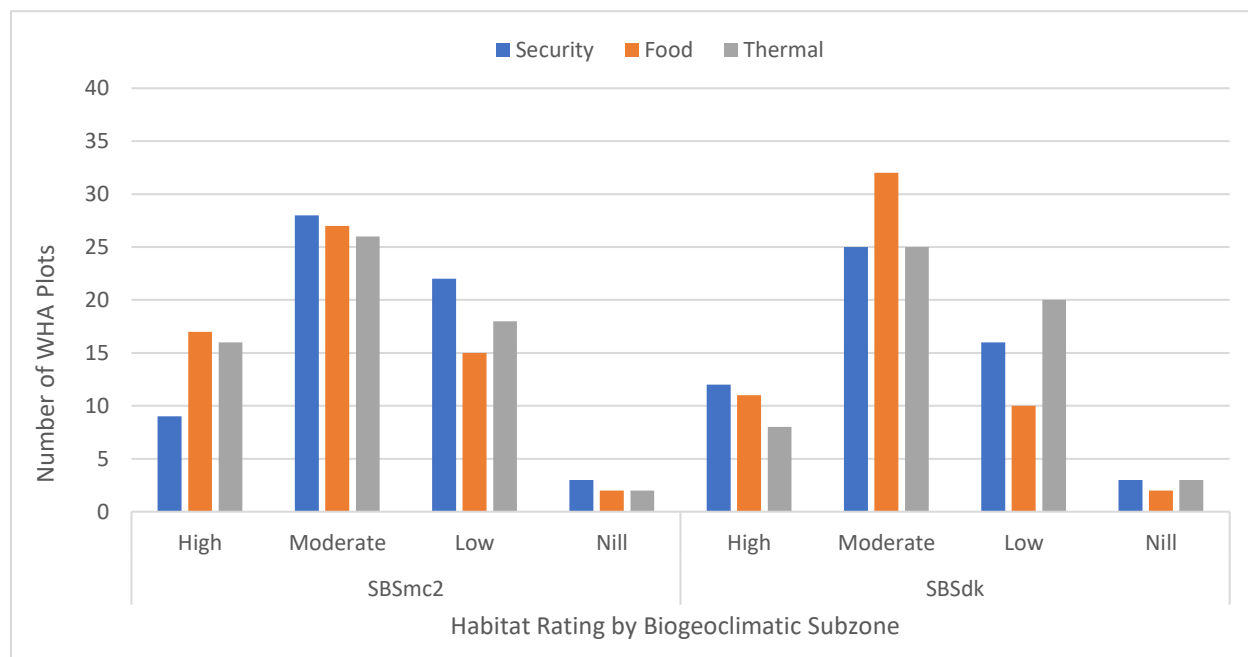


Figure 3.3-7: Suitability ratings for Western toad Security, Food and Thermal habitats within the W-LSA.

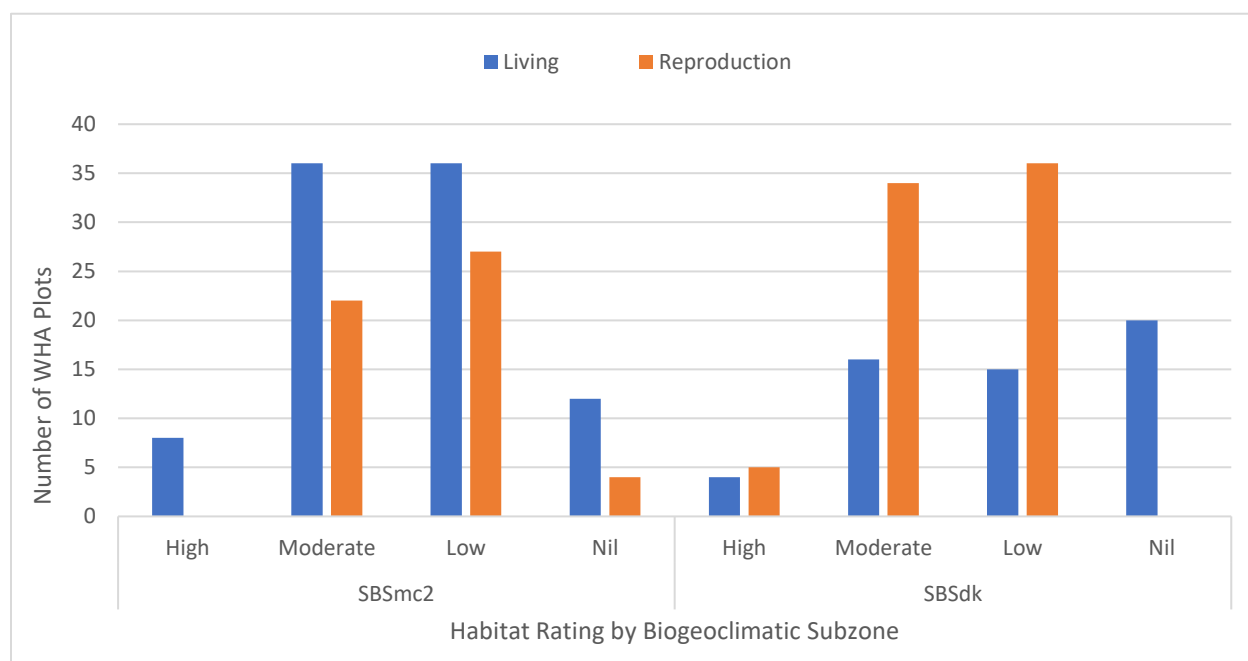


Figure 3.3-8: Suitability ratings for Western toad Living and Reproduction habitats within the W-LSA.

3.3.3 Habitat Suitability Model Summary

The western toad habitat suitability model results are outlined below based on a species account and model that was developed as part of the baseline report. Three life requisites were modelled: Living habitats during the spring, summer and fall; Reproducing habitats during the spring and summer; and Hibernation habitats during the winter. The habitat attributes that were used within the habitat suitability model for those life requisites and seasons are summarized briefly in Table 3.3-6, with more detailed information on the development of the models and model assumptions found in *Appendix B2: Western Toad Species Account and Habitat Model*.

Table 3.3-6: Summary of habitat attributes and structural stages used to identify high value habitats for the habitat suitability model life requisites.

Life Requisites (Seasons)	Habitat Attributes
Living (Growing (Spring, Summer, Fall))	Mature forests with dense undergrowth, clearings, wetlands, clearcuts, burns, and grasslands that contain high shrub cover and/or woody debris or other features that provide cover. Connectivity (migration/dispersal corridors) between terrestrial and aquatic habitats that contain dense undergrowth or high shrub cover to provide thermal and security cover.
Reproducing (Growing (Spring, Summer))	Water bodies that persist through the summer on a regular basis that allow enough time for development from egg to metamorphosis. Presence of emergent vegetation (sedges and grasses) or woody debris within water bodies that are shallow or contain shallow areas (some aquatic habitats don't have sedges and grasses but will have a moderate abundance of algae).
Hibernation (Winter)	Forested habitats with thick (30 cm to 1.5 m), loose soils that allow juvenile and adult toads to burrow below the frost line. Areas of early snow accumulations; moist habitats that have, that contain large coarse woody debris, interstitial spaces in boulder piles and bedrock or existing cavities/rodent burrows that protect from freezing and desiccation.

The results of the baseline habitat suitability models for the W-LSA are summarized in Table 3.3-7 and outlined in Figure 3.3-9 to Figure 3.3-11. Model results for Living during the spring, summer and fall seasons identified approximately 22% of the W-LSA as High value habitats, primarily within mature, moist coniferous forests within the SBSdk and SBSmc2 subzones. The majority (55%) of the W-LSA was identified as Low value habitats, within the higher elevation ESSFmc and BAFAun subzones, as well as early seral, agricultural and rural/urban areas within the lower elevation SBSmc2 and SBSdk subzones. Reproducing habitats are limited within the W-LSA, with only 4.3% (1,553.3 ha) identified as Low to High value habitat, primarily within wetlands, ponds and riparian habitats. Habitat modeling for Hibernation habitats, identified 4,703.4 ha (13.2% of the W-LSA) as High value Hibernation habitats, primarily withing riparian areas and mature conifer habitats within the SBSmc2 and SBSdk subzones.

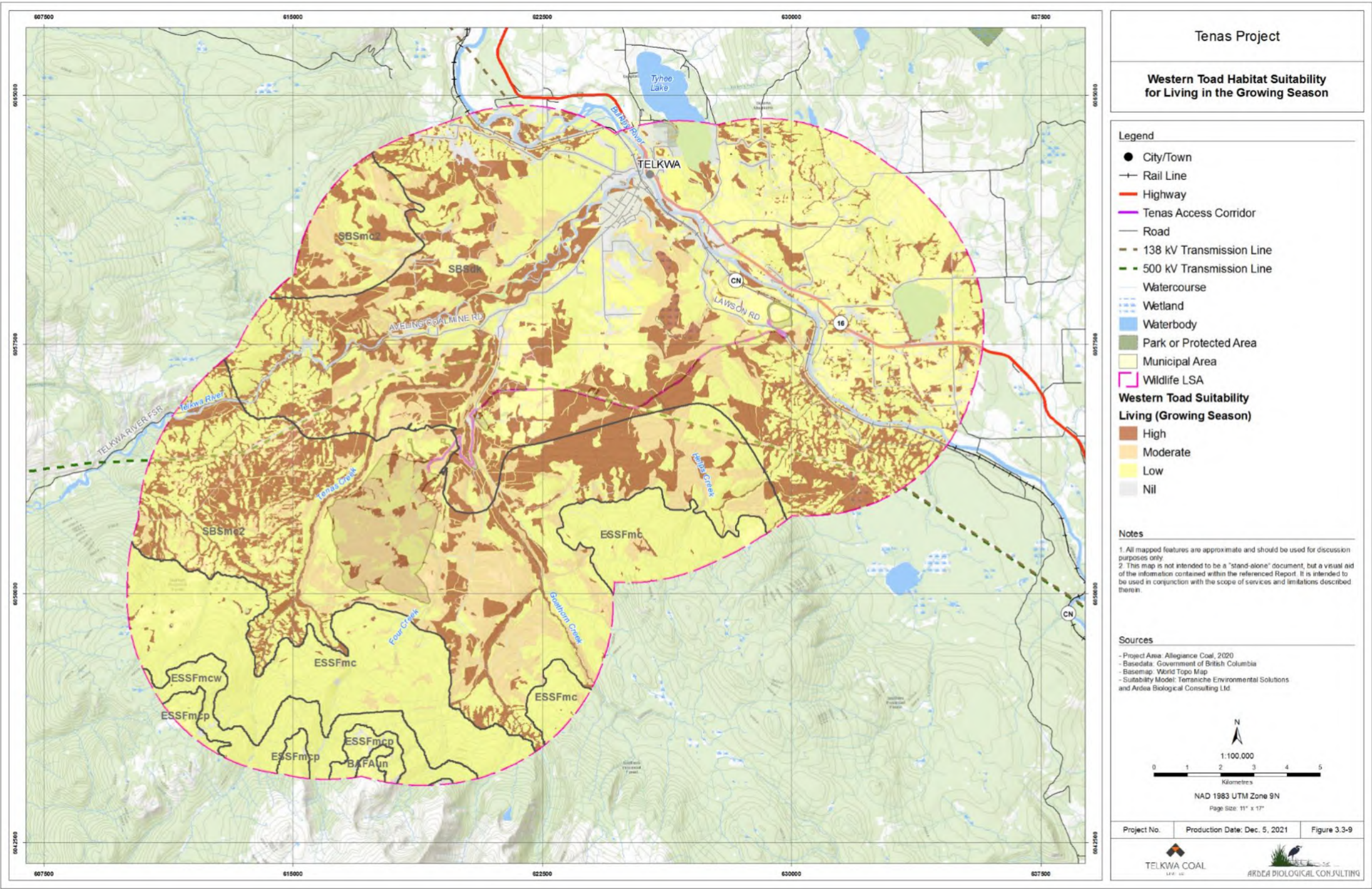
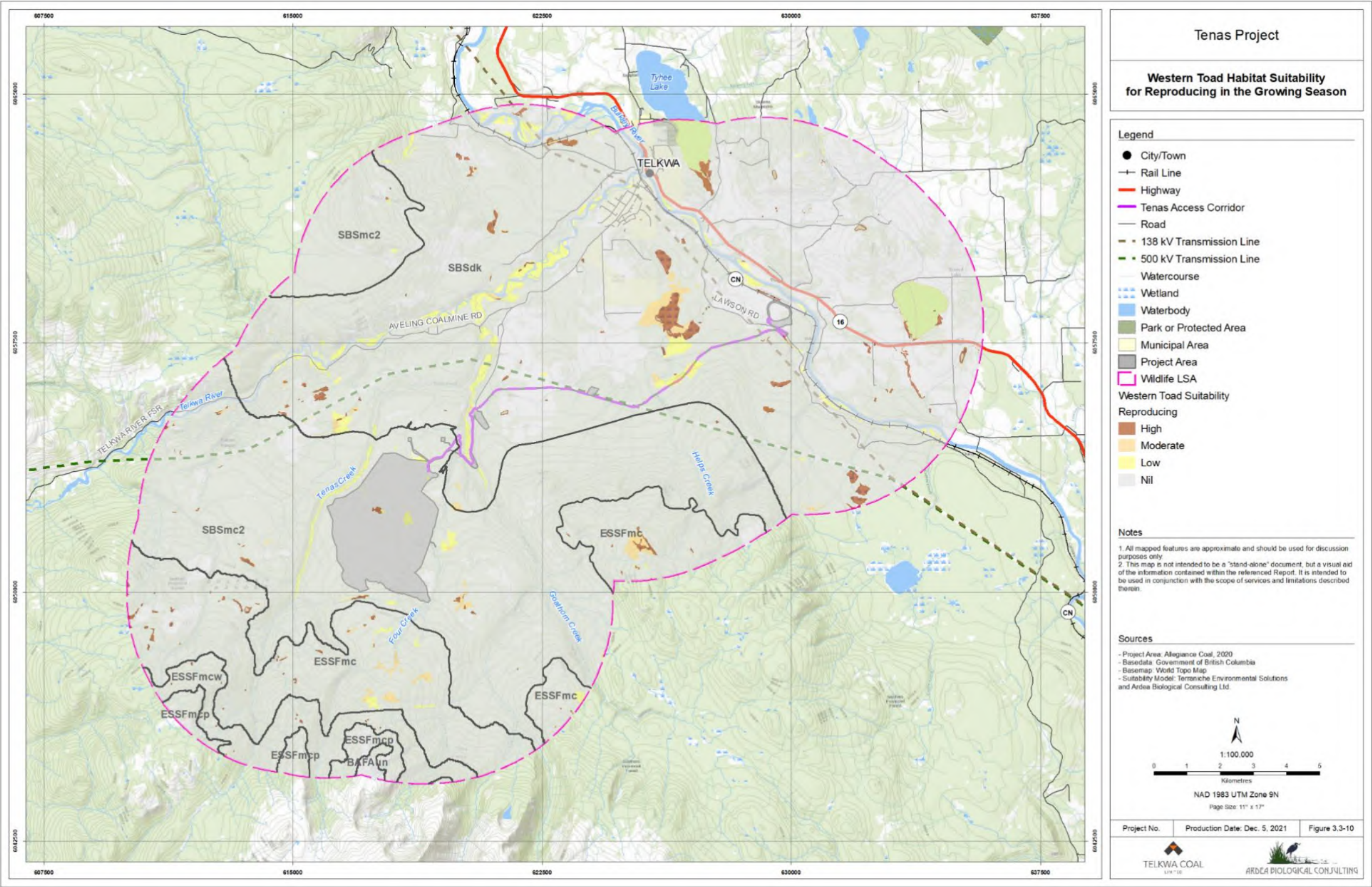


Figure 3.3-9: Habitat suitability model ratings for western toad Living (Spring, Summer, Fall) within the W-LSA.



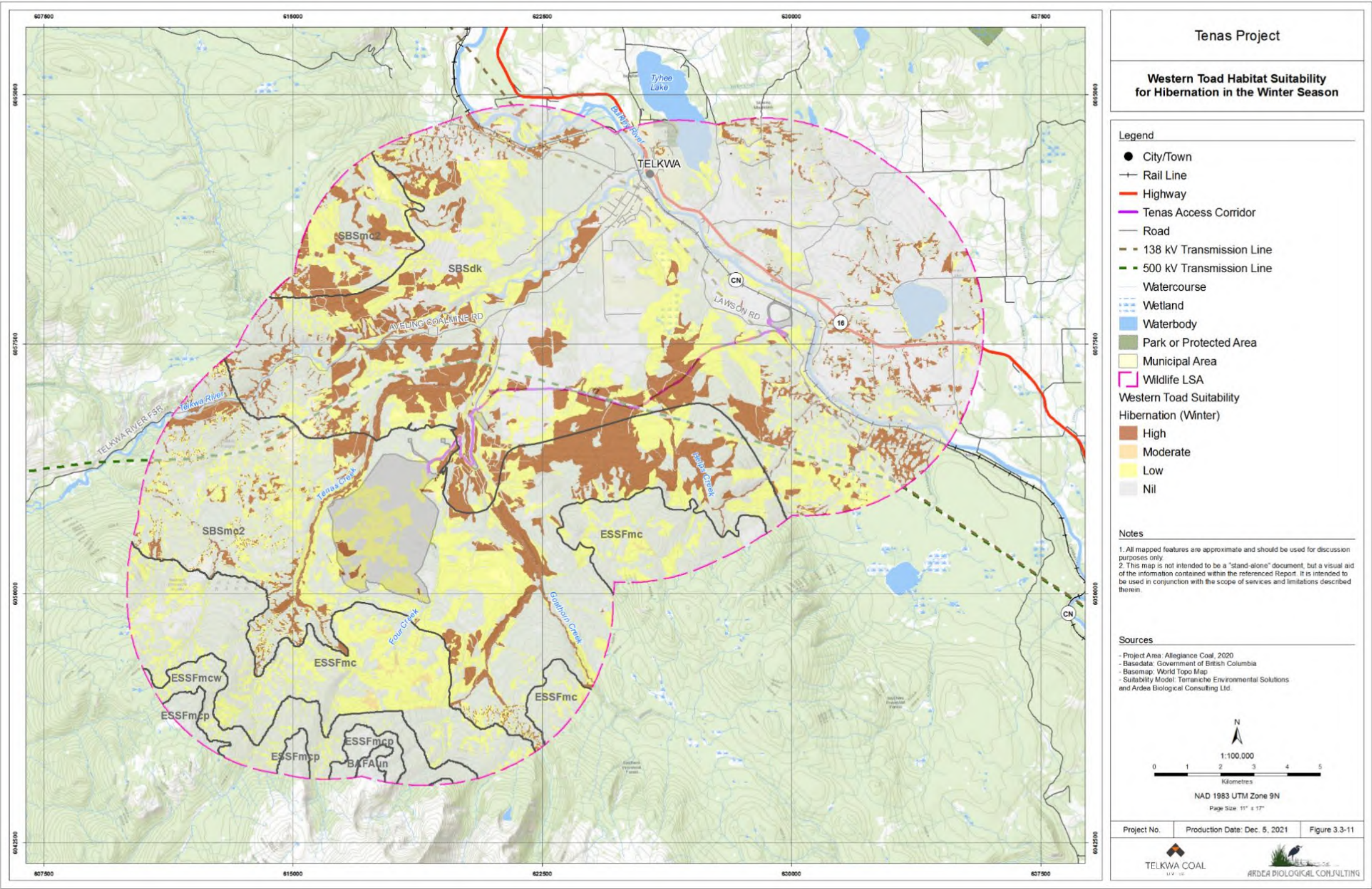


Figure 3.3-11: Habitat suitability model ratings for western toad Hibernation (Winter) within the W-LSA.

Table 3.3-7: Summary of the Western toad baseline habitat suitability by life requisite and season within the W-LSA.

Life Requisites (Seasons)	Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)
Living (Spring, Summer, Fall)	High	7,704.7	21.6%
	Moderate	5,433.2	15.2%
	Low	19,917.9	55.8%
	Nil	2,670.7	7.5%
	Total	35,726.5	100.0%
Reproducing (Spring, Summer)	High	329.6	0.9%
	Moderate	337.4	0.9%
	Low	886.3	2.5%
	Nil	34,173.2	95.7%
	Total	35,726.5	100.0%
Hibernation (Winter)	High	4,703.4	13.2%
	Moderate	58.2	0.2%
	Low	8,115.7	22.7%
	Nil	22,849.2	64.0%
	Total	35,726.5	100.0%

3.4 Bats

3.4.1 Existing Information on Bats

Conservation Context

A review of the BC CDC federally or provincially listed species that could be potentially found within the W-RSA. A query was done using the BC CDC *Species Explorer* website (BC CDC 2014a) and a review Community Bat Programs of BC, Skeena Region (Community Bat Projects of BC 2018) of the bat species likely to be found within the Skeena Stikine Forest District, which contains the Wildlife RSA (Table 3.4-1).

A bat inventory conducted by Roberts and Roberts (2000) confirmed the following species in the Skeena region: long-legged myotis (*Myotis volans*), little brown myotis (*M. lucifugus*), Yuma myotis (*M. yumanensis*), California myotis (*M. californicus*), western long-eared myotis (*M. evotis*), silver-haired bat (*Lasionycteris noctivagans*), and big brown bat (*Eptesicus fuscus*). Within the W-RSA, Roberts and Roberts (2000) captured little brown myotis, long-legged myotis, and long-eared myotis, while silver-haired bats were acoustically detected in the W-RSA. Both Yuma and California myotis have been detected outside of the W-RSA in the Kispiox River area and north of Terrace (Roberts and Roberts 2000), and are included within the list of potential species for the W-RSA as the BGC subzones they were found in are within the W-RSA.

Eastern red bat (*Lasiurus borealis*) distribution throughout BC is not well documented and the current distribution of known specimens of Eastern red bat in northern BC are limited to northeast BC near Dawson Creek (Nagorsen and Paterson 2012) and the Kootenays (Fenton et al. 1993). A recent review of known locations of captured Eastern red bats, showing no confirmed northern BC locations west of the Rocky Mountains (Solick et al. 2020). Eastern red bats are known to be wayward migrants and capable of long-

distance movements, including landing on ships over 200 km offshore or travelling beyond the treeline in Nunavut (van Zyll de Jong 1985) and it is possible that they could be found west of the Rocky Mountains. They were included in our baseline reporting due to the results obtained from the ultrasonic monitoring surveys.

Hoary bats (*Lasiurus cinereus*) have not been captured or detected acoustically in the Skeena region (Roberts and Roberts 2000), and the closest locations outlined in E-Fauna mapping (Klinkenberg 2019) are in southeast Alaska and northern Vancouver Island. They are included in the baseline reporting due to the results obtained from the ultrasonic monitoring surveys.

Pallid bats (*Antrozous pallidus*) are considered one of the rarest mammals in BC and have only been documented in arid environments within the southern Okanagan Valley (ECCC 2017). The seasonal movement patterns of pallid bats are largely unknown (Willis and Bast 2000, Rambaldini and Brigham 2011, BC CDC 2015a, ECCC 2017). This species is included in the assessment due to the results obtained from the ultrasonic monitoring surveys.

In 2014, three bat species were emergency listed on Schedule 1 under SARA due to dramatic reductions in populations from White-Nose Syndrome (WNS) (Environment Canada 2015). WNS is a serious disease affecting hibernating bats; the name derives from the white fungus that appears on the muzzle and other body parts of infected bats. WNS is responsible for very high mortality levels (90-100%) in infected

To slow the spread of the devastating WNS, Environment Canada has created a recovery strategy for three species: little brown myotis, northern myotis and tri-colored bat as part of the Recovery Strategy Series (Environment Canada 2015).

Table 3.4-1: Conservation status of bat species that potentially occur in the W-RSA.

Species Name		Conservation Status ¹		
		Provincial	Federal	
Common	Scientific	BC CDC	COSEWIC	SARA Schedule 1
Big Brown Bat	<i>Eptesicus fuscus</i>	Yellow	Not Assessed	Not Assessed
California Myotis ²	<i>Myotis californicus</i>	Yellow	Not Assessed	Not Assessed
Eastern Red Bat ³	<i>Lasiurus borealis</i>	Unknown	Not Assessed	Not Assessed
Hoary Bat ³	<i>Lasiurus cinereus</i>	Yellow	Not Assessed	Not Assessed
Little Brown Myotis	<i>Myotis lucifugus</i>	Yellow	Endangered	Endangered
Long-eared Myotis	<i>Myotis evotis</i>	Yellow	Not Assessed	Not Assessed
Long-legged Myotis	<i>Myotis volans</i>	Yellow	Not Assessed	Not Assessed
Northern Myotis	<i>Myotis septentrionalis</i>	Blue	Endangered	Endangered
Pallid Bat ³	<i>Antrozous pallidus</i>	Red	Threatened	Threatened
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	Yellow	Not Assessed	Not Assessed
Yuma Myotis ²	<i>Myotis yumanensis</i>	Yellow	Not Assessed	Not Assessed

Notes: 1) See Table 2.1-2 in Section 2.1.1 for status definitions.

2) Not known to occur in W-RSA - included as they have been detected west of the W-RSA

3) Not known to occur in W-RSA - included for discussion of results obtained

Management Initiatives

Provincially, The BC MECCS has partnered with the B.C Community Bat Program (BC Bats) in developing public programs, protocols and practices to monitor threats to bats (BC Bats 2014). BC Bats promotes conservation, develops best practices for civilians to deal with bat issues, and conducts annual bat counts to collect population and roost data throughout the province.

Bats in BC are also protected under the *Wildlife Act* (Government of BC 1996) and from hunting or harassment; as well as requiring permits for capture or salvage.

A comprehensive sector-specific BMP for Bats in BC was developed in 2016 by the Ministry of Environment and presents guidelines to mitigate potential direct and indirect impacts on bats and their habitats (BC MOE 2016). Chapter 2 specifies BMPs for mine developments and inactive mine habitats.

Although none of the land management plans mention bats as a species of interest, all three provide strategies for the protection of bat habitat. The plans provide objectives for the retention of wildlife trees which are a crucial aspect of bat roosting habitat as well as the protection of wetlands which serve as foraging habitat for several species (BVCRB and IRT 1998, BCDF 1999, BC MAL 2005).

Little Brown and Northern Myotis Ecology

For the purpose of this baseline report we focus on the ecologies of two listed bat species; little brown myotis and northern myotis who have been identified as occurring within the W-RSA based on the survey results. Generalized ecologies of the other bat species that could potentially be found within the W-RSA are outlined in Appendix C2: *Bat Species Additional Information*.

Historical Range and Distribution

Little brown myotis is widespread throughout mainland BC and on several islands, including Vancouver Island and Haida Gwaii, and is found in all biogeoclimatic (BGC) zones, except Alpine Tundra (Nagorsen and Brigham 1993, Eder and Pattie 2001, BC CDC 2015b).

Little brown myotis has the largest altitudinal range of any bat species in BC. It has been observed from sea level to 2,288 m with males being more abundant than females at higher elevations. Studies suggest that it is unlikely that breeding occurs at higher elevations (Nagorsen and Brigham 1993).

Northern myotis has a more restricted range than little brown myotis, and extends from the southern Columbia Mountains through central BC and the Peace Region up to the Yukon border (Nagorsen and Brigham 1993, Eder and Pattie 2001, BC CDC 2015c). There have been recent captures of this species in the Hazelton-Skeena region, suggesting that their range extends into the Coast Mountains (BC CDC 2015c). Northern myotis is found in the Boreal White and Black Spruce (BWBS), Interior Cedar - Hemlock (ICH), Mountain Hemlock (MH), and Sub-Boreal Spruce (SBS) BGC zones in BC (BC CDC 2015c).

Data on habitat use in BC for northern myotis is largely lacking. Northern myotis have been observed up to 700 m elevation in Mount Revelstoke National Park (Nagorsen and Brigham 1993) but data is still lacking for elevation ranges throughout the province.

Habitat Use

Foraging

Foraging habitat for bats is often characterized by high insect prey abundance and uncluttered flight paths (Grindal 1995, Crampton and Barclay 1998, Davis et al. 2000). Little brown myotis feeds mainly over open areas with high insect abundance such as water features, riparian areas, and forest edges near water (Davis and Hitchcock 1965, Anthony et al. 1981, Eder and Pattie 2001, Swystun et al. 2007, Harvey et al. 2011). Little brown myotis prefers foraging over calm ponds and lake edges compared to turbulent waters such as streams and rivers. Mackey and Barclay (1987) found that little brown myotis may concentrate their foraging over calm waters rather than turbulent streams and riffles as water movement can interfere with detecting and location prey. Little brown myotis is considered a bat species with medium manoeuvrability and echolocation precision and often selects foraging habitats with less cluttered flight paths where hawking and capture of prey is easier (Grindal 1995).

Northern myotis often feeds over small ponds and forest clearings under the tree canopy (Nagorsen and Brigham 1993) or on forested hillsides and ridges (Harvey et al. 2011) where insect abundance is high. The vast majority of research done on the foraging habits of northern myotis has occurred in eastern North

America (Broders et al. 2006, Henderson and Broders 2008). Northern myotis is considered a bat species with high manoeuvrability and echolocation precision and can select foraging habitats in more cluttered environments below the tree canopy compared to other bats (Menzel et al. 2002).

Roosting

Little brown myotis and northern myotis are forest-dwelling bats that utilize natural cavities and man-made structures for roosting such as tree cavities, trees with exfoliating bark, rock crevices, caves, and old mines (Fenton and Barclay 1980; Brigham 1991; Menzel et al. 2002; Randall et al. 2014). Although both species are known to use forests as growing season habitat, little is known about the use of sub-boreal forests by forest-dwelling bats (Fenton and Barclay 1980; Menzel et al. 2002; Parsons et al. 2003). The geographical distribution of growing season habitat is strongly influenced by temperature and precipitation, which in turn, may strongly influence insect availability (Anthony et al. 1981, Parsons et al. 2002).

Growing season habitat selection is determined by roosting and foraging requirements (Crampton and Barclay 1998). Growing season habitat for bats can be characterized by forests with high potential for suitable roost trees (e.g. night roosts, day roosts and maternal roosts) with proximity to ideal foraging habitat (Fenton 1997, van den Driessche et al. 2000, Swystun 2007). Night roosts are usually incidental roosts where bats may rest between foraging flights throughout the night (Grindal 1995). Day roosts are used for longer periods of time when bats are relatively inactive (often in torpor) and have more requirements (heat, shelter, and protection from predators) (Nagorsen and Brigham 1993, Grindal 1995, Crampton and Barclay 1998) than night roost sites. Maternal roosts are used by reproductive females and their offspring and are critical to offset the increased energy expenditures required during reproduction and subsequent pup rearing months. Maternal roosting sites tend to be more limited within the landscape as they have a narrower range of thermal, security and proximity criteria (Nagorsen and Brigham 1993, Grindal 1995, Eder and Pattie 2001, Parsons et al. 2003, Harvey et al. 2011).

Hibernation

The little brown and northern myotis hibernate in a variety of natural and man-made structures including caves, rock crevices, large diameter hollow trees, and abandoned mines (Nagorsen and Brigham 1993, Gellman and Zielinski 1996, Zielinski and Gellman 1999). The hibernation sites have high humidity (70 to 100%), relatively consistent temperatures at or above freezing (1 to 5°C), and security from adverse weather and predators (Fenton and Barclay 1980, Nagorsen and Brigham 1993, Crampton and Barclay 1998, Davis et al. 2000, Reimer et al. 2014).

Although caves and abandoned mines are considered optimal structures for hibernation for little brown and northern myotis, lack of karst features in much of western North America and British Columbia suggests that these species would need to migrate long distances or find hibernacula in other natural or anthropogenic features (Neubaum 2018). Little brown myotis has been observed to migrate relatively long distances (600 to 800 km) from mine and cave hibernation sites to summer foraging areas (Fenton 1969, Norquay et al. 2013). Research in North America and Norway on winter activity levels (Lausen and Barclay 2006, Klug-Baerwald et al. 2016, Johnson et al. 2017, Blomberg et al. 2021) and non-cave hibernation sites (Michaelsen et al. 2013, Johnson et al. 2017, Neubaum 2018, Blomberg et al. 2021) indicate that myotis species such as little brown and northern myotis are overwintering in rocky crevices, scree slopes and other non-cave sites. This suggests that these features could be used as hibernation sites in portions of their range in BC.

Little brown and northern myotis typically hibernate alone or in small groups, although some hibernacula in eastern Canada contain thousands of hibernating little brown myotis (Nagorsen and Brigham 1993). Little brown and northern myotis may hibernate within the same hibernacula. Movements to winter hibernacula occur in late summer and early fall (Nagorsen and Brigham 1993, Davis et al. 2000, Eder and Pattie 2001). Both species participate in swarming behaviour prior to hibernation, starting with the breakdown of maternal colonies in late July and continuing until hibernation (Davis and Hitchcock 1965, Nagorsen and Brigham 1993).

3.4.2 Assessment and Survey Results

Bat Ultrasonic Monitoring

A total of 1,425 ultrasonic recording files with approximately 373.1 minutes of recordings were analyzed using the Kaleidoscope™ Pro software from the ARUs in 2017 and 2018. A summary of the recording and analysis statistics for 2017 and 2018 is provided in Table 3.4-2. Due to changes in recording parameters between survey years to reduce file sizes (see Table 2.5-1), there was a reduction in the overall operating hours and total recording minutes from 2017 to 2018. Although the number of minutes analyzed was lower in 2018, due to the smaller recording lengths in 2018, the total number of files analyzed was higher in 2018, with a corresponding increase in the number of *NoID* and *Classified* files in 2018 compared to 2017.

Comparison of the full frequency and low frequency analyses found that there were fewer *Noise* and *NoID* classifications for the full frequency analysis over the low frequency analysis (Table 3.4-2). This is partly attributed to the pre-processing of the full frequency data to remove most of the *Noise* files, while it is possible that the low frequency analysis likely cut off pulse frequencies greater than 50 kHz causing an increase in unrecognized pulses. The number of files with *Classified* calls was higher in both 2017 and 2018 for the full frequency analysis compared to the low frequency analysis, primarily due to the lower number of potential bat species that would be classified under the low frequency analysis. Differences in the overall number of *Classified* files in 2018 could be due to differences in factors including weather, the habitats the ARU were located in, and species distributions in those habitats.

Table 3.4-2: Summary of ARU ultrasonic recording and analysis statistics in the W-LSA for 2017 and 2018.

Item	2017	2018
Number of active ARUs	4	3
Number of sites sampled	5	3
Sampling period ¹	May 28 to Sep. 17	May 31 to Sep. 25
Sampling frequency	Every Night	Every 3 Nights
Total minutes analyzed	259.0	114.1
Average / Minimum / Maximum recording (seconds)	30.0 / 30.0 / 30.0	7.5 / 0.5 / 15.0
Number of files analyzed	518	907
Number of Noise files (Full frequency / Low frequency)	71 / 138	76 / 151
Number of NoID files (Full frequency / Low frequency)	100 / 145	164 / 235
Number of classified files (Full frequency / Low frequency)	347 / 235	667 / 521

The initial full frequency and low frequency analyses completed using the Kaleidoscope™ Pro software classified call pulses for a variety of bat species. Although it is recognized that classification software is not 100% effective in classifying bat calls (Lemen et al. 2015, Reichert et al. 2018, Nocera et al. 2019, Fraser et al. 2020) it does provide a rapid method of identifying large volumes of calls and highlights a basis for further manual classification work (Lemen et al. 2015).

The likelihood of presence for a species is defined by Wildlife Acoustics (2018b) as a set of calls from a species at a location with a P-value <0.05 and > 5 pulses using a maximum likelihood analysis. A summary of the P-values for bat species within the W-LSA for both the full frequency and low frequency analyses are provided in Table 3.4-3. Both analyses identified the presence of big brown bat, hoary myotis, little brown myotis, long-eared myotis and silver-haired bat with low p-values, indicating they are *Likely Present* at several ARU locations. Eastern red bat was only detected in the low frequency analysis, with several locations indicating they are *Likely Present*, while pallid bat was also identified in the low frequency analysis as *Likely Present* at one location (Site 6). Both long-legged and Northern myotis had pulses identified by

the software but no sites were identified as having a likelihood of presence. No calls from California myotis or Yuma myotis were classified by the software at any ARU locations in the W-LSA.

Table 3.4-3: Likelihood of presence of bat species detected at ARU locations in the W-LSA from full frequency (8 to 200 kHz) and low frequency (8-50kHz) analyses.

Common Name	2017					2018			Total Pulses Identified
	Site 1	Site 2	Site 3	Site 4	Site 7	Site 6	Site 8	Site 9	
Big Brown Bat	-	-	-	0.478	0.328	0.816	0.000	-	1,319
	0.182	-	-	0.951	-	-	0.000	-	1,214
California Myotis	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
Eastern Red Bat	-	-	-	-	-	-	-	-	-
	0.907	0.040	-	0.000	-	0.000	0.632	-	436
Hoary Bat	-	0.000	0.197	0.022	-	0.075	0.844	0.004	194
	-	0.000	0.197	0.017	-	0.043	0.630	0.004	190
Little Brown Myotis	0.000	0.000	0.375	0.000	-	0.000	0.000	-	9,720
	0.000	0.000	0.124	0.000	-	0.000	0.000	-	6,314
Long-eared Myotis	-	0.138	0.000	0.000	-	0.000	0.018	-	340
	-	-	0.005	-	-	0.000	-	-	152
Long-legged Myotis	0.979	1.000	0.224	1.000	0.091	0.633	0.602	0.091	156
	-	-	-	-	-	0.517	0.681	0.091	53
Northern Myotis	-	1.000	-	-	-	-	1.000	-	15
	-	-	-	0.714	-	-	-	-	10
Pallid Bat	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	0.001	-	-	13
Silver-haired Bat	0.203	0.003	0.622	0.110	0.000	0.001	0.000	-	2,179
	-	0.000	0.624	0.084	0.000	0.003	0.000	-	2,054
Yuma Myotis	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-

Notes: “-” = No Pulses Classified

Shading = Full frequency analysis; **Shading** = Low frequency analysis

Bold = Species likely Present (P-value < 0.05 and > 5 pulses) (Wildlife Acoustics 2018b)

A total of 312 of the 1,425 ARU analysis files (22%) obtained in 2017 and 2018 were manually reviewed to classify the bat calls within the files. The number of files reviewed by year ranged from 16% to 32% and by ARU Site ranged from 13% to 51% as shown in Table 3.4-4.

Table 3.4-4: Summary of ARU files reviewed manually for each ARU location and year.

Year	ARU Site 1	ARU Site 2	ARU Site 3	ARU Site 4	ARU Site 7	ARU Site 6	ARU Site 8	ARU Site 9	Total
2017	34%	24%	51%	33%	46%				32%
2018						25%	13%	50%	16%

Within the 312 ARU files manually reviewed, 319 sets of bat pulses were identified, as some files had several bat species identified within the file. Table 3.4-5 summarizes the results of the manual call review, outlining the number and proportion of call files for each species identified at each ARU site. Some species were identified at several sites relatively evenly (e.g. little brown myotis, long-eared myotis, long-legged myotis, silver-haired bat), while other species were more often identified at one or two sites (e.g. big brown bat at Site 8; Eastern red bat at Site 6). Species with low numbers of manual classifications (e.g. pallid bat and Northern myotis) also have low number of pulses classified by the software (Table 3.4-3) suggesting that these species were either difficult to classify or had a limited presence in the W-LSA. No pulses were detected in the manual review for either California or Yuma myotis.

Table 3.4-5: Bat species manually classified at each ARU location in the W-LSA.

Common Name	2017					2018			Total Files Reviewed
	Site 1	Site 2	Site 3	Site 4	Site 7	Site 6	Site 8	Site 9	
Big Brown Bat	-	-	-	1 (7%) ¹	3 (20%)	11 (73%)			15
California Myotis	-	-	-	-	-	-	-	-	0
Eastern Red Bat	-	1 (6%)	-	4 (22%)	-	10 (56%)	3 (17%)	-	18
Hoary Bat	-	2 (40%)	-	-	-	-	3 (60%)	-	5
Little Brown Myotis	7 (8%)	21 (23%)	1 (1%)	14 (15%)	-	16 (17%)	33 (36%)	-	92
Long-eared Myotis	5 (16%)	2 (6%)	9 (29%)	6 (19%)	-	5 (16%)	4 (13%)	-	31
Long-legged Myotis	2 (8%)	6 (23%)	1 (4%)	3 (12%)	1 (4%)	7 (27%)	5 (19%)	1 (4%)	26
Northern Myotis	1 (8%)	2 (17%)	-	-	2 (17%)	3 (25%)	4 (33%)	-	12
Pallid Bat	-	-	-	1 (25%)	-	2 (50%)	1 (25%)	-	4
Silver-haired Bat	1 (2%)	7 (16%)	1 (2%)	2 (5%)	6 (14%)	5 (11%)	22 (50%)	-	44
Yuma Myotis	-	-	-	-	-	-	-	-	0

Notes: 1) Number of files classified for species at ARU Site and percent of total files reviewed for that species
 “-” = No pulses classified

Summary of Bat Species Presence in the W-LSA

Combining the results of the software classification full and low frequency analyses and the manual review to classify calls, a summary of the bat species *Likely Present*, *Possibly Present* and *Not Detected* at the ARU locations in the W-LSA is provided in Table 3.4-6.

Big brown bats were identified at ARU Sites 4, 7, and 8 from the manual classification, as well having a likelihood of presence based on the software classification analyses at Site 8 (Table 3.4-6). The high number of call pulses identified by the software analyses (1,319 full frequency; 1,214 low frequency), along with the manual classification of their calls within 15 files caused this species to be assessed as *Likely Present* within the W-LSA. This species was identified most often in mature mixed forest edge habitats found at ARU Site 8 based on the number of classified pulses per ARU operating hour ().

Eastern red bats were classified during the low frequency analysis by the software as having a high likelihood of presence at ARU Sites 2, 4 and 6 with a total of 436 pulses classified. The full frequency analysis did not detect pulses for this species. The manual review of calls, found 18 files containing Eastern red bat calls with the majority detected at ARU Site 6 (56% of files containing their calls). The majority of Eastern red bat classifications were located at ARU Site 6 in mature mixed forest edge habitats, with mature conifer forest edges also being common, followed by some calls from young pine forest habitats (Figure 3.4-1). Although the software analysis and manual classification indicates that Eastern red bat was detected within the W-LSA there is a lack of a confirmed specimen east of the Rocky Mountains in northern BC (Solick et al. 2020). For this reason, we assessed Eastern red bat as *Possibly Present* in the W-LSA.

Table 3.4-6: Summary of bat species classification methods to identify potential bat species at each ARU site within the W-LSA in 2017 and 2018.

Common Name	2017					2018			Presence of Species in W-LSA
	ARU Site 1	ARU Site 2	ARU Site 3	ARU Site 4	ARU Site 7	ARU Site 6	ARU Site 8	ARU Site 9	
Big brown bat				M	M		S S M		Likely
California myotis									Not Detected
Eastern red bat		S M		S M		S S M			Possibly
Hoary bat		S S M		S S		S		S	Possibly
Little brown myotis	S S M	S S M	M	S S M		S S M	S S M		Likely
Long-eared myotis	M	M	S S M	S		S S M	S		Likely
Long-legged myotis	M	M	M	M	M	M	M	M	Likely
Northern myotis	M	M			M	M	M		Likely
Pallid bat				M		S M	M		Possibly
Silver-haired bat	M	S S M	M	M	S S M	S S M	S S M		Likely
Yuma myotis									Not Detected

Notes: S = Species likely present (P-value <0.05 and > 5 pulses (Wildlife Acoustics 2018b))

M = Species classified as present during manual review of calls

Shading indicates full frequency analysis; Shading indicates low frequency analysis

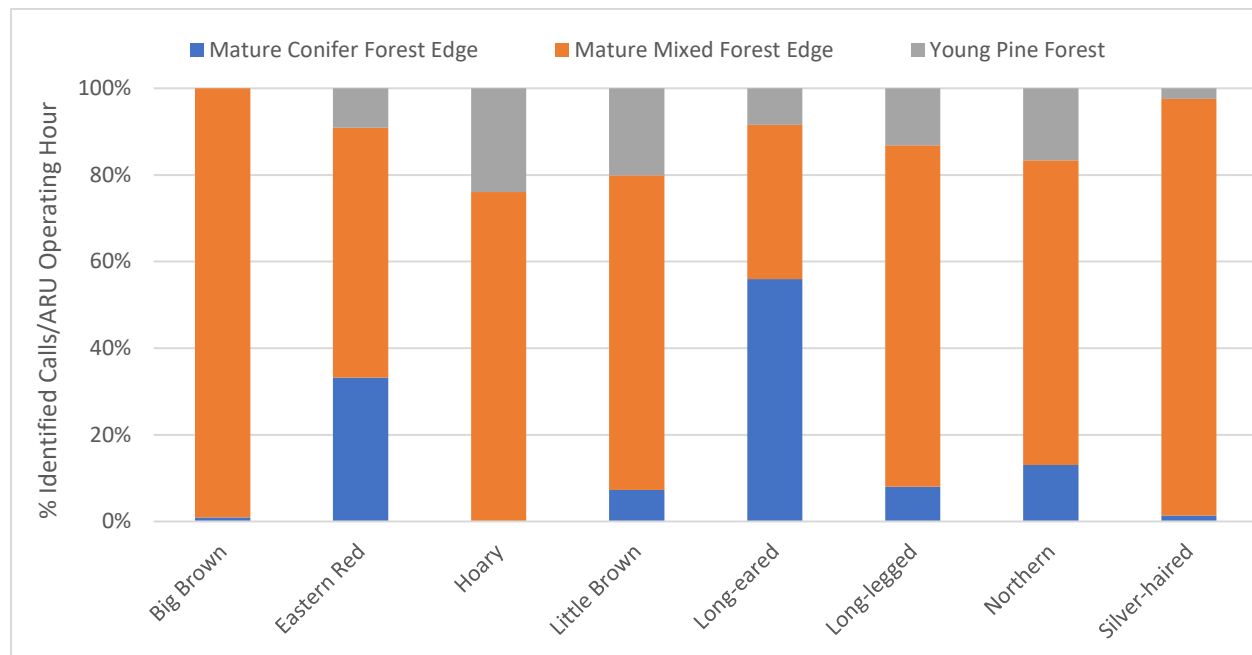


Figure 3.4-1: Proportion of bat species identified per ARU operating hour within forested habitat types within the W-LSA during 2017 and 2018.

Hoary bat was identified in both the full frequency and low frequency analyses (Table 3.4-3), with a total of 194 pulses identified (27 files) and 190 pulses identified (28 files) respectively. During the manual review process, all 27 files from the full frequency analysis were assessed and only 29 pulses (15%), in five files, were able to be identified as hoary bat calls (6 pulses at ARU Site 2 and 23 pulses at ARU Site 6). This low proportion of confirmed hoary bat calls within the files suggests some challenges in the software's and the reviewers' ability to detect this species effectively. Confirmed specimens for Hoary bat in the interior of BC are in the Okanagan and Kootenays as well as along the coast of BC (Klinkenberg 2019) are 2020). Based on the low number of identified pulses in the manual review we assessed hoary bat to be *Possibly Present*, and if not a result of identification errors, would likely be vagrant individuals and not part of a population in the W-LSA (Table 3.4-6).

Little brown myotis were the most detected bat species during the surveys with the full frequency analysis identifying 9,720 pulses and the low frequency analysis identifying 6,314 pulses. Both analyses identified likelihood of presence at ARU Sites 1, 2, 4, 6 and 8 (Table 3.4-3), with manual reviews confirming calls at all of those sites (Table 3.4-5) in the 92 files reviewed. Little brown myotis were found to be primarily using the mature, mixed forest edge habitats found at ARU Site 8, with some use of young pine forest (ARU Site 2) and mature conifer forest edge (ARU Sites 1, 4 and 6) (Figure 3.4-1). Based on the number of sites identified by the software analyses and the manual review, little brown myotis were identified as *Likely Present* over most of the ARU sites surveyed in the W-LSA (Table 3.4-6).

Long-eared myotis were identified more often with a likelihood of presence using the full frequency analysis than the low frequency analysis (Table 3.4-3), which is likely due to the low frequency analysis cutting off the top end of the calls. Forty-four files were identified in the full frequency analysis as containing long-eared myotis calls for a total of 340 pulses identified. A total of 31 files were reviewed manually and pulses for this species identified at almost all of the ARU sites except ARU Site 7 and 9 (Table 3.4-5). Long-eared myotis were identified as *Likely Present* within the W-LSA, based on the number of ARU Sites identified with a likelihood of presence ($P < 0.05$ and > 5 pulses) (Wildlife Acoustics 2018b) and manual review files confirming that species presence. The majority of long-eared myotis detections occurred in mature conifer forest edge habitats, followed by mature mixed forest edge and young pine forest habitats (Figure 3.4-1)

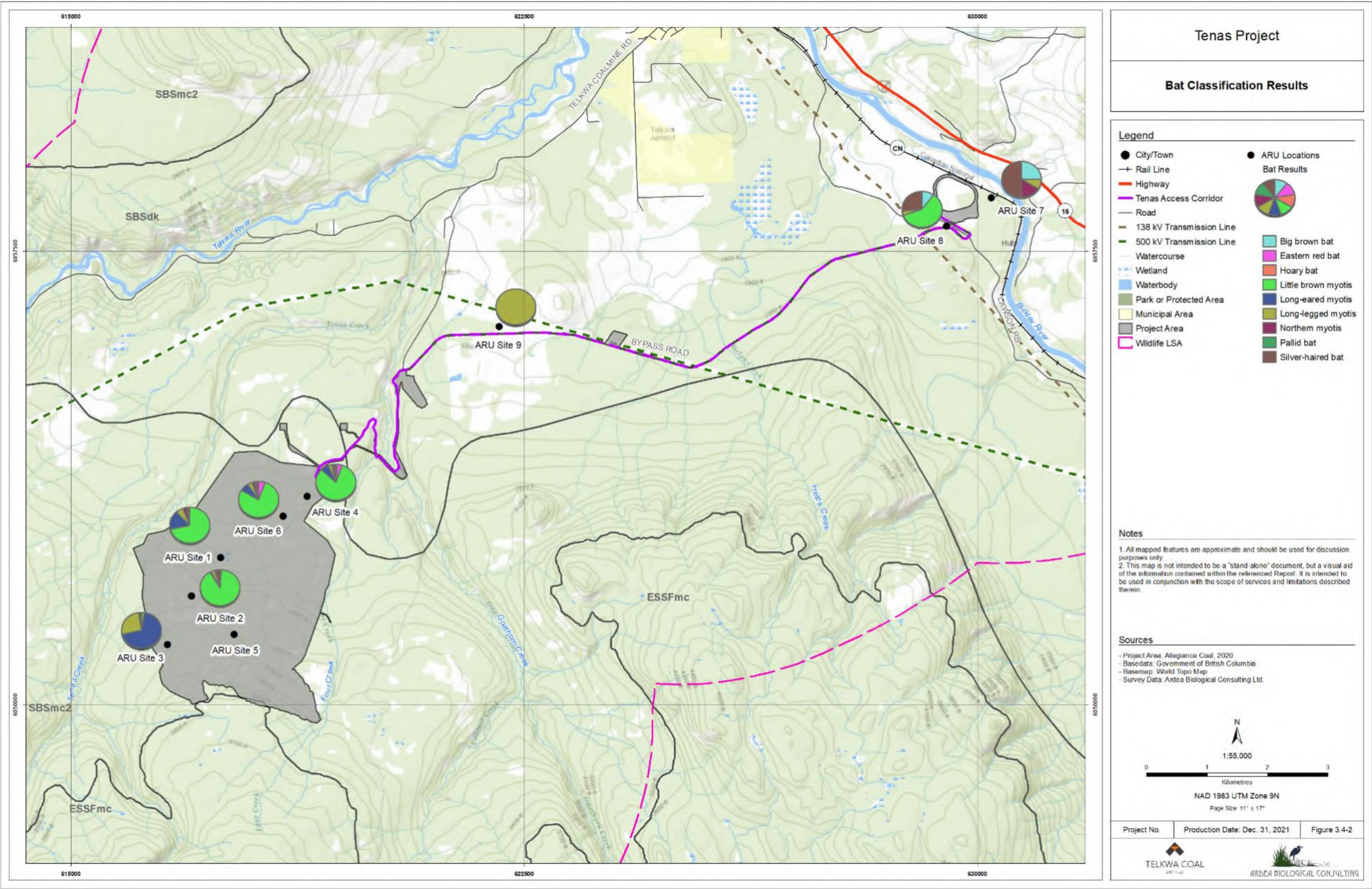
Long-legged myotis was not identified during either the full frequency or low frequency analyses as having a likelihood of presence at any of the ARU sites during 2017 or 2018 with only 153 pulses identified in the full frequency and 53 pulses identified in the low frequency analyses (Table 3.4-3). They were however, identified within 26 of the files manually reviewed at all of the ARU sites (Table 3.4-5). Although the software was unable to classify any ARU sites as having a likelihood of presence, the manual review identified 26 files to contain calls identified as this species. Based on the number of identified calls and that Roberts and Roberts (2000) had captured a long-legged myotis at Canyon Creek within 10 km from the W-LSA, we assessed long-legged myotis to be *Likely Present* within the W-LSA, although probably at very low numbers (Table 3.4-6). Mature mixed forest edge habitats were identified from calls as the most often used habitat, followed by young pine forest and mature conifer forest edge habitats (Figure 3.4-1).

Northern myotis was another species that was not identified in either the full or low frequency analysis as having a likelihood of presence at the ARU sites, due to the low number of pulses identified during those analyses (Table 3.4-3). Twelve files were found to contain calls of northern myotis during the manual review, with the majority identified at ARU Site 8 (Table 3.4-5). As there were only a limited number of calls identified as Northern myotis, we assessed this species to be *Possibly Present* in the W-LSA (Table 3.4-6). Due to the range of ARU sites being used, all habitats were used by this species, with mature mixed forest edges the primary use, followed by mature conifer edges and young pine stands used almost equally (Figure 3.4-1).

Pallid bat was initially detected during 2017 by the software (once at one site) and a limited number of calls were identified as possible pallid bat calls by the software were reviewed manually and found to potentially match available reference sonograms. The low frequency software analysis identified calls at ARU Site 6 in 2018 to have a likelihood of presence for pallid bat (Table 3.4-3). The manual review conducted by Ardea found four files from 2017 and 2018 that contained potential pallid bat calls. These files were sent to senior biologists Jennifer Prive of EDI and Mike Sarell of Ophiucon Consulting, who both have experience in identification of this species. Based on their review, two files were identified as likely pallid bat calls, while two files were identified as possibly containing pallid bat calls (Table 3.4-5). Difficulties in the accuracy of both automated and manual classifications of bat calls have been identified due to the overlaps in call characteristics (i.e. frequencies, duration, shape, etc.) of many species, which makes 100% accuracy of species identification impossible (Lemen et al. 2015, Reichert et al. 2018, Nocera et al. 2019, Fraser et al. 2020). As pallid bats have only been confirmed within the interior of the province in the Okanagan (ECCC 2017), and errors in the software and the manual review are possible, we have identified pallid bat as *Possibly Present*, with the calls potentially coming from vagrant individuals and not part of a population in the W-LSA (Table 3.4-6).

Silver-haired bat were identified at four ARU sites by the software in both the full frequency and low frequency analyses as having a likelihood of presence, and were the second most common species based on pulse identifications with over 2,000 pulses identified (Table 3.4-3). A total of 44 files manually reviewed were found to contain pulses identified as silver-haired bat with the majority of the files from ARU Site 8 (Table 3.4-5). Almost all of the silver haired bat habitat use was found to be within the mature mixed forest edge habitat (Figure 3.4-1). Based on the large number of pulses and manually identified files for this species we identified it as a *Likely Present* within the W-LSA (Table 3.4-6).

A summary of the relative abundance of manual and software call identifications for the various bat species at the ARU Sites is shown in Figure 3.4-2 shows the relative abundance of the software and manual identifications of bat species at the ARU sites. Little brown myotis was the most common species detected within the W-LSA, being identified as the most prevalent species at four sites in the minesite area and at one site near the access corridor and overlooking the rail infrastructure area. Long-eared myotis was the most common species identified at ARU Site 3 in the southwest portion of the minesite area, while long-legged myotis was the only species identified from a limited number of calls at ARU Site 9. Silver-haired bat was the most common species identified near the rail infrastructure area from sampling in 2017 (Figure 3.4-2).



Forest Bat Roost Assessments

Fifty-four bat roost assessments were carried out from August 16th 2018 to August 24th 2018 in mature and old growth forests within the W-LSA. Twenty-seven plots each were completed within the SBSmc2 and SBSdk BGC subzones. A total of 462 trees were reviewed in the 54 sites and 163 trees that were over 15 cm in diameter at breast height (DBH) were measured and assessed for wildlife tree attributes and as potential maternal and day/night roosting trees for forest bats. Table 3.4-7 provides a summary of the 15 assessment sites that were identified as having potential maternal roosting trees, while Figure 3.4-5 shows the assessment locations and which sites had potential maternal roosting trees and the number of potential day/night roosting trees.

The distribution of day/night roost ratings for the W-LSA is outlined in Figure 3.4-3, showing that the majority of sites assessed could potentially provide roosting for 6 to 20 bats within the 400 m² plot area. Except for one location, every assessment site was found to contain at least one Day/Night roosting tree (e.g. having cracks, flaking bark or cavities); indicating that the mature and old-growth forests within the W-LSA supported at least some potential for Day/Night roosting for forest bats.

Of the 20 tree species identified as suitable for potential maternal roosting the majority were subalpine fir (*Abies lasiocarpa*, n=8) followed by black cottonwood (*Populus trichocarpa*, n=4) (Figure 3.4-4). Other potential maternal roosting trees were lodgepole pine (*Pinus contorta*, n=3), trembling aspen (*Populus tremuloides*, n=3), and hybrid spruce (*Picea engelmannii* x *glauca*, n=2). Eight potential maternal roosting trees were in the SBSdk subzone, and 12 were located in SBSmc2.

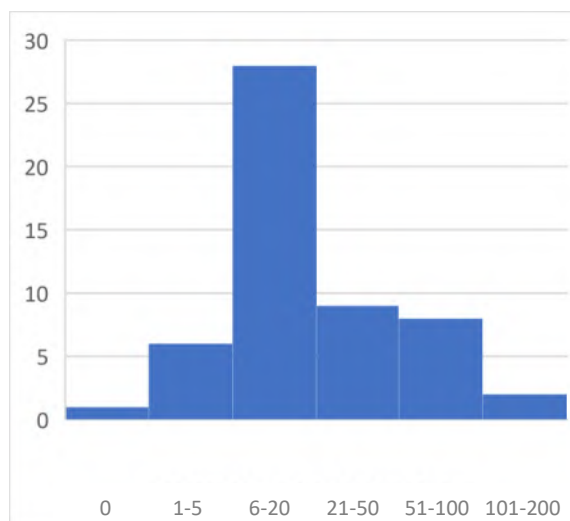


Figure 3.4-3: Histogram of potential day/night roosting trees within plots in the W-LSA.

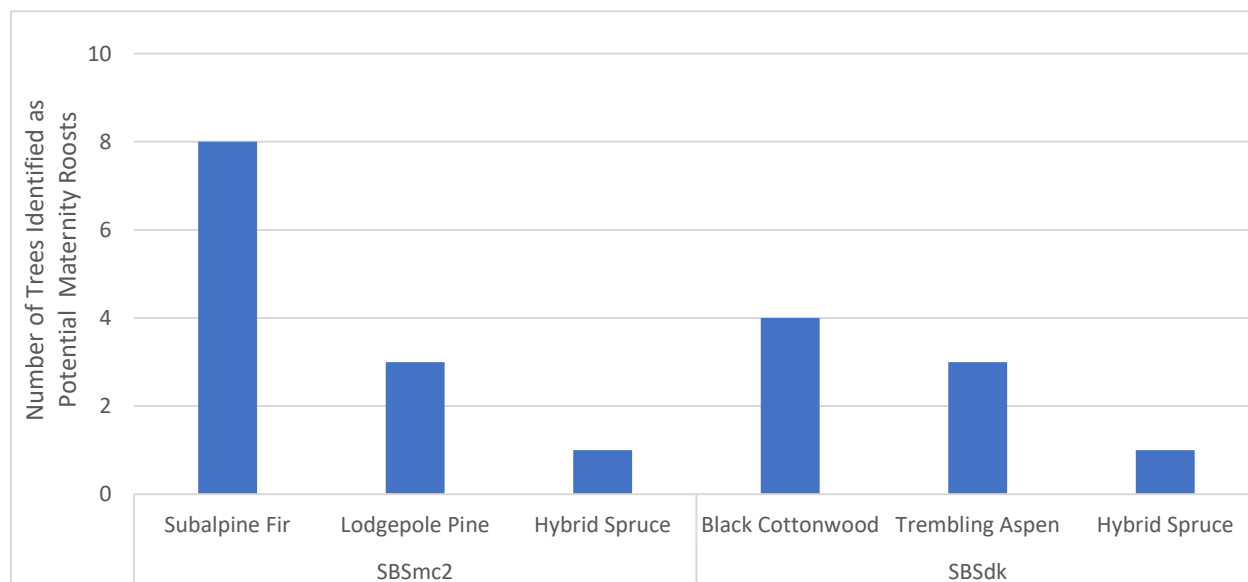
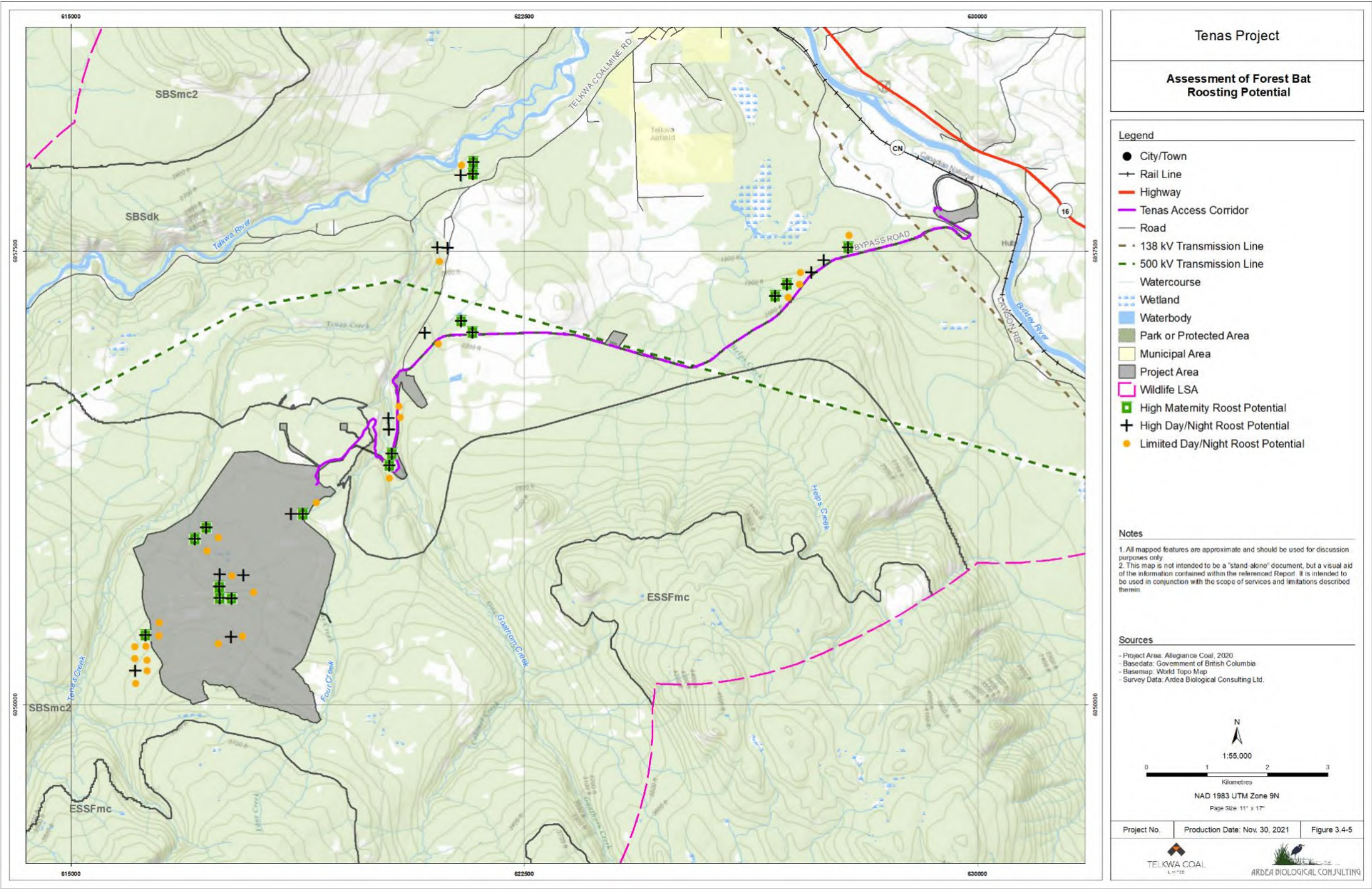


Figure 3.4-4: Distribution of tree species identified as potential maternal roosts during bat roost assessments in 2018.

Table 3.4-7: Summary of maternal roost sites assessed during the forest bat roost assessments in 2018.

Map ID	Location	BEC Subzone	Site Description*	Maternal Roost Potential*	Night Roost Potential	Model Maternal Score
BR02	Access Corridor	SBSdk	Mature Aspen/Spruce with Birch Stand - Telkwa River Floodplain	Yes	Yes	1
BR03	Access Corridor	SBSdk	Young Spruce Aspen Stand with Birch - Telkwa River Floodplain	Yes	Yes	1
BR12	Minesite	SBSmc2	Mature Fir/Spruce Stand	Yes	Yes	2
BR13	Minesite	SBSmc2	Old Growth Fir/Spruce Stand with Lodgepole Pine and Cottonwood	Yes	Yes	1
BR14	Minesite	SBSmc2	Old Growth Fir/Spruce Stand with Cottonwood	Yes	Yes	1
BR15	Minesite	SBSmc2	Mature Fir/Spruce Stand, 20% Blowdown	Yes	Yes	4
BR18	Minesite	SBSdk	Mature Spruce Stand with Paper Birch and Lodgepole Pine, Rolling Ridges	Yes	Yes	2
BR25	Access Corridor	SBSdk	Mature Trembling Aspen Stand with Spruce	Yes	Yes	1
BR34	Minesite	SBSmc2	Old Growth Fir/Spruce Stand beside cutblock	Yes	Yes	2
BR38	Access Corridor	SBSdk	Old Growth Cottonwood Stand with Spruce and Trembling Aspen	Yes	Yes	1
BR46	Access Corridor	SBSdk	Old Growth Cottonwood Stand next to Goathorn Creek	Yes	Yes	1
BR47	Access Corridor	SBSdk	Mature Aspect Spruce Stand next to Goathorn Creek	Yes	Yes	1
BR49	Minesite	SBSmc2	Mature Fir/Spruce Stand	Yes	Yes	3
BR52	Minesite	SBSmc2	Old Growth Fir/Spruce Stand near Wetland	Yes	Yes	2
BR53	Minesite	SBSmc2	Mature Lodgepole Pine/Balsam Fir/Spruce Stand near Wetland	Yes	Yes	3



The distribution of all trees within the bat roost assessment plots compared to the trees over 15 cm DBH assessed as wildlife trees is outlined in Figure 3.4-6. Overall, hybrid spruce and subalpine fir were the leading species throughout the bat roost assessments making up 36% and 31% of all trees within the plot. Scouler's willow only accounted for 2% of all trees in the plots and black cottonwood was 5%. Subalpine fir was the most common tree over 15 cm (24%) in the plots, followed by hybrid spruce, and paper birch. When comparing the distribution of all trees to the distribution of trees over 15 cm DBH, black cottonwood, paper birch and lodgepole pine disproportionately represented large trees (Figure 3.4-6).

Black cottonwood and lodgepole pine disproportionately represented potential maternity roosting trees throughout the bat roost assessment sites. Of the 163 trees assessed, only 10% (17) were black cottonwood, however, 24% of the assessed black cottonwood trees were determined to be suitable for maternal roosting (Figure 3.4-7). While hybrid spruce represented 22% of all trees over 15 cm DBH, only 5% of hybrid spruce trees assessed were found to be potentially suitable for maternal roosting, while 20% of subalpine fir were determined to have maternal roosting potential. Lodgepole pine snags accounted for only 8% of all assessed trees, but 23% of assessed pine trees were identified as potentially suitable for maternal roosting. No paper birch trees were considered suitable for maternal roosting despite paper birch accounting for 20% of all assessed trees.

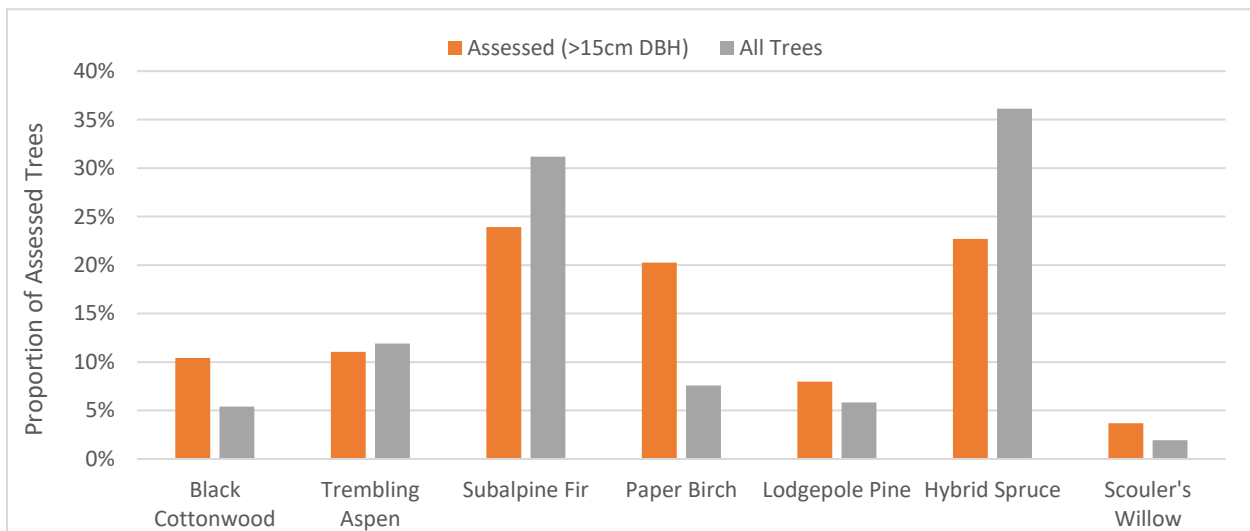


Figure 3.4-6: Comparison of tree species (> 15cm DBH) to all trees assessed.

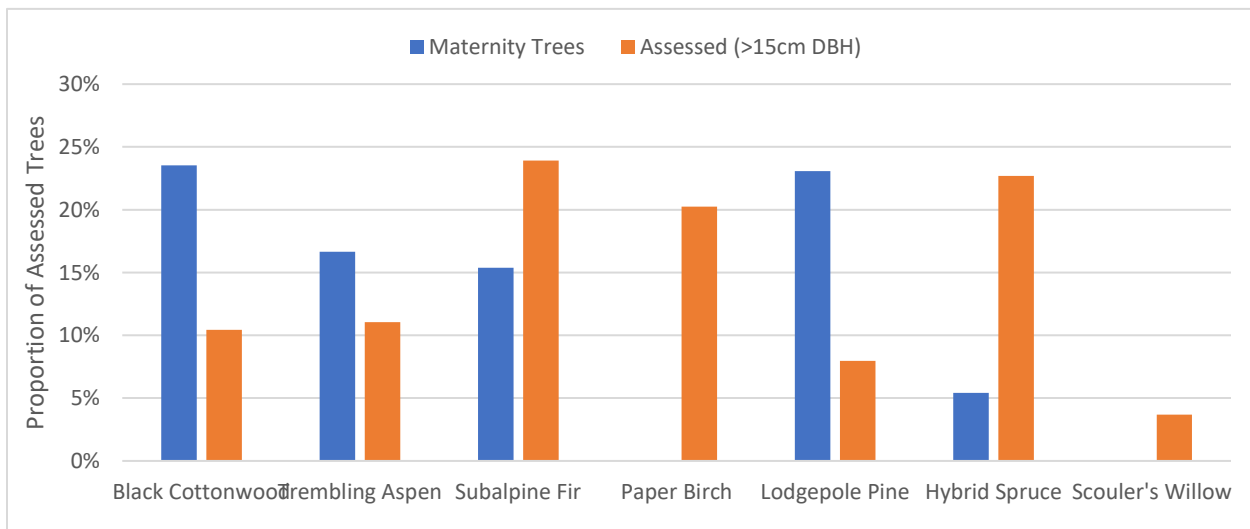


Figure 3.4-7: Comparison of maternal roosting potential trees to wildlife trees (> 15cm DBH).

Incidental Bat Observations

One bat was observed flying over a wetland (WF01) on August 1st 2018 during wetland function assessments at approximately midday. Wetland WF01 is described as a marsh (Wm05) with areas of open water and is located in the access corridor approximately 300 m south west of ARU Site 8 (Figure 3.4-2).

3.4.3 Habitat Suitability Model Summary

The forest bat habitat suitability model results are shown in Table 3.4-8 based on the species account and model (Appendix C2: *Forest Bat Species Account and Habitat Model*) developed as part of the baseline program. The mapping for the forest bat model habitat suitability is provided in Figure 3.4-8 to Figure 3.4-15 for the W-LSA and W-RSA.

Model results for Food habitat in the growing season identified approximately 1% within both the W-LSA and the W-RSA as high value habitat, while moderate and low value habitats modelled made up almost 50% of the W-LSA and 32% in the W-RSA. There were proportionally more suitable Security/Thermal (day/night roosting) habitats modelled within the W-LSA than the W-RSA, which may be due to the older ages, higher amounts of dead standing trees and more buildings and urban areas within the W-LSA compared to the W-RSA. High value reproduction (maternal roosting) habitats in the growing season made up over 6% of the W-LSA and 5% of the W-RSA, while moderate and low value habitats made up almost 13% and over 11% respectively. Less than 1% of the W-LSA and W-RSA were identified as suitable hibernation habitat, including an abandoned mine on the north side of the Telkwa River, which was unable to be assessed for available access by bats as its location was determined after the baseline field program was completed.

Table 3.4-8: Summary of the results of the baseline forest bat habitat suitability model by season within the W-LSA and the WRW-RSA.

Model	Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wildlife RSA (ha)	Wildlife RSA (%)
Food (Growing)	High	436.4	1.2%	1,957.3	1.0%
	Moderate	10,870.2	30.4%	40,043.0	20.6%
	Low	6,799.0	19.0%	23,325.4	12.0%
	Nil	17,620.2	49.3%	129,324.8	66.4%
	Total	35,725.9	100.0%	194,650.5	100.0%
Security/Thermal (Growing) (Day/Night Roosting)	Suitable	11,349.9	31.8%	49,831.0	25.6%
	Unsuitable	24,376.0	68.2%	144,819.5	74.4%
	Total	35,725.9	100.0%	194,650.5	100.0%
Reproduction (Growing) (Maternal Roosting)	High	2,333.5	6.5%	9,866.9	5.1%
	Moderate	2,019.5	5.7%	11,021.2	5.7%
	Low	2,584.0	7.2%	10,668.1	5.5%
	Nil	28,788.8	80.6%	163,094.3	83.8%
	Total	35,725.9	100.0%	194,650.5	100.0%
Hibernation (Winter)	Suitable	23.4	0.1%	414.4	0.2%
	Unsuitable	35,702.5	99.9%	194,236.1	99.8%
	Total	35,725.9	100.0%	194,650.5	100.0%

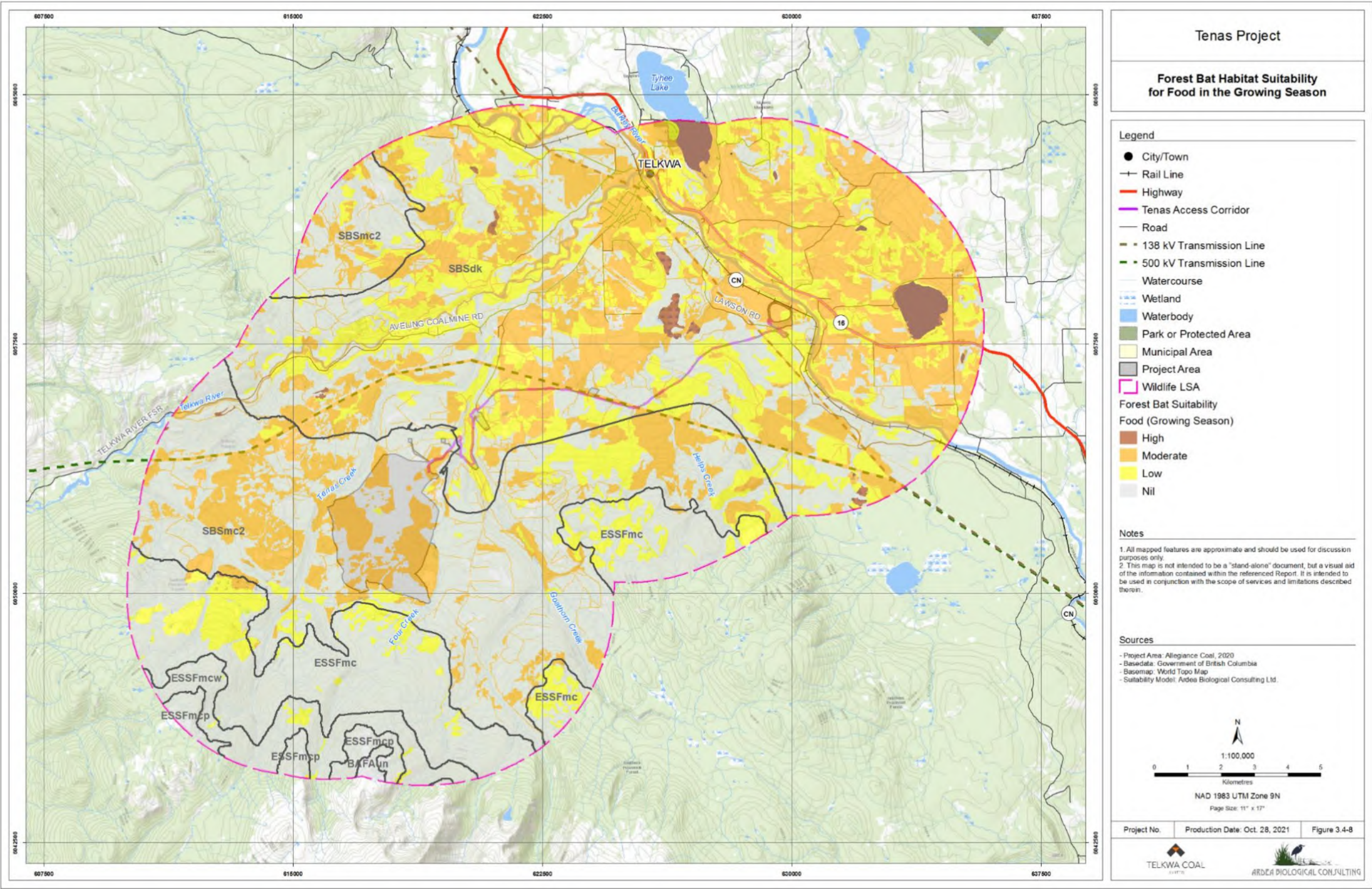


Figure 3.4-8: Habitat suitability model ratings for forest bat food habitat in the growing season in the W-LSA.

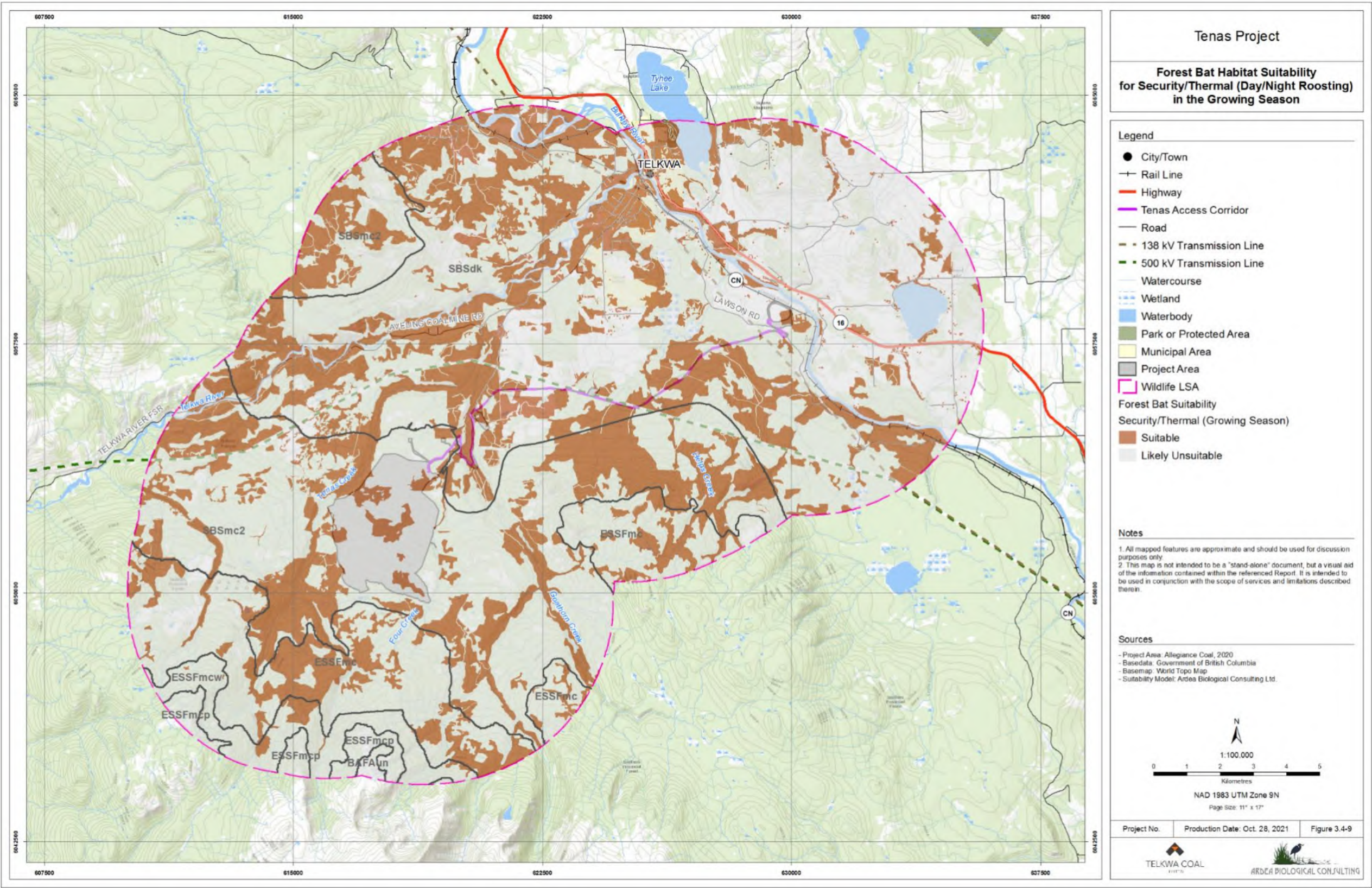


Figure 3.4-9: Habitat suitability model ratings for forest bat security/thermal (day/night Roosting) habitat in the growing season in the W-LSA.



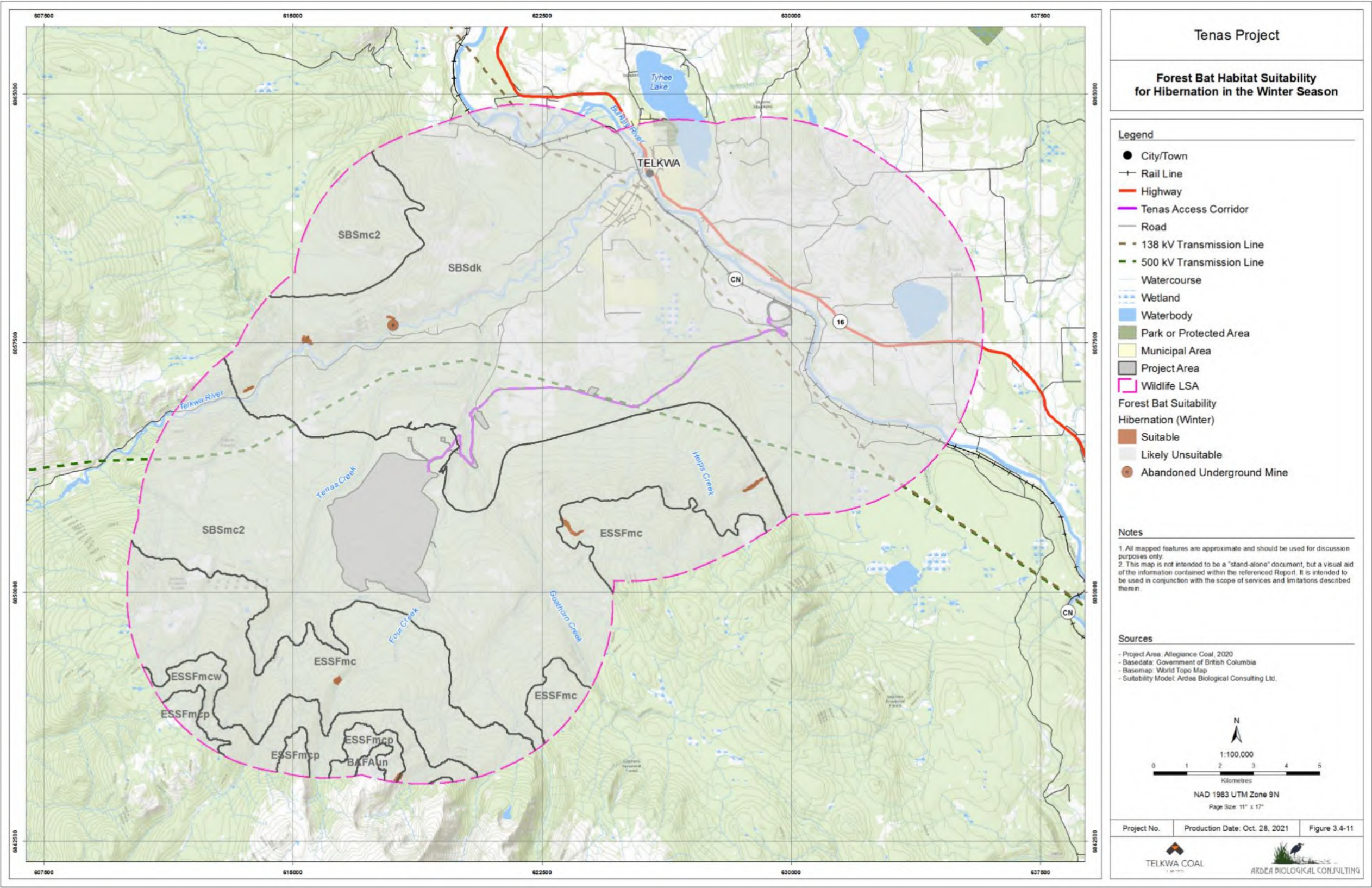


Figure 3.4-11: Habitat suitability model ratings for forest bat hibernation habitat in the winter season in the W-LSA.

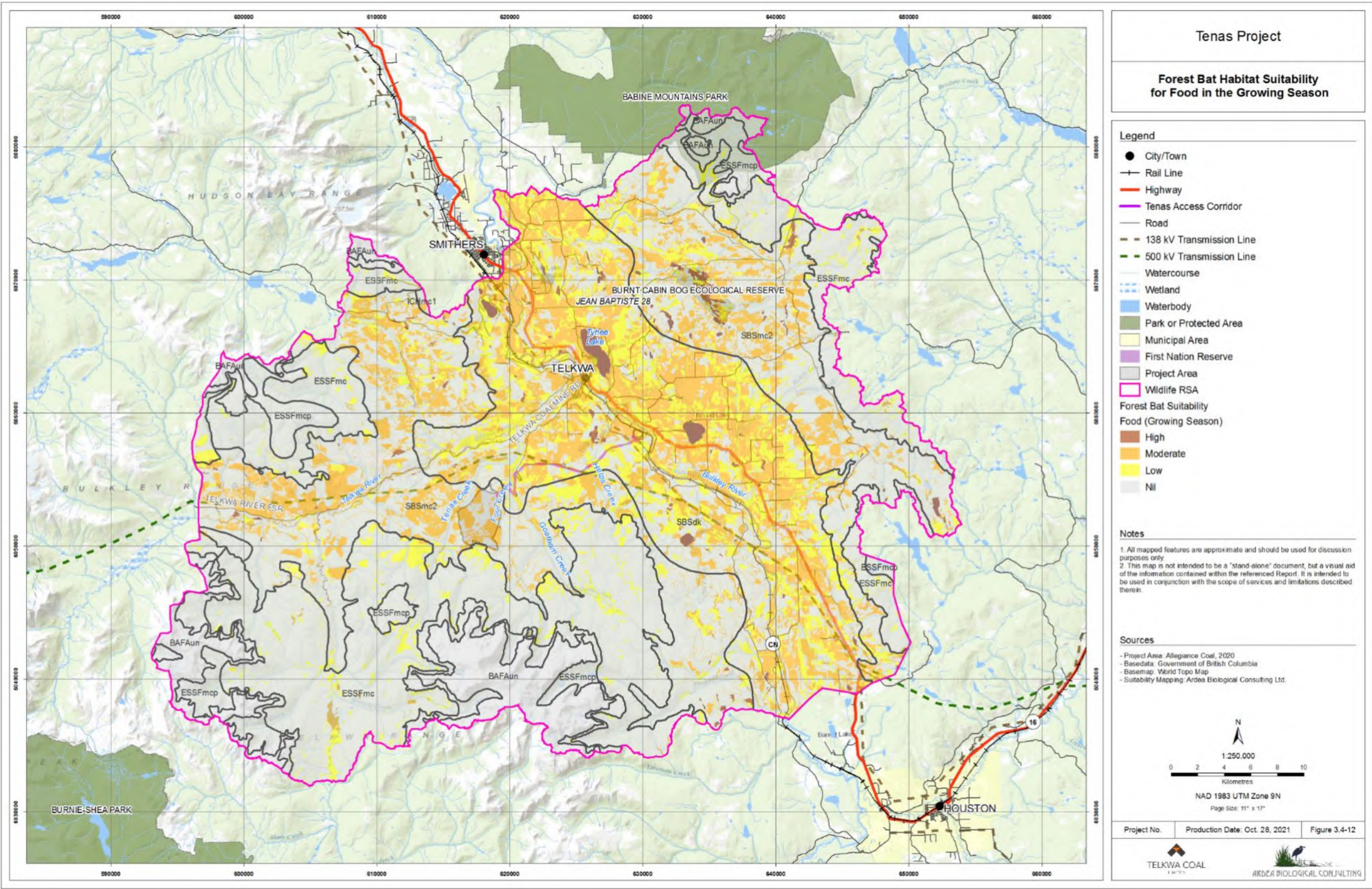


Figure 3.4-12: Habitat suitability model ratings for forest bat food habitat in the growing season in the W-RSA.

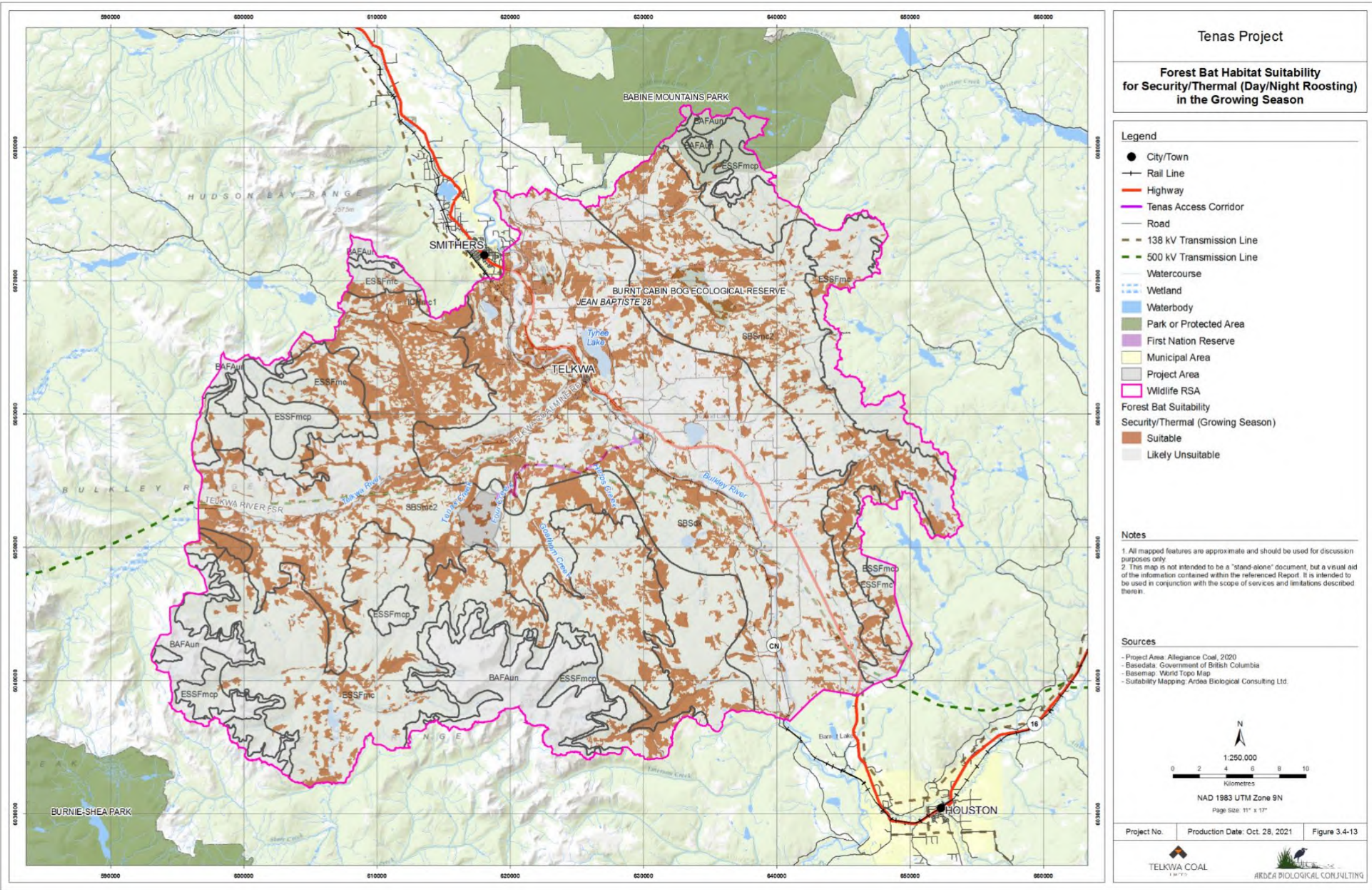


Figure 3.4-13: Habitat suitability model ratings for forest bat security/thermal (day/night roosting) habitat in the growing season in the W-RSA.

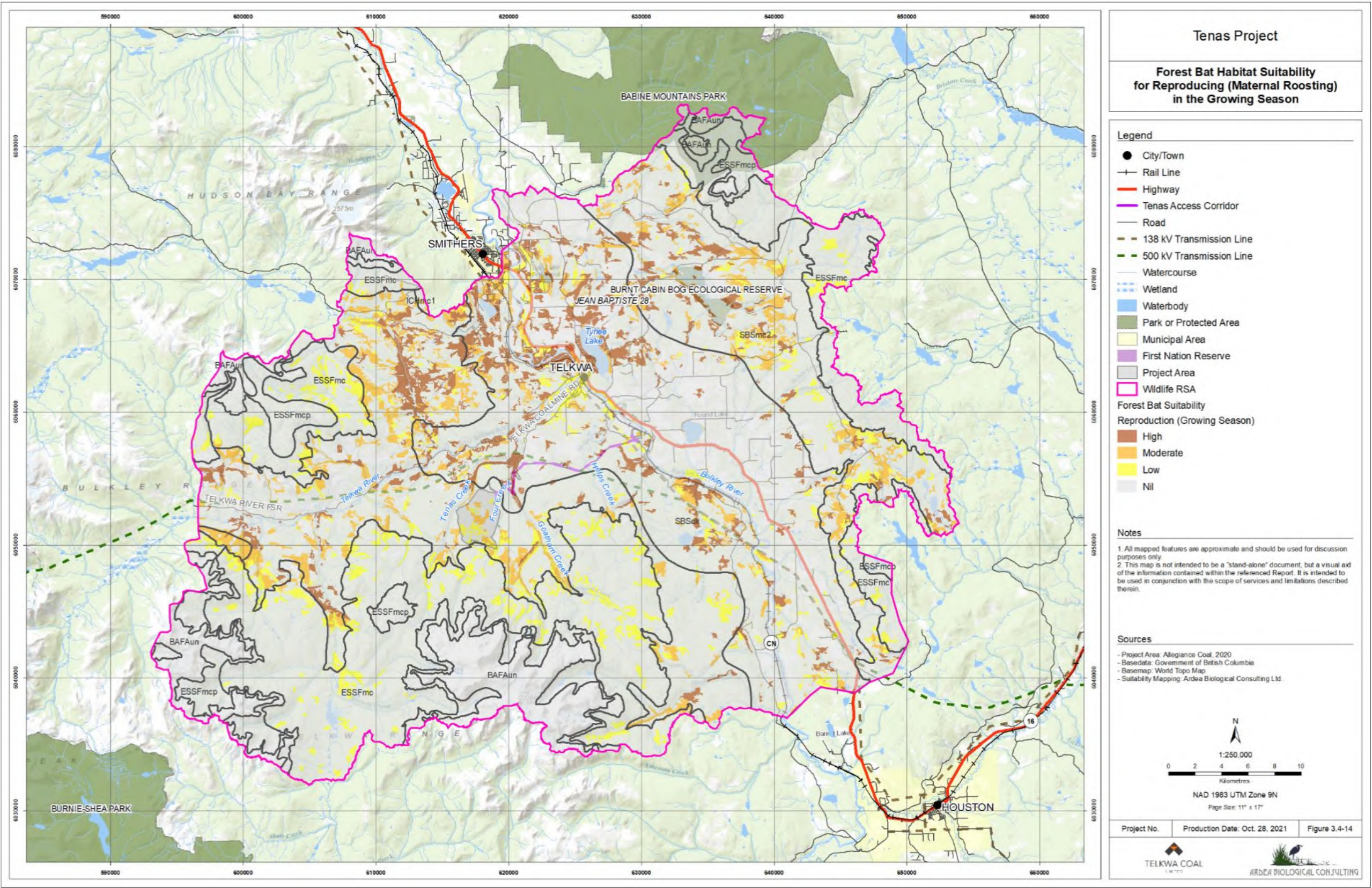
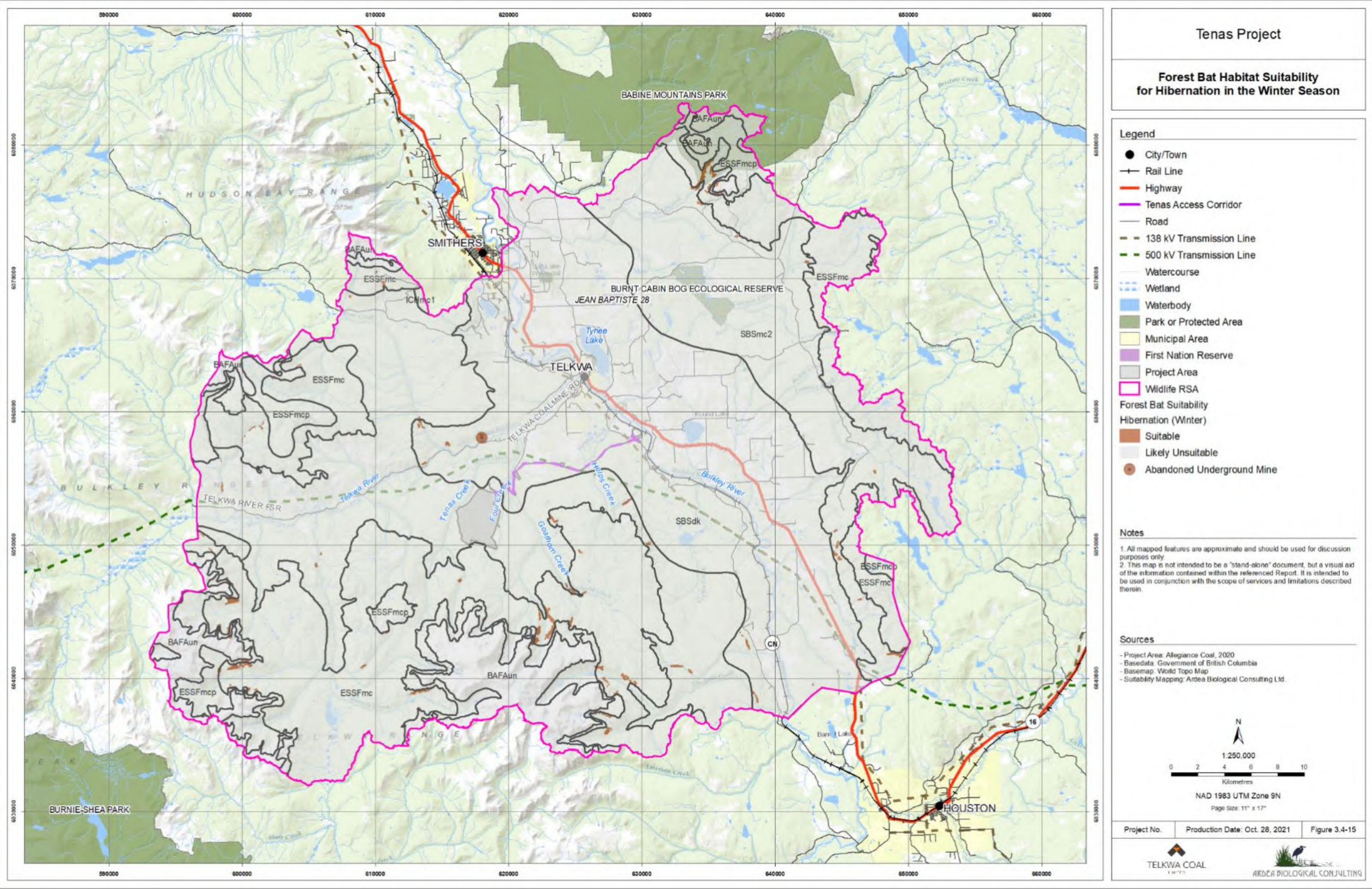


Figure 3.4-14: Habitat suitability model ratings for forest bat reproduction (maternal roosting) habitat in the growing season in the W-RSA.



3.5 Furbearers

3.5.1 Existing Information on Furbearers

Historical EAs performed in the project area identified the presence of several furbearer species during their studies. TAESCO (1985) confirmed the presence of the following species during 1983 and 1984 winter snow tracking surveys; marten, fisher, short-tailed weasel, long-tailed weasel, mink, river otter, grey wolf, coyote, red fox, lynx, cougar, and wolverines. Tracking indicated that the most common furbearers were marten and weasel followed by were coyote, fox, mink, fisher lynx and wolf. Red squirrels and snow shoe hare were noted as being very common in parts of the study area. Beaver was not confirmed to be present during these surveys and appeared to be low in numbers. TAESCO (1985) also reported that a pack of 10 to 15 wolves were using the Telkwa River area in the winter of 1983 and 1984.

During subsequent wildlife surveys (Hatler 1990) noted wolf sign including fresh tracks in 7 of 9 transects. Hatler also reported that a local resident noted small groups of wolves visiting their farm. Coyote sign was observed throughout the project area and one red fox was observed. Hatler commented that both coyote and fox were most likely common in the project area. The 1990 surveys found that snowshoe hare sign was abundant, being the second most abundant sign next to moose sign. Although no lynx sign was observed, the abundance of snowshoe hare sign prompted Hatler to conclude that lynx would 'doubtlessly occur in the area'. Limited mustelid sign was observed in the 1990 surveys including marten scat and short-tailed weasels. Red squirrels and voles accounted for the majority of rodent sign.

Based on the work completed by TAESCO (1985) and Hatler (1990), Edie (1998b) conducted additional habitat assessments for other furbearer species. He concluded that the number of wolverines, if present at all in the area would be limited, and would only have a very small part of their home range affected by the Telkwa Coal project as proposed in 1998. He also concluded that due to fisher tracks being observed regularly during the TAESCO (1985) assessments, that fisher use most, if not all of the forested habitat within the Telkwa Coal project area proposed in 1998. Using TAESCO's assessment work and various studies on fisher in BC, Edie (1998b) estimated that 3 to 6 fishers could be partially or completely displaced by development of the 1998 Telkwa Coal project area and his assessment was that the local fisher population would be reduced during the life of the mine and for sometime after.

Conservation Context

A review of the BC CDC was completed using the BC CDC *Species Explorer* website (BC CDC 2014a) for furbearer species likely to be found within the Skeena Stikine Forest District, which contains the W-RSA and the results are provided in Table 3.5-1.

Table 3.5-1: Conservation status of furbearers that potentially occur in the W-RSA.

Species Name		Conservation Status ¹		
		Provincial	Federal	
Common	Scientific	BC CDC	COSEWIC	SARA Schedule 1
American Marten	<i>Martes americanis</i>	Yellow	Not Assessed	Not Assessed
American Mink	<i>Neovison vison</i>	Yellow	Not Assessed	Not Assessed
Beaver	<i>Castor canadensis</i>	Yellow	Not Assessed	Not Assessed
Canada Lynx	<i>Lynx canadensis</i>	Yellow	Not Assessed	Not Assessed
Cougar	<i>Puma concolor</i>	Yellow	Not Assessed	Not Assessed
Coyote	<i>Canis latrans</i>	Yellow	Not Assessed	Not Assessed
Fisher (population 5, Columbian)	<i>Pekania pennant</i>	Red	Not Assessed	Not Assessed

Species Name		Conservation Status ¹		
		Provincial	Federal	
Common	Scientific	BC CDC	COSEWIC	SARA Schedule 1
Grey Wolf	<i>Canis lupus</i>	Yellow	Not Assessed	Not Assessed
Red Fox	<i>Vulpes vulpes</i>	Yellow	Not Assessed	Not Assessed
Red Squirrel	<i>Tamisciurus hudsonics</i>	Yellow	Not Assessed	Not Assessed
River Otter	<i>Lontra canadensis</i>	Yellow	Not Assessed	Not Assessed
Short-tailed Weasel	<i>Mustela ermine</i>	Yellow	Not Assessed	Not Assessed
Snowshoe Hare	<i>Lepus americanus</i>	Yellow	Not Assessed	Not Assessed
Wolverine (<i>luscus</i> subspecies)	<i>Gulo gulo luscus</i>	Blue	Special Concern	Special Concern

Notes: 1) See Table 2.1-2 in Section 2.1.1 for status definitions.

Except for fisher and wolverine, all furbearer species potentially occurring within the W-RSA are classified by the BC CDC as Yellow listed and except for wolverine none are listed under SARA Schedule 1. There are two provincially listed populations of fisher that occur in BC; the Boreal population in northeast BC, which is blue listed; and the Columbian population in the central interior of BC which is red listed (BC CDC 2021). The fisher population within the W-RSA is considered part of the Columbian population (R. Weir, Carnivore Conservations Specialist, BC MOE, pers. comm., May 7, 2021), which is Red listed by the province. There are two wolverine sub-species found in BC, the *vancouverensis* sub-species which is restricted to Vancouver Island and the adjacent central coast and the *luscus* sub-species, which is found in the remainder of the province (BC CDC 2021). All wolverine sub-species in BC have been assessed by COSEWIC as Special Concern (COSEWIC 2014) and are listed under Schedule 1 of SARA (BC CDC 2021).

Management Initiatives

Furbearers are classified as wildlife under the *Wildlife Act* and are managed under the provincial Fur Management Program. Harvesting of furbearers is primarily through trapping and requires a licence or permit under the *Wildlife Act* and associated regulations. Some furbearer species such as cougar, coyote, grey wolf and snowshoe hare are also hunted under regulations within the *Wildlife Act*. Guidebooks prepared by the BC Trappers Association and BC Environment provide ecological and harvest management guidance for trappers in the management of a range of species including marten, fisher and wolverine (Hatler et al. 2003a, 2003b, Hatler and Beal 2003). The land management plans for the area (i.e. the Bulkley LRMP [BVCRB and IRT 1998] and the Bulkley SRMP [BC MAL 2005]) do not explicitly provide management direction for marten, fisher or wolverine as species of interest, although they suggest that management of harvesting and general biodiversity guidelines (e.g. coarse woody debris, mature forest retention and ecosystem networks) will potentially benefit them. They also identify that both fisher and wolverine are listed species and require management through species at risk regulations, policies and guidelines. Habitat management objectives outlined for marten, fisher and wolverine in BC MFLNRO (2014a) may also assist proponents during mitigation planning and implementation related to fisher habitat management.

Both fisher and wolverine are identified as Regionally Important Wildlife within the *Identified Wildlife Management Strategy* under the FRPA (Badry 2004, BC CDC 2021) and have specific management measures identified for the species within the W-RSA (BC MWLAP 2004a). The provincial Fisher Habitat Working Group has developed habitat tools, including spatial data and supporting decision tables with conditions and targets, to assist forestry professionals with fisher habitat management in BC (Fisher Habitat Working Group 2021). These habitat tools are tailored by Natural Resource District (NRD) and Fisher Habitat Zones (FHZs) and are intended to help identify retention targets for important fisher habitat

requirements (i.e., denning and resting sites) at the stand and landscape scales during forestry operations. Although these habitat tools do not represent a habitat suitability or capability model for fisher and are not intended for assessing the effects of industrial development projects on fisher habitat, they may assist proponents during mitigation planning and implementation related to fisher habitat management. The W-RSA is located within the Skeena-Stikine NRD in the Sub-Boreal FHZ. In general, the minesite overlaps portions of the Sub-Boreal FHZ (moist/wet subzones) and the Tenas access corridor overlaps portions of the Sub-Boreal FHZ (dry subzones). Habitat attributes captured in the spatial data for these zones that are the focus of habitat retention for fisher include denning habitats (for birthing and rearing), broom resting habitats, cavity resting habitats, and CWD resting habitats.

American Marten

American marten is a medium-sized member of the weasel family related to fisher and wolverine that are found within coniferous boreal and taiga forests across North America (Gibilisco 1994). Within BC they are found within most of the forested portions of the province (BC CDC 2020), utilizing a range of primarily mature forest habitats to provide important feeding, thermal, security and reproductive habitats.

Distribution and Habitat Use

Highly suitable marten winter habitats are mesic to hygric mature and old-growth coniferous forests that have high levels of coarse woody debris (CWD), 20% to 60% canopy closure, little deciduous canopy and little to intermediate high and low shrub cover. Forests located in the SBS biogeoclimatic zone of the Central Interior Ecoprovince provide suitable marten winter habitat when the mature forest reaches the mature seral stage (Lofroth 1993). Mesic habitats support the greatest number of small rodent prey and the greatest variety of understory plant species (Koehler and Hornocker 1977).

Due to its smaller body size, the marten has a greater ability to travel across deep, soft snow than the fisher (Raine 1981 *In* Buskirk and Ruggiero 1994). Martens tend to climb trees more than the fisher, but like the fisher, most travel and hunting occurs on the surface of the ground (Grinnell et al. 1937 and Francis and Stephenson 1972 *In* Buskirk and Ruggiero 1994). Martens are flexible in their activity patterns and may be active during the day or night (Hauptman 1979 *In* Buskirk and Ruggiero 1994). Clark and Campbell (1977) observed that marten activity was affected by weather conditions, with reduced activity occurring during continuous rainfall and snowfall.

The general diet of martens includes voles, squirrels, mice, ungulates (as carrion) and soft mast, especially the berries of *Vaccinium* spp. and *Rubus* spp. Several studies found that red-backed voles were the primary prey during all seasons (Koehler et al. 1975, Clark and Campbell 1977, Soutiere 1979) while deer mice and shrews are a low preference food (Koehler et al. 1975, Soutiere 1979, Buskirk and Ruggiero 1994), except on Vancouver Island where red-backed voles are absent and deer mice are a staple (Buskirk and Ruggiero 1994). The general diet of martens overlaps considerably with that of the fisher, and it is possible that competition between the two species may result (de Vos 1952). During the critical season of winter, the abundance and availability of small mammals are important determinants of health in martens (Buskirk and Ruggiero 1994).

Reproduction and Kit Rearing

Marten breed from late June to early August, with most mating occurring in July (Markley and Bassett 1942 *In* Buskirk and Ruggiero 1994). Due to delayed implantation, the total gestation period for marten is 260 to 275 days (Ashbrook and Hansen 1927 and Markley and Bassett 1942 *In* Buskirk and Ruggiero 1994), but active gestation occurs only during the last 27 days (Jonkel and Weckworth 1963 *In* Buskirk and Ruggiero 1994). Parturition occurs in March and April of the year following breeding (Strickland et al. 1982 *In* Buskirk and Ruggiero 1994) and mean litter size is 2.85 kits with a range of 1 to 5 kits per litter (Strickland and Douglas 1987 *In* Buskirk and Ruggiero 1994).

Female marten care for the young, finding a suitable natal den, collecting nesting material, moving kits to other dens (Henry and Ruggiero n.d. and Wynn and Sherburne 1984 *In* Buskirk and Ruggiero 1994), post-

partum grooming and nursing (Brassard and Bernard 1939 and Henry and Ruggerio n.d. *In* Buskirk and Ruggiero 1994) and providing food for young (Buskirk and Ruggiero 1994). Marten kits are weaned after 42 days (Mead 1994 *In* Buskirk and Ruggiero 1994) and emerge from dens after 50 days, but litters may be moved earlier between maternal dens (Hauptman 1979 and Henry and Ruggerio n.d. *In* Buskirk and Ruggiero 1994).

Movement

Most adult martens are non-migratory and make use of relatively constant home ranges in order to satisfy feeding, security and reproducing life requisites. Animals that have not yet established home ranges include dispersing juveniles and non-resident adults (Buskirk and Ruggiero 1994). Soutiere (1979) found that active logging did not cause a shift in home ranges within partially cut forest and that transient martens moved indiscriminately between undisturbed and partially cut forest. *In* Wyoming, Clark and Campbell (1977) reported that shifts in home ranges might have occurred as a result of logging. Buskirk and Ruggiero (1994) state that seasonal shifts in marten home range do not occur, but marten may migrate during a rare case of unpredictable environmental change.

The home range of males is larger than that of females, but the mean home range size of individual martens in a population varies by geographic location, prey abundance and available habitat types (Buskirk and McDonald 1984 *In* Buskirk and Ruggiero 1994). In Maine, Soutiere (1979) found that the minimum home range size of male martens varied from 0.1 km² to 7.6 km², and for females, home range varied from 0.1 km² to 2.3 km². Also in Maine, Steventon (1982) found that the mean home range for three males was 8.2 km² and the home range of one female was 2.25 km². In Newfoundland, Bateman (1986) recorded home range sizes of 27.5 km² for one male and 17.7 km² for one female. In the Central Interior Ecoprovince of British Columbia, Lofroth (1993) reported an average male home range size of 5.25 km² and an average female home range size of 3.16 km². The home range of male martens may be larger than that of females so that males can gain access to multiple mates (Powell 1994 *In* Buskirk and Ruggiero 1994). Home range size is usually much larger in areas with clearcuts than in areas where forests are undisturbed or selective harvest has been practiced (Soutiere 1979, Thompson and Colgan 1987 *In* Buskirk and Ruggiero 1994). In Ontario, Taylor and Abrey (1982) found that the size and shape of home ranges differed between homogeneous and heterogeneous habitats.

Younger seral stages generally have lower population densities and larger individual home ranges than older seral stages (Soutiere 1979). In Idaho, Koehler et al. (1977) reported that the highest activity by martens within home ranges was in or near mature mesic spruce/fir stands with greater than 30% canopy cover. Lofroth (1993) found that marten home ranges contained mainly mesic to hygric habitats ranging in successional stage from young forest to old-growth forest. He felt that by establishing home ranges, martens included preferred habitat types and avoided or infrequently used habitats that had little value. Lofroth (1993) also found that large male martens included substantial areas of mid-seral stages within home ranges, which was likely due to the abundance of snowshoe hare found in these habitat types. A comparison to unused areas, areas of high use by marten in northeastern US were best described by the following overstory features of a stand: higher live-tree basal areas, taller trees, greater snag volumes (Payer and Harrison 2002 *in press*), and larger downed logs.

A detailed species account for marten is available in Appendix D that outlines these habitat requirements.

Fisher

Fisher is a medium-sized member of the mustelid family; they are excellent climbers and are capable of high-speed pursuits on the ground and in the trees (Eder and Pattie 2001). BC's fisher population is estimated to be between 1,195 to 2,036 animals (BC CDC 2020c). They occur throughout the forested regions of BC but are considered to be rare in coastal ecosystems and to have limited distributions in the southern interior and southeast BC (Eder and Pattie 2001, Weir 2003, Badry 2004, BC MFLNRO 2014a). The SBS, SWB, and BWBS BGC zones support preferred fisher habitat in BC, particularly in dense riparian and wetland forest habitats (Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010, BC

MFLNRO 2014a). Although the range of fisher in BC overlaps several BGC subzones/variants (Badry 2004), they are most common in a few select BGC subzones, including the SBSdk and SBSmc (Weir and Almuedo 2010), which comprise a large portion of the W-RSA at lower elevations (MAP). A study conducted in north central BC reported a density estimate of 9 to 11 fishers per 1,000 km² for the SBS BGC zone (Weir and Corbould 2006). Fishers occur at low to mid elevations (i.e., up to 2,500 m) with most individuals found below 1,000 m; they avoid high elevation habitats (Badry 2004, BC CDC 2010b, Weir and Almuedo 2010). During winters with high snowfall, fisher is likely restricted to lower elevations where movements are easier (Badry 2004). They do not exhibit seasonal changes in elevation (Badry 2004).

Distribution and Habitat Use

Fishers prefer mature and old coniferous and mixed forests where abundant coarse woody debris (CWD) and productive understory shrub cover provide foraging opportunities and security cover; large wildlife trees provide natal and maternal den sites and resting sites; and dense canopy closure (i.e., greater than 30%) provides security cover and snow interception (Eder and Pattie 2001, Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010, Proulx 2011, BC MFLNRO 2014a, Fisher Habitat Working Group 2019). They generally avoid more open habitats and younger forests, as well as forested areas that have been thinned by fire or logging, as these areas typically lack abundant CWD and productive understory shrub cover, large wildlife trees, and dense canopy closure (Eder and Pattie 2001, Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010, Weir and Corbould 2010, Fisher Habitat Working Group 2019). However, fisher will forage in a variety of structural stages, including non-vegetated through young forest sites, providing sufficient prey and security cover are present (Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010). Younger structural stages (i.e., non-vegetated through tall shrub sites) are typically avoided during winter as low snow interception leads to higher snow levels that may restrict movements (Weir 2003, Badry 2004).

Fishers are omnivorous generalists, and opportunistic hunters (Eder and Pattie 2001, Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010). Their diet is influenced by prey availability, abundance, and size and they are adaptable to changes in prey dynamics, switching prey sources as needed based on availability (Weir 2003, Badry 2004). Most of their diet consists of rodents, snowshoe hares (*Lepus americanus*), porcupines (*Erithizon dorsatum*), grouse, and other small birds and mammals; they also feed on carrion, fish, snakes, berries, nuts, and other vegetation (Eder and Pattie 2001, Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010). During summer, hunting activity is strongly correlated with abundant CWD and productive understory shrub cover where prey is plentiful (Badry 2004). During winter, hunting activity primarily occurs above the snow layer and snow conditions may influence hunting success and fisher distribution (Badry 2004).

As noted above, the SBS BGC zone, comprising a large portion of the W-RSA, supports fisher habitat, particularly in dense riparian and wetland forest habitats (Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010, BC MFLNRO 2014a). Connectivity between riparian and wetland forest habitats, and between riparian/wetland forest and upland habitats, is necessary to facilitate movements between important habitats within established home ranges or dispersal movements to establish new home ranges (Badry 2004, BC MFLNRO 2014a, Fisher Habitat Working Group 2019). Movement habitat is characterized by dense (i.e., greater than 50% canopy cover) tree/shrub habitat that is relatively continuous (i.e., openings less than 50 m wide), which provides increased security cover to limit predation risk (BC MFLNRO 2014a, Fisher Habitat Working Group 2019).

Other than females with kits at natal and maternal den sites (described below), fisher do not base activities within home ranges from a single location (Weir 2003, Badry 2004). They use resting sites throughout their home ranges for several purposes, including for security and thermal cover, but these sites are used on a more temporary basis with no indication of strong site fidelity (Eder and Pattie 2001, Weir 2003, Badry 2004, BC CDC 2010b). Research from the northeast region of BC (Weir 2003, Badry 2004, Weir et al. 2005) suggests that fisher use four main types of structures as resting sites, as outlined in the following:

- ▶ Rest sites on branches are arboreal sites that are usually associated with abnormal growths (i.e., broom rust or witches' broom) on large (i.e., greater than 40 cm diameter) spruce (*Picea spp.*) or subalpine fir (*Abies lasiocarpa*), but may occasionally be associated with large limbs on black cottonwood or spruce (Weir 2003, Badry 2004, Weir et al. 2005). For rest sites associated with abnormal growths, other research from the interior of BC indicates these growths must be large enough (i.e., typically greater than 40 cm diameter) to provide a platform for fisher to rest on (Weir and Almuedo 2010). Other research from the interior of BC also indicates fisher may use large limbs on trembling aspen (*Populus tremuloides*) as rest sites (Weir and Almuedo 2010).
- ▶ Rest sites in cavities are characterized by chambers in the decayed heartwood of large black cottonwood, trembling aspen, or Douglas-fir (*Pseudotsuga menziesii*) that are created by broken branches or by cavity nesting birds (Weir 2003, Badry 2004, Weir et al. 2005).
- ▶ Rest sites in CWD are typically associated with a single large piece of CWD (i.e., greater than 35 cm diameter) but may occasionally be associated with several smaller pieces of CWD (Weir 2003, Badry 2004, Weir et al. 2005). Elevated pieces of CWD (i.e., 25 to 50 cm off the ground) may be preferred over CWD directly on the ground (Badry 2004, Weir and Almuedo 2010). Fisher may use CWD in all stages of decay, from intact/hard (i.e., decay class 1) through to many small pieces/soft portions (i.e., decay class 5); however, CWD that is hard to partly decaying with large pieces (i.e., decay class 2 to 3) is preferred (Badry 2004, BC MOFR 2007, Weir and Almuedo 2010). Rest sites may be located inside, between, or underneath CWD, which may occur naturally or be a by-product of human activities (Weir 2003, Badry 2004, Weir et al. 2005).
- ▶ Rest sites on the ground are characterized by large diameter, loosely arranged rock piles, pre-existing burrows in the soil excavated by other animals (Weir 2003, Badry 2004, Weir et al. 2005), or cavities excavated by fisher in the snow (Eder and Pattie 2001).

Research from the northeast region of BC showed that rest sites on branches were used most frequently (57%), followed by rest sites in cavities (20%), rest sites in CWD (19%), and rest sites on the ground (5%) (Weir 2003, Badry 2004, Weir et al. 2005). Rest site selection by fisher is likely influenced by a variety of factors, including ambient temperature, season, snowpack depth, wind speed, line of sight (for prey detection), predator avoidance, and the availability of suitable rest sites on the landscape (Weir 2003, Badry 2004, Weir et al. 2005, Weir and Almuedo 2010)

Reproduction and Kit Rearing

Fisher have a low reproductive output relative to their lifespan (Weir 2003, Badry 2004); few individuals live longer than four years (BC CDC 2010b). Females are sexually mature at two years of age and may produce one litter per year (Eder and Pattie 2001, Weir 2003, Badry 2004); however, not all sexually mature females may breed each year (Weir 2003, BC CDC 2010b). In BC, parturition typically occurs between mid March and early April with litter sizes ranging from one to four kits (two to three kits is most common) (Eder and Pattie 2001, Weir 2003, Badry 2004, BC CDC 2010b, BC MFLNRO 2014a). Breeding occurs shortly after kits are born, but the embryos do not implant until January or February (Eder and Pattie 2001, Badry 2004). Females give birth in natal dens where they may rear their kits until June (Eder and Pattie 2001, Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010, BC MFLNRO 2014a). Once the female leaves the natal den with her kits, she may use between one to five maternal dens to continue rearing her kits (Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010). Natal and early rearing between March 15 and June 30 is considered a sensitive time period for fisher in northern BC (BC MFLNRO 2014a).

Females select specific sites for natal and maternal dens that offer a high degree of security and thermal cover; tree cavities created by broken branches or by cavity nesting birds are common locations for these dens, particularly cavities in large, deteriorating, deciduous trees (Eder and Pattie 2001, Weir 2003, Badry 2004, BC CDC 2010b, Weir and Almuedo 2010, Proulx 2011). Research in BC suggests that females select atypically large (i.e., greater than 90 cm diameter; mean diameter 105 cm) and declining black cottonwood (*Populus balsamifera ssp. trichocarpa*) or balsam poplar (*Populus balsamifera ssp. balsamifera*) trees with

cavities that are located an average of 15 m above the ground (Weir 2003, Badry 2004, Weir and Almuedo 2010). The size of the tree at the cavity entrance hole is typically greater than 40 cm in diameter to accommodate a sufficiently sized cavity (i.e., usually greater than 30 cm in diameter) for rearing a litter of kits (Weir and Almuedo 2010). Such trees are not common on the landscape and may represent a limiting factor for fisher populations in BC, which likely explains why females show high fidelity to natal and maternal den sites (Weir 2003, Badry 2004, Weir and Almuedo 2010, BC MFLNRO 2014a). Based on natal and maternal dens identified in BC, researchers suggest that candidate trees for these purposes are those that are large with heart rot and a trunk diameter greater than 54 cm at 5 m above ground (Weir 2003, Badry 2004, Weir and Almuedo 2010). Deciduous trees suitable for natal or maternal den sites are typically associated with wetter moisture regimes (Badry 2004, Weir and Almuedo 2010, Proulx 2011), which explains the fisher's preference for riparian and wetland forest habitats.

Information is limited on dispersal of juvenile fisher from their natal home ranges. In eastern portions of their range in the United States, research indicates that juvenile fishers disperse during their first winter and typically establish home ranges within 11 km of their natal den sites (Weir 2003, Badry 2004). In comparison, research from the Williston region of BC showed that juvenile fisher may not disperse and establish home ranges until they are two years old, and may disperse further from their natal home ranges (i.e., up to 20 km) (Weir 2003, Badry 2004).

Movement

The fisher is a solitary animal and typically only interact with other fisher during mating and territorial defence (other than females with kits) (Weir 2003, Badry 2004, Weir et al. 2009, BC CDC 2010b). They are also non-migratory, occupying the same home range year-round without displaying seasonal movements or range shifts (BC CDC 2010a). Based on studies across North America, fisher establish relatively large home ranges, ranging in size from 4 to 32 km² for females (mean 15 km²) and 19 to 79 km² for males (mean 38 km²) (Weir 2003, Badry 2004, Weir et al. 2009). Home ranges of individuals of the same sex rarely overlap (Weir 2003, Badry 2004, Weir et al. 2009, BC CDC 2010b). However, the size and spatial arrangement of home ranges may differ depending on the availability of resources (e.g., prey, suitable denning and resting habitat, and mating opportunities) (Weir 2003, Badry 2004, Weir et al. 2009). Home ranges may be larger and/or show more overlap if the abundance of resources is lower and/or not uniformly distributed across the landscape (Weir 2003, Badry 2004, Weir et al. 2009). This appears to be the case in central BC where researchers reported substantially larger home ranges for females (i.e., range 11 to 81 km²; mean 38 km²) and males (i.e., range 46 to 225 km²; mean 161 km²) (Weir et al. 2009). According to research conducted by the Fisher Habitat Working Group in BC, fisher (not differentiated by gender) in the Sub-Boreal Fisher Habitat Zone (FHZ), which encompasses the W RSA, established home ranges of approximately 50 km² in moist/wet subzones (e.g., SBSwk, SBSmk, SBSmm, and SBSmw) and 25 km² in dry subzones (e.g., SBSdw, SBSdh, SBSd) (Fisher Habitat Working Group 2019).

Despite relatively short dispersal distances from natal home ranges and the lack of seasonal movements, fishers are known to travel widely throughout their established home ranges in search of resources (Eder and Pattie 2001, Weir 2003, Badry 2004). They typically travel up to 5 to 6 km/day within their home ranges, following circuits of up to 96 km (Weir 2003, Badry 2004). Transient individuals searching for new home ranges may travel greater distances of up to 50 km or more within a few days (Weir 2003, Badry 2004, BC CDC 2010b). A study conducted in central BC documented translocated fishers covering areas greater than 700 km² while transient and searching for new home ranges (Weir 2003, Badry 2004). Major rivers and topographic features do not appear to deter fisher movements (Weir 2003, Badry 2004). Fisher activity may be reduced during winters with colder temperatures and/or deep, soft snow (Weir 2003, Badry 2004). In response to deep, soft snow, fisher will modify their habitat use patterns to include forest stands with higher canopy closure and increased snow interception (Weir 2003, Badry 2004).

Wolverine

Wolverine is the largest terrestrial member of the mustelid family and are widely distributed throughout BC, occurring in forested and montane habitats although they are rare on the coast and avoid the dry grassland regions of the southern interior (Weir 2004, BC CDC 2010a). BC's wolverine population is estimated at 3,530 animals (Lofroth and Krebs 2007, BC CDC 2010a). The range of wolverines in BC overlaps several BGC zones /subzones (Weir 2004), including all zones/subzones of the W RSA (MAP). In the mountainous regions of BC, females typically use alpine zones (e.g., BAFA) during summer and lower elevation ESSF zones during winter (Weir 2004). In comparison, males typically use ESSF zones during summer and lower elevation forested zones (e.g., SBS zones, which comprise a large portion of the W RSA) during winter (Weir 2004). Wolverine densities are low throughout their range in Canada, ranging from 5 to 10 individuals per 1,000 km² (COSEWIC 2014d). The highest predicted densities of wolverines in BC occur in the interior mountains (BC MFLNRO 2014a). A study conducted in the Omineca and Columbia mountains in BC calculated mean density estimates of 6.5 and 5.8 wolverines per 1,000 km², respectively (Lofroth and Krebs 2007, COSEWIC 2014).

Distribution and Habitat Use

Wolverines occur at all elevations, from valley bottoms and riparian areas up into subalpine and alpine habitats (Eder and Pattie 2001, Weir 2004, BC MFLNRO 2014a, COSEWIC 2014d). The upper elevational limit of their range is likely influenced by the distribution of prey (Weir 2004). Adult females typically use higher elevation habitats and steeper terrain compared to males or other female age classes (Lofroth 2001, Weir 2004, COSEWIC 2014d), particularly during summer when they are feeding their young in alpine and subalpine habitats where predation risk is lower (Lofroth 2001, Krebs et al. 2007). Males and other female age classes tend to use lower elevation forested habitats more frequently compared to adult females (Lofroth 2001, Weir 2004, COSEWIC 2014). All elevations are used by both sexes during summer, with males venturing up into higher elevation habitats in search of mating opportunities, while lower elevation habitats are used more frequently by males during winter (Lofroth 2001, COSEWIC 2014d).

Wolverines use a variety of forested and montane habitats as long as there is a sufficient food supply, suitable habitat for raising kits (i.e., natal and maternal den sites and rendezvous sites — see below), and minimal anthropogenic disturbance (Weir 2004, BC CDC 2010a, BC MFLNRO 2014a, COSEWIC 2014). Research indicates habitat selection occurs more at the landscape scale rather than the stand scale (with the exception of reproductive females selecting specific features for natal and maternal dens), which corresponds with the establishment of large home ranges (see below) (Weir 2004, BC MFLNRO 2014a, COSEWIC 2014d). Wolverines may use habitats across a variety of structural stages but prefer later stages (i.e., mature and old forest habitats) that provide abundant foraging opportunities and thermal and security cover (Lofroth 2001, Weir 2004, BC MFLNRO 2014a). Reproductive females use a combination of early and late structural stages, with early stages being characterized by sparse/cryptogram or herb habitats at high elevations that are used during denning and rearing (see below) (Lofroth 2001, Weir 2004, BC MFLNRO 2014a). Middle structural stages (i.e., shrub/herb and pole/sapling habitats) are used least frequently by wolverines (Lofroth 2001, Weir 2004).

A study conducted in the Omineca and Columbia mountains in BC concluded that habitat selection by males during summer and winter was primarily influenced by food availability (Krebs et al. 2007). During summer, male presence was positively correlated with recently logged areas and mid-elevation avalanche terrain where prey (e.g., marmots (*Marmota* spp.), snowshoe hares, and other small mammals and birds) was abundant (Krebs et al. 2007). During winter, male presence was positively correlated with lower elevation forests and moose winter ranges where opportunities for scavenging carrion were greater due to increased wolf activity (Lofroth 2001, Krebs et al. 2007). In comparison, a more complex combination of food availability, predation risk, and anthropogenic disturbance influenced habitat selection by females during summer and winter (Krebs et al. 2007). During summer, female presence was positively correlated with high elevation subalpine and alpine habitats where prey (e.g., marmots and ground nesting birds) was abundant but predation risk lower; they avoided areas with roads and recent logging activity (Krebs et al.

2007, Lofroth et al. 2007). During winter, female presence was positively correlated with lower elevation moose winter ranges in more rugged landscapes where opportunities for scavenging carrion were greater but predation risk and anthropogenic disturbance were lower due to more difficult terrain (Lofroth 2001, Krebs et al. 2007). A study conducted in north central BC indicated that late successional riparian forest habitat may be preferred foraging habitat based on high wolverine activity rates documented in this habitat type (Lofroth 2001, Weir 2004).

Research from the Omineca region of BC identified three seasons of activity for wolverines, which are influenced by biological factors (e.g., breeding and foraging) and climatic conditions (Lofroth 2001).

- ▶ The summer season from approximately late May to mid-September, which starts with den emergence of kits and ends with the beginning of marmot hibernation. This season includes female provisioning of young and the mating season for wolverines.
- ▶ The fall and early winter season from approximately mid-September to mid-December. During this season, foraging options are limited as marmots are hibernating and ungulates (i.e., potential sources of carrion) are relatively dispersed across the landscape and generally still in healthy condition.
- ▶ The winter and late spring season from approximately mid-December to late May, which includes parturition and natal and maternal denning for adult females. Carrion from starvation, predator kills, avalanche kills, and other reasons is a main food source for wolverines during this season.

Wolverines are generalist predators and opportunistic scavengers (Weir 2004, Lofroth et al. 2007, COSEWIC 2014d). Their diet varies seasonally and annually in response to prey availability and distribution (Lofroth et al. 2007, COSEWIC 2014d). Fresh prey is consumed more frequently during summer and carrion, including cached items, is consumed more frequently during winter (Weir 2004, COSEWIC 2014). Important prey species include marmots, ground squirrels (*Spermophilus spp.*), snowshoe hares, porcupines, and ground nesting birds (e.g., grouse, ptarmigan); they also consume beavers (*Castor canadensis*) and a variety of other small mammals and birds (Eder and Pattie 2001, Weir 2004, BC CDC 2005, Krebs et al. 2007, Lofroth et al. 2007, BC MFLNRO 2014a, COSEWIC 2014). Fish may comprise an important part of the wolverine diet in areas with anadromous salmon runs (Eder and Pattie 2001, Weir 2004, BC CDC 2005). Several ungulate species (e.g., moose, elk, caribou, deer, and mountain goat) are also regularly consumed, primarily as carrion (Eder and Pattie 2001, Weir 2004, BC CDC 2010a, Krebs et al. 2007, Lofroth et al. 2007, BC MFLNRO 2014a, COSEWIC 2014). As the availability of large ungulate carrion decreases, the proportion of small mammals in the diet increases (Weir 2004, Lofroth et al. 2007). To a lesser extent, the wolverine diet also includes berries, fungi, nuts, and other vegetation (Weir 2004, BC CDC 2010a, Lofroth et al. 2007).

Wolverines are known to cache food items for later consumption during periods of resource scarcity, such as during the winter season (see above) (Weir 2004, BC CDC 2010a, Inman et al. 2012, COSEWIC 2014d). Cache sites are typically located in cool, structured microsites (e.g., boulder piles, rocky screes, snowdrifts, and swamps) that help to minimize bacterial growth, insect attraction, and discovery by other scavengers (Inman et al. 2012). Availability of suitable cache sites may be a limiting factor for wolverine populations, particularly for reproductive females (Inman et al. 2012).

Reproduction and Kit Rearing

Wolverines have low reproductive rates (BC CDC 2010b, Government of Canada 2011, COSEWIC 2014d). Most wolverines are sexually mature at two to three years of age and live for approximately 10 to 18 years (BC CDC 2010a, Government of Canada 2011, COSEWIC 2014d). Females may produce one litter per year; however, in some areas, they may only produce a litter every two to three years (BC CDC 2010a, COSEWIC 2014d). Wolverines exhibit delayed implantation with breeding occurring during summer and embryos implanting in January or February (Weir 2004). Parturition typically occurs between late February and mid-April with litter sizes ranging from one to five kits (two to three kits is most common) (Eder and Pattie 2001, Weir 2004, BC MFLNRO 2014a, COSEWIC 2014d). Females give birth in natal dens where

they nurse their kits for eight to nine weeks (Eder and Pattie 2001, Weir 2004, BC MFLNRO 2014a). Once the female leaves the natal den with her kits, she may use between one to four maternal dens while rearing her kits (Weir 2004). Natal and early rearing between February 1 and June 29 is considered a sensitive time period for wolverines in northern BC (BC MFLNRO 2014a).

Reproductive females require seasonal habitats in proximity to successfully raise young (Weir 2004), including the following attributes:

- ▶ lower elevation habitat that provides a reliable source of food (i.e., primarily large ungulate carrion) that can be cached to meet the energetic demands of lactating during late winter/early spring;
- ▶ higher elevation habitat that provides specific features for den sites and food caching, as well as spatial separation from predators; and
- ▶ and an abundant source of prey (e.g., marmots and ground nesting birds) to feed young kits during summer (Weir 2004, Lofroth et al. 2007, Copeland et al. 2010, Inman et al. 2012, BC MFLNRO 2014a, COSEWIC 2014d).

Reproductive females locate natal and maternal den sites in high elevation habitats (e.g., high elevation forest, subalpine valleys, and talus slopes) near the treeline where deep, insulating snow cover (i.e., greater than 1 m) persists into late spring (Lofroth 2001, Weir 2004, Copeland et al. 2010, McKelvey et al. 2011, Inman et al. 2012, BC MFLNRO 2014a, COSEWIC 2014d). Den sites are often associated with small forest openings less than 100 m wide (Weir 2004). Dens offer varying degrees of security and thermal protection with natal dens typically being more isolated and less accessible than maternal dens (Eder and Pattie 2001, COSEWIC 2014). Natal dens are often located underground but may also be located within CWD (i.e., decay class 1 to 3, i.e. intact/hard to partly decaying with large pieces) or rocky colluvium (e.g., talus boulders or along eskers) on the ground, all of which are buried by snow and accessed via snow tunnels (Eder and Pattie 2001, Weir 2004, BC Ministry of Forests and Range 2007, Copeland et al. 2010, BC MFLNRO 2014a, COSEWIC 2014d). Natal dens may also be located directly in snow tunnels (Copeland et al. 2010, BC MFLNRO 2014a, COSEWIC 2014d). Maternal dens may be located in similar sites as natal dens (i.e., within CWD or rocky colluvium on the ground), or may be associated with less isolated sites such as exposed tree roots, tree hollows, under tree branches, or in shrubby thickets in riparian areas (Eder and Pattie 2001, Weir 2004, COSEWIC 2014d).

Females often show high fidelity to specific den sites and general denning areas, returning for several consecutive years to raise kits (Weir 2004, BC MFLNRO 2014a, COSEWIC 2014d). Availability of suitable denning habitat and required snow conditions may be a limiting factor for wolverine populations (Copeland et al. 2010, BC MFLNRO 2014a). In addition to natal and maternal dens, reproductive females also use rendezvous sites, which are sheltered locations where kits are left during the females' foraging expeditions (Weir 2004, COSEWIC 2014d).

Young wolverines typically stay with their mothers during their first winter and disperse the following spring (Eder and Pattie 2001, Weir 2004, BC MFLNRO 2014a). Subadult females generally disperse shorter distances from their natal ranges compared to subadult males (Weir 2004, COSEWIC 2014d). Maximum dispersal distances for subadult females and males in Canada range from 225 to 300 km and 200 to 874 km, respectively (COSEWIC 2014d). Prior to establishing permanent home ranges, which is usually completed by two years of age, subadults are transient, wandering widely across the landscape (Weir 2004). Rugged terrain is generally not a barrier to movement with transient wolverines known to traverse tundra and glaciers (COSEWIC 2014d).

Movement

Wolverines are solitary and typically only interact with other wolverines during mating and territorial defense (other than females with kits) (BC CDC 21010a). They are also non-migratory, occupying the same home range year-round, although habitat use within home ranges may change seasonally by elevation (see above) (Government of Canada 2011). Adult wolverines occupy distinct home ranges that they maintain for

many years (Weir 2004). The home ranges of dispersing subadults are not as distinct and are typically much larger than the established home ranges of adults (Lofroth 2001, COSEWIC 2014d). The home ranges of males are typically at least three times the size of female home ranges (Lofroth 2001, Weir 2004). Research from across Canada indicates variable home range sizes ranging from 230 to 1,580 km² for adult males and 50 to 400 km² for adult females (Government of Canada 2011, COSEWIC 2014d). In comparison, research from the Omineca region of BC indicates an average home range size of 1,366 km² for adult males and 405 km² for adult females (Lofroth 2001, Weir 2004, BC MFLNRO 2014a). The average home range size for subadult males and females in the Omineca region was much larger (i.e., 3,513 km² and 1,229 km², respectively) (Lofroth 2001, COSEWIC 2014d). The home ranges of males may overlap with other males and females, but the home ranges of reproductive females generally do not overlap (Weir 2004, COSEWIC 2014). The degree of overlap between home ranges is influenced by the availability and distribution of food and denning habitat (BC CDC 2010a).

Movements of wolverines throughout their extensive home ranges are strongly influenced by prey availability and distribution (Weir 2004). They are capable of travelling great distances in short time periods, with movements varying on a daily or weekly basis from 2 to 5 km up to 100+ km (Lofroth 2001, Kyle and Strobeck 2002, Weir 2004). Despite maintaining natal dens, reproductive females may still move up to 20 km a day while foraging (Weir 2004). Research conducted in BC indicates wolverines prefer to travel through mature and old forest habitats that provide better thermal and security cover, and generally avoid moving through more open habitats such as young cut blocks (Weir 2004). They may travel regularly over established routes (BC CDC 2010a). Connectivity between watersheds and seasonally important habitats (e.g., foraging areas and denning areas) is essential (Weir 2004, BC MFLNRO 2014a). Key movement corridors include riparian areas and low elevation passes between valleys (Weir 2004). Anthropogenic features and activities (e.g., reservoirs, transportation corridors, logging and mining) are known to interfere with wolverine movement patterns (Weir 2004, BC CDC 2010a, BC MFLNRO 2014a).

BC Trapper Harvest Data

In BC, furbearers are legally designated species that have traditionally been hunted or trapped for their fur, and are important for their social, economic, and biodiversity values. Traplines are held by local residents and furbearers are trapped yearly. The revenue generated from this industry contributes to the local economy and the activity contributes to the social fabric of the communities of the Indigenous communities living in the vicinity of the Project. The Cultural Use Study for the Tenas Project (Budhwa et al. 2020) provides additional information on Traditional Knowledge of furbearer species important to Indigenous communities in the Telkwa area.

Fur trapping harvest returns for the province were obtained from the BC Government for the period 1985 to 2017, from which the trapping returns from MU 6-08 and MU 6-09 were extracted for the period 1998 to 2017 (20 years). Those traplines that were primarily contained within the W-RSA were selected and the fur trapping returns for those traplines extracted from the data. Since it is not possible to determine exactly where trapping occurred within a trapline area, the species being targeted for trapping or the effort spent trapping, the data is only useful for general information purposes. Table 3.5-2 summarizes the percent of the traplines within the W-RSA and the years that trapping return data is available, while Figure 3.5-1 shows the distribution of the trapline areas in relation to the W-LSA and W-RSA for the Project.

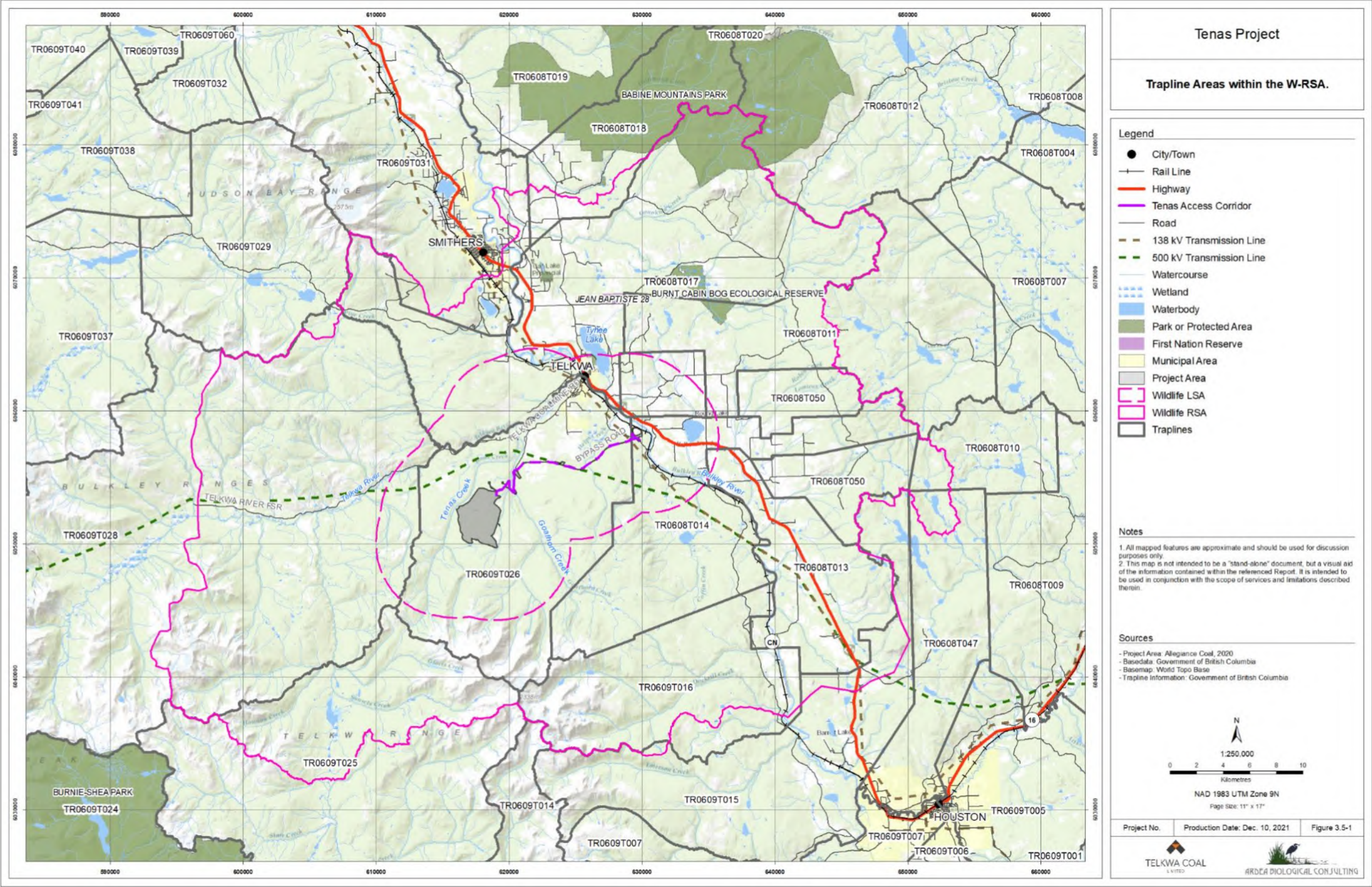


Figure 3.5-1: Trapline areas within the W-LSA and W-RSA of the Telkwa Coal Project.

The Project is almost entirely within trapline number TR0609T026, with the W-LSA containing small portions of other trapline areas. Several trapline areas are completely contained within the W-RSA (TR0608T013, TR0608T014, TR0608T017 and TR0608T050) with the majority of traplines TR0609T016 and TR0609T028 also within the W-RSA. Just over 30% of traplines TR0608T011 and TR0609T025 are within the W-RSA (Figure 3.5-1). The number of years of trapping data that is available varies considerably for the traplines, with the most data available for TR0608T017, but no data available for trapline TR0608T014, and only one year (2001) of harvest returns was reported for trapline TR0609T026.

Table 3.5-2: Percent of trapline areas within the W-RSA and years they were actively trapped.

Trapline Area	Percent of Trapline Area in RSA	Trapping Years
TR0608T011	36	1998 to 2017
TR0608T013	100	1998, 2004, 2013, 2014, 2015, 2016
TR0608T014	100	No trapping data available
TR0608T017	100	1999 to 2006, 2008, 2009, 2011, 2012, 2013, 2015
TR0608T050	100	2000, 2003 to 2015, 2017
TR0609T016	87	1999, 2017
TR0609T025	31	1998, 2006, 2007, 2008, 2011
TR0609T026	100	2001
TR0609T028	52	1998 to 2002, 2004, 2005, 2007, 2009 to 2016

A summary of the species harvested by the trapline holders is provided in Figure 3.5-2. Although these results could provide information on the relative abundance of furbearers within the W-RSA, it should be noted that different trappers, and sometimes in different years in the same area, focussed their trapping efforts based on pelt price, species abundance and snow conditions (Obbard et al. 1987). In addition, caution in interpretation is also needed as these are historic records in a landscape that has seen large scale changes through forestry, agriculture and a changing climate. The results should therefore be used cautiously to give an indication of the species present historically, the species that were a focus for trapping, and the trapline areas where these animals were caught.

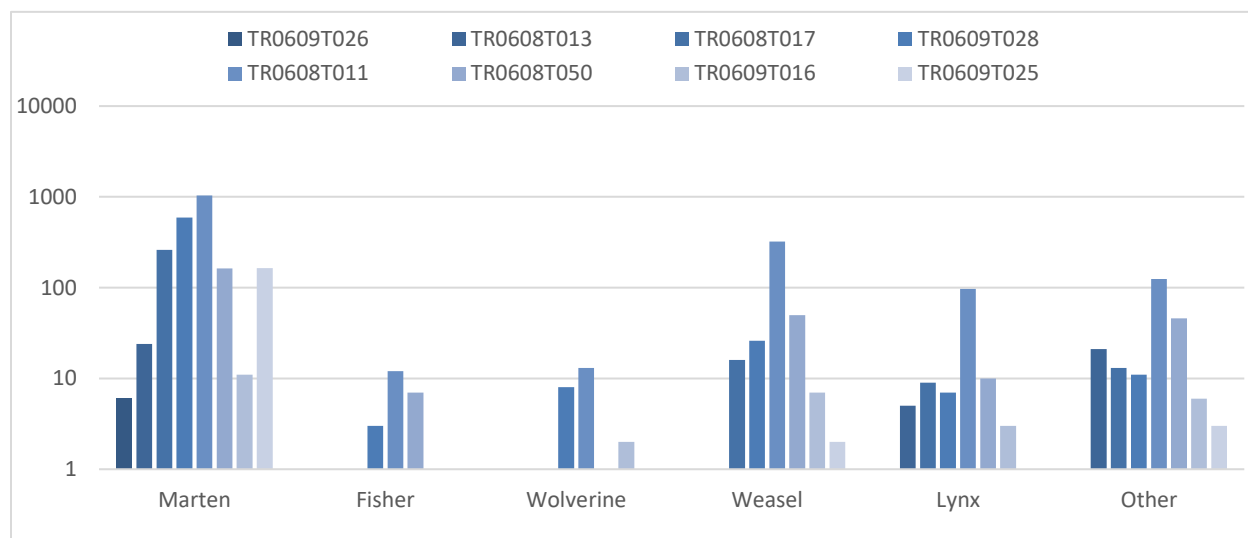


Figure 3.5-2: Summary of trapped species by trapline area within the W-RSA from 1998 to 2017 (Others include: river otter, mink, coyote, wolf, fox, red squirrel, beaver, muskrat).

Marten have historically been the most common species harvested within the trapline areas from 1998 to 2017 within the W-RSA, making up 71% of all trapping returns in the last 20 years (Figure 3.5-3). Ermine were the second most common animal trapped, accounting for 13%, followed by lynx with 4%. Both fisher and wolverine accounted for approximately 1% of the overall trapping harvest from 1998 to 2017.

BC Big Game Harvest Data

Furbearers other than wolves are not reported within the big game harvest database, although species such as coyote and snowshoe hares are regularly hunted by both residents and non-residents. The number of wolves harvested within MU 6-08 and 6-09 is outlined in Figure 3.5-4.

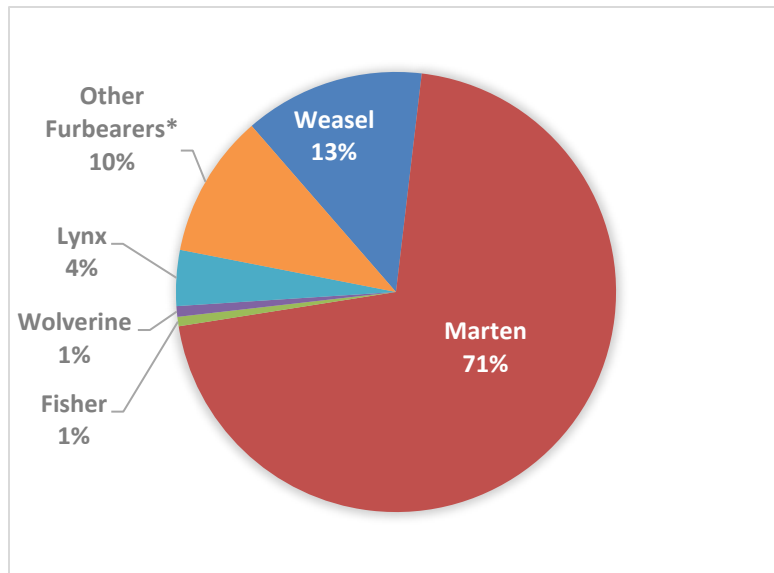


Figure 3.5-3: Percentage of species trapped in all traplines 1998-2017 (Other furbearers include river otter, mink, coyote, wolf, red fox, red squirrel, beaver, muskrat).

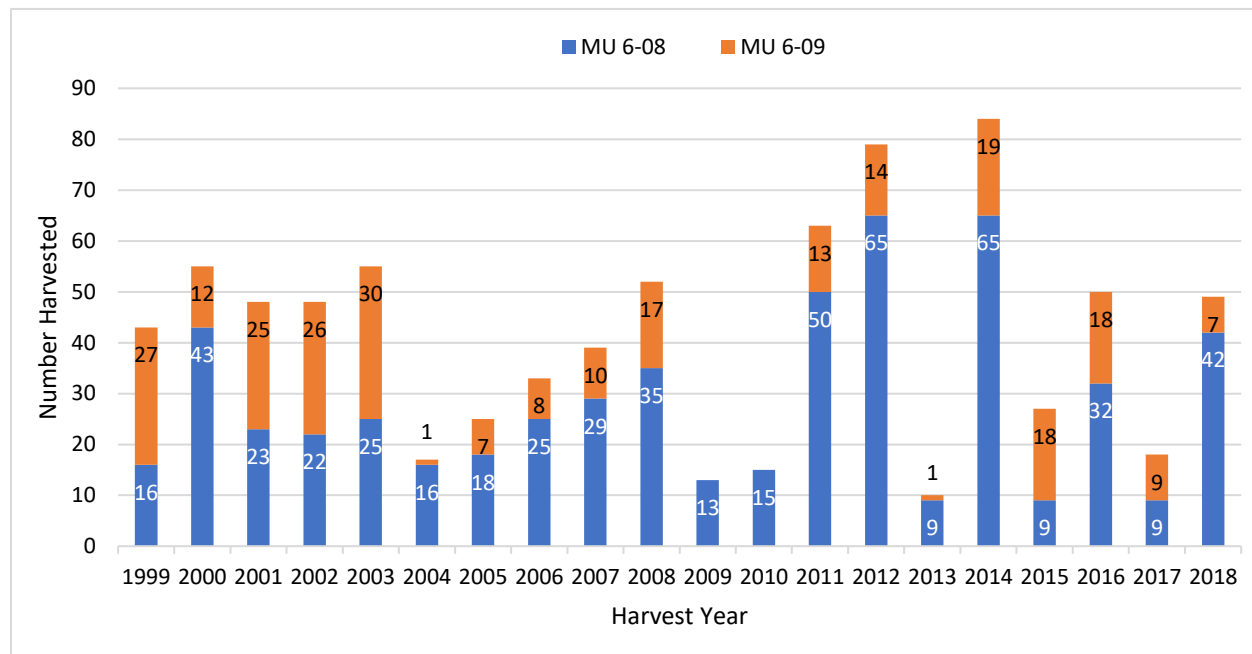


Figure 3.5-4: Summary of wolves harvested within MU 6-08 and MU 6-09 from 1999 to 2018.

Wolf harvest numbers varied greatly between 1999 and 2018, with 10 to 15 animals harvested in 2009, 2010 and 2013 numbers rising to highs of 79 and 84 wolves harvested in 2011 and 2014 respectively. Overall, most wolves were harvested in MU 6-08, with 68% (561 animals) of the total harvest (823 animals) occurring within that MU.

3.5.2 Assessment and Survey Results

Snow Track Surveys

Snow track surveys were completed within several areas of the W-LSA during the winter of 2018 from mid January to early March, with eight furbearer species identified as using the area. A summary of the track densities observed for furbearer species within general forest habitats is provided in Figure 3.5-5, while the track densities within general age structures within the SBSdk and SBSmc2 BGC subzones is outlined in Figure 3.5-6. Furbearer track densities within the minesite area, rail infrastructure area and along Goathorn Creek within the W-LSA are outlined in Figure 3.5-7.

Snowshoe hare tracks were the most abundant sign observed during the snow track surveys, and were found within all forest types, in almost all BGC subzones and forest structures, and within each of the general areas surveyed in the W-LSA (Figure 3.5-5, Figure 3.5-6 and Figure 3.5-7). Overall, track density observed within the W-LSA was 9.5 tracks/km/days since snowfall (TKDSS) over 26,887 m of transects completed. Conifer forests recorded the highest track densities (10.5 TKDSS) within the three forests, with mixed forests having an overall density of 9.2 TKDSS and riparian forests a density of 2.7 TKDSS (Figure 3.5-5). Densities ranged from just over 1.2 TKDSS to 12.8 TKDSS within the SBSmc2 - Edge and SBSmc2 - Young forests respectively (Figure 3.5-6). Within the general areas of the W-LSA, snowshoe hare track densities ranged from 1.9 TKDSS along Goathorn Creek to 13.4 TKDSS in the rail infrastructure area (Figure 3.5-7).

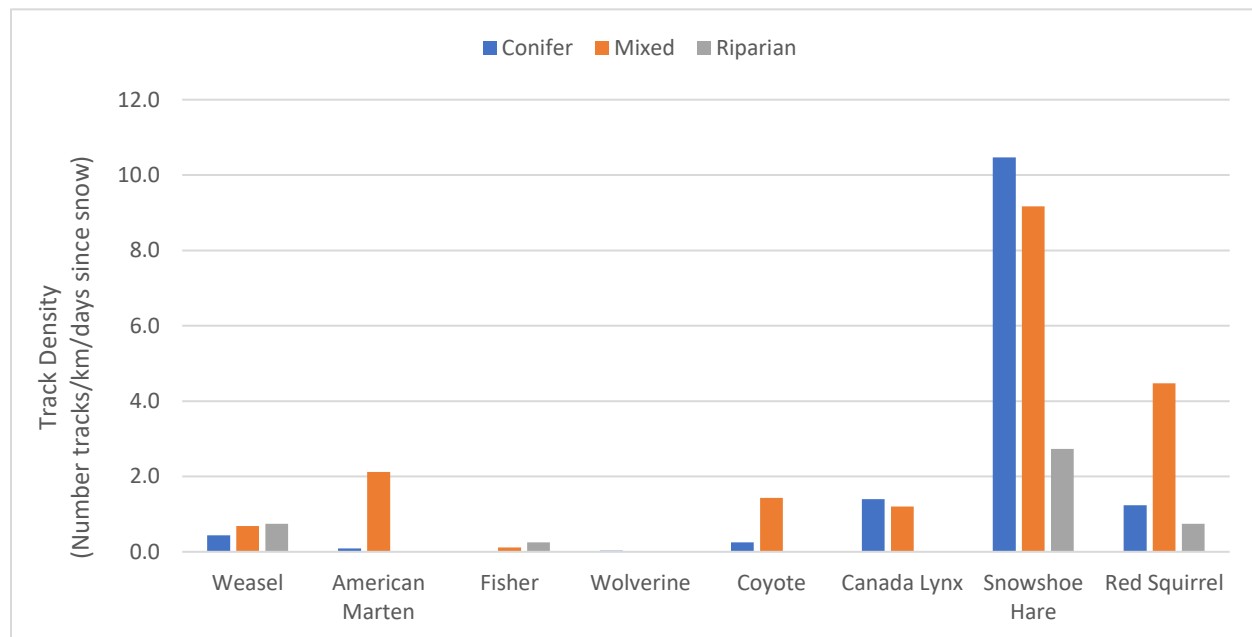


Figure 3.5-5: Summary of furbearer species track densities within conifer, mixed and riparian forest habitats within the W-LSA, January to March 2018.

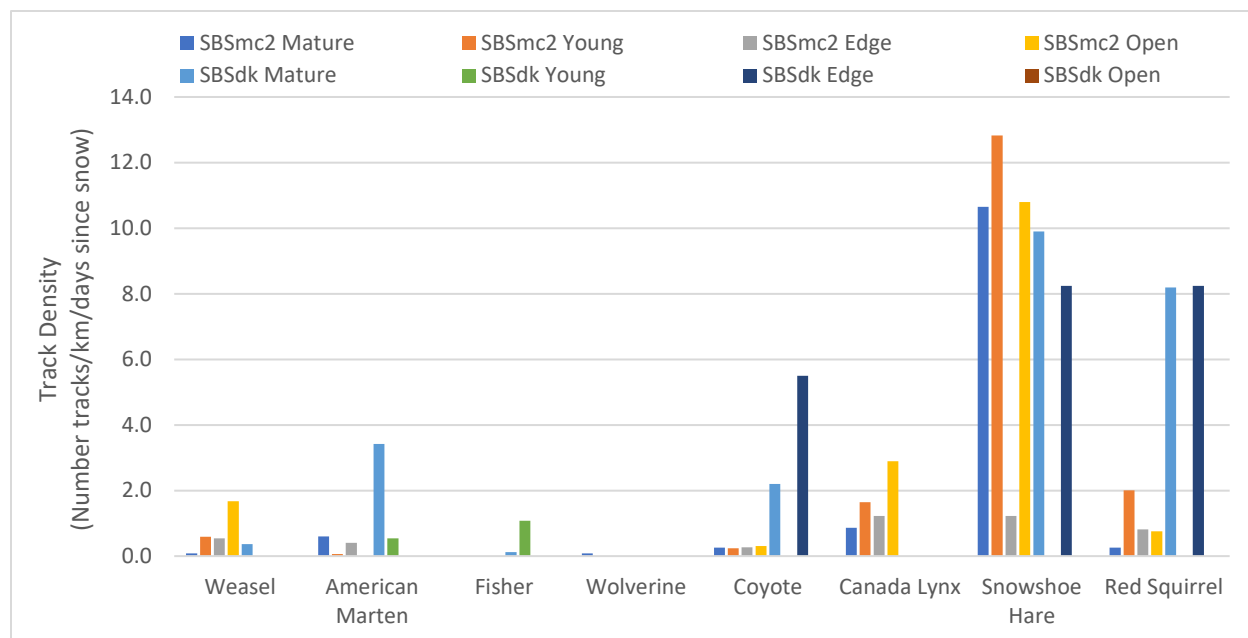


Figure 3.5-6: Summary of furbearer species track densities within BGC subzones and general forest structure within the W-LSA, January to March 2018.

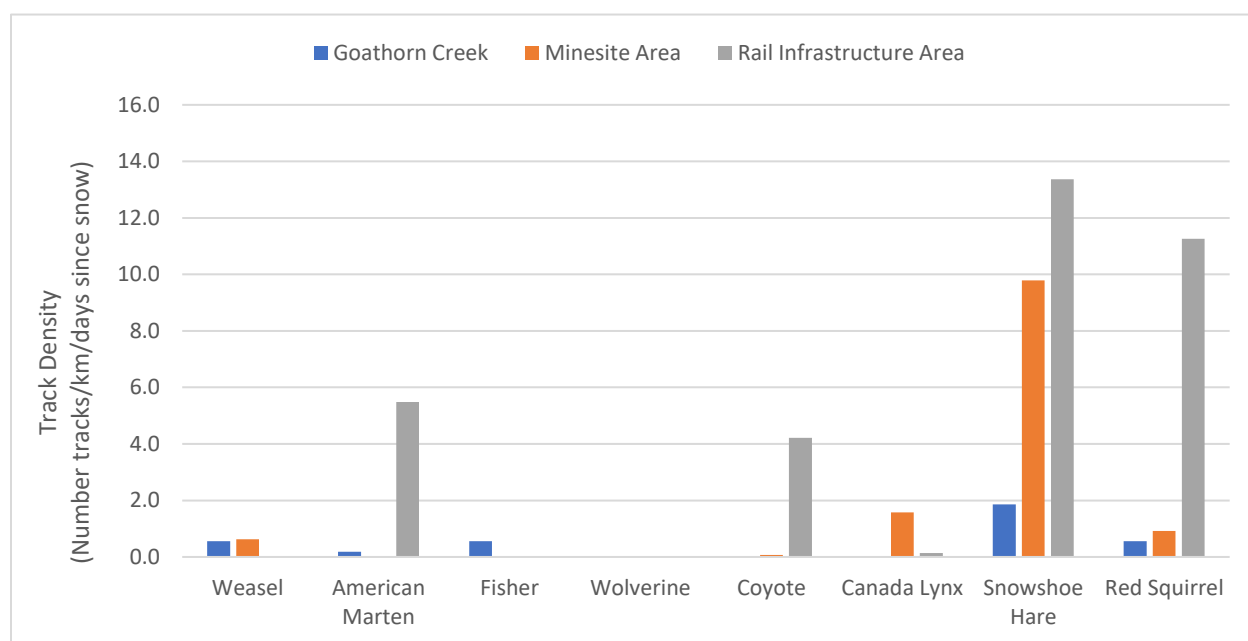


Figure 3.5-7: Summary of furbearer species track densities within the general areas of the W-LSA, January to March 2018.

American marten track density over the entire W-LSA was only 0.7 TKDSS over the total transect distance of 26,877. Within mixed forests marten track densities were 2.1 TKDSS, while conifer forests were 0.1 TKDSS, no tracks were recorded for marten in riparian forests (Figure 3.5-5). Highest track densities for marten were recorded within SBSdk - Mature forests (3.4 TKDSS); with track densities ranging from 0.1 TKDSS to 0.6 TKDSS in SBSmc2 - Young and SBSmc2 - Mature forests respectively (Figure 3.5-6). Track densities within the rail infrastructure area was 10.5 TKDSS, and 0.2 TKDSS in the Goathorn Creek area, and no tracks observed within the minesite area (Figure 3.5-7).

Listed furbearer species observations during the snow track surveys included one set of wolverine tracks found January 27th in the central portion of the minesite area within coniferous, SBSmc2 - Mature forests (Figure 3.5-5, Figure 3.5-6 and Figure 3.5-7). Fisher tracks were identified in two locations within the Goathorn Creek area, one set on January 12th, in the upper portion and one set on March 3rd, in the lower portion near the Telkwa River. Both were within the SBSdk BGC subzone, with the tracks from January within a mature, riparian forest and the March tracks within a young mixed forest (Figure 3.5-5, Figure 3.5-6 and Figure 3.5-7)

Wildlife Trail Cameras

The wildlife trail cameras obtained a total of 267 images of four furbearer species: coyote (45 images), Canada lynx (202 images), red squirrel (1 image) and snowshoe hare (19 images) during 2017 and 2018 within the W-LSA. Canada lynx was captured by the cameras more than any other furbearer species. A comparison of new images across the camera sites per 100 days of camera operation (Figure 3.5-8) found that at camera sites 3, 5 and 7 images of lynx ranged from 6.3 to 16.5 images/100 days of camera operation. Although usually an elusive and rarely observed animal in the area, 75 trigger events resulted in images of Canada lynx by the cameras over the two survey years. Based on the images obtained it is likely that at least one lynx den site was within the minesite area as several juveniles (likely one year old in 2017) were observed in the images at several cameras on multiple occasions (Plate 3.5-1).

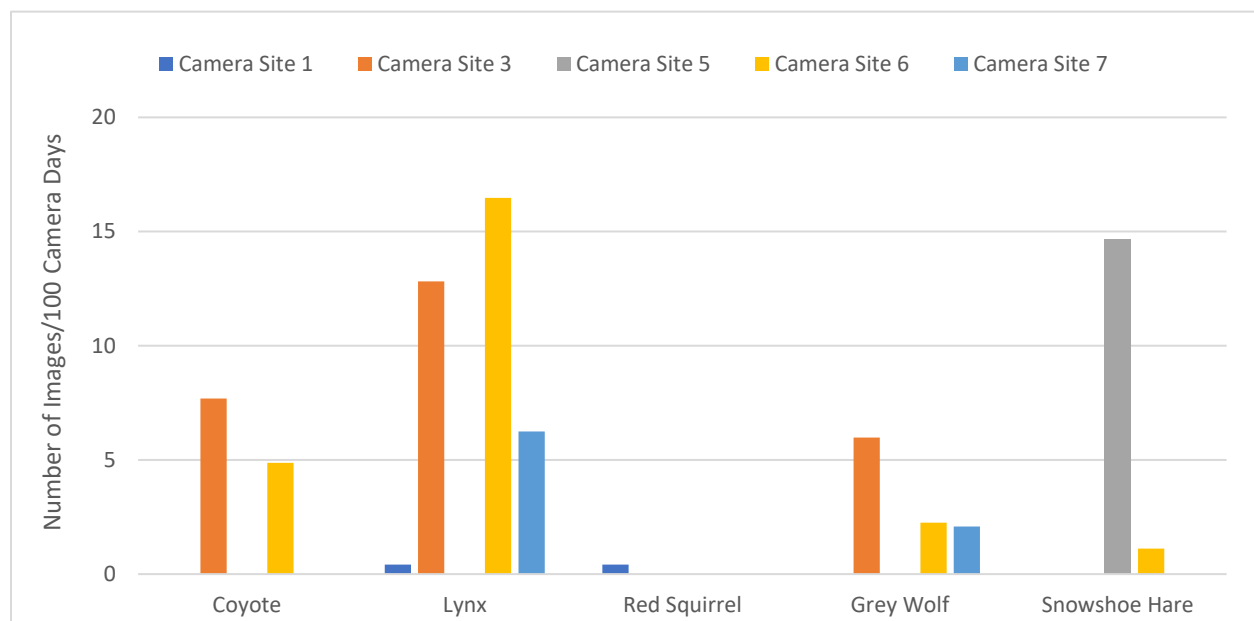


Figure 3.5-8: Summary of furbearer images captured by wildlife trail cameras within the W-LSA in 2017 and 2018.



Plate 3.5-1: Two young Canada lynx photographed on September 5, 2017 at Camera Site 6.

Coyotes and grey wolves were also captured often at several camera sites during 2017 and 2018, with coyote photos primarily of single animals, while up to four grey wolves were captured at several camera site from a single trigger event. Camera site 3, located along a road was only active in 2018, yet obtained the majority of images for both coyote (7.7 images/100 camera days) and wolves (5.9 images/100 camera days) (Figure 3.5-8).

Wildlife Trail Assessments and Incidental Observations

Wildlife trail assessments did not identify any significant trail use by furbearers during the surveys in 2019, although two observations of wolf tracks associated with a wildlife trail were recorded near Tenas Creek. Snowshoe hare sign was the most common observation related to furbearers (n = 210) and made up 48% of the observations, with red squirrel the second most common (n = 98; 22%) and grey wolf the third (n = 87; 20%) (Table 3.5-3).

Table 3.5-3: Summary of observations of furbearer sign and activity from WHA plots and incidental observations within the W-LSA from 2017 to 2019.

Species	Type of Sign / Activity / Use										Total
	Excrement	Feeding	Body Part ¹	Living ²	Territoriality	Carcass	Disturbed ³	Dam	Tracks	Wildlife Trail	
American Marten	3										3
Beaver		5		1				2			7
Canada Lynx	17						3		5		25
Coyote	4				1				2		7
Grey Wolf	41				3				41	2	87

Species	Type of Sign / Activity / Use									
	Excrement	Feeding	Body Part ¹	Living ²	Territoriality	Carcass	Disturbed ³	Dam	Tracks	Wildlife Trail
Red Fox									1	
Red Squirrel		75	1	9	11		1		1	
Snowshoe Hare	86	45	5	56		12	1			
Unknown Mustelid	1									
Total	152	125	6	66	15	12	5	2	50	2

Note: 1)) Body Part: portions of an animal's body which are left behind but do not indicate the animal is dead (e.g. antler sheds, hair)

2) Living: Activity ambiguous or could not be specified

3) Disturbed: Behaviour for the purpose of avoiding the observer, activity before disturbance unknown

Excrement was the most often sign observed for the furbearer species (n = 152; 35%), followed by feeding (n = 125; 28%), with squirrel middens observed at 75 locations distributed within the W-LSA (Figure 3.5-10). Grey wolf tracks and other wolf sign were observed quite often along roads and other areas within the W-LSA and once along a wildlife trail near Tenas Creek (Figure 3.5-10). Photos from the wildlife cameras suggesting that a pack of possibly four animals was using the W-LSA during 2017 to 2019.

Wildlife Habitat Assessments

Habitat suitability ratings were collected for fisher, lynx and American marten within the W-LSA for use in the development of potential wildlife habitat suitability models. Ratings for American marten for food, security and thermal habitat attributes were collected at 190 locations within the W-LSA and are provided in Figure 3.5-9, while overall suitability ratings for Living and Denning habitats are provided in Figure 3.5-11. Suitability ratings for fisher and Canada lynx are provided in Appendix D.

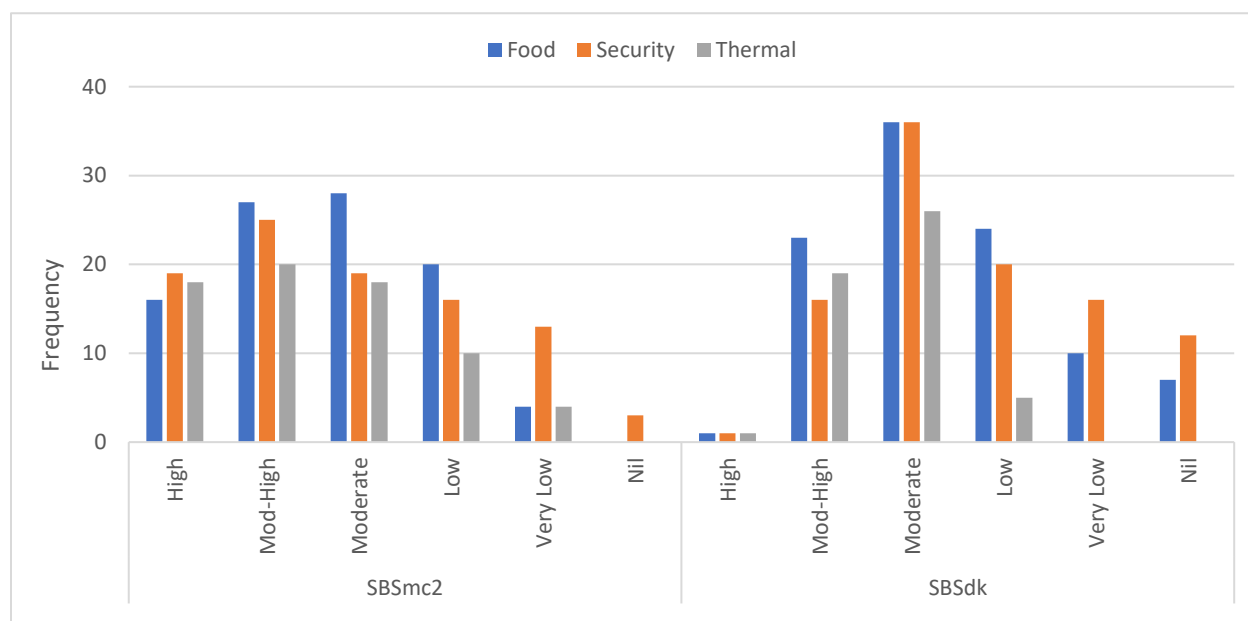


Figure 3.5-9: Suitability ratings for American marten Food, Security and Thermal habitat attributes within the W-LSA from 2017 to 2019.

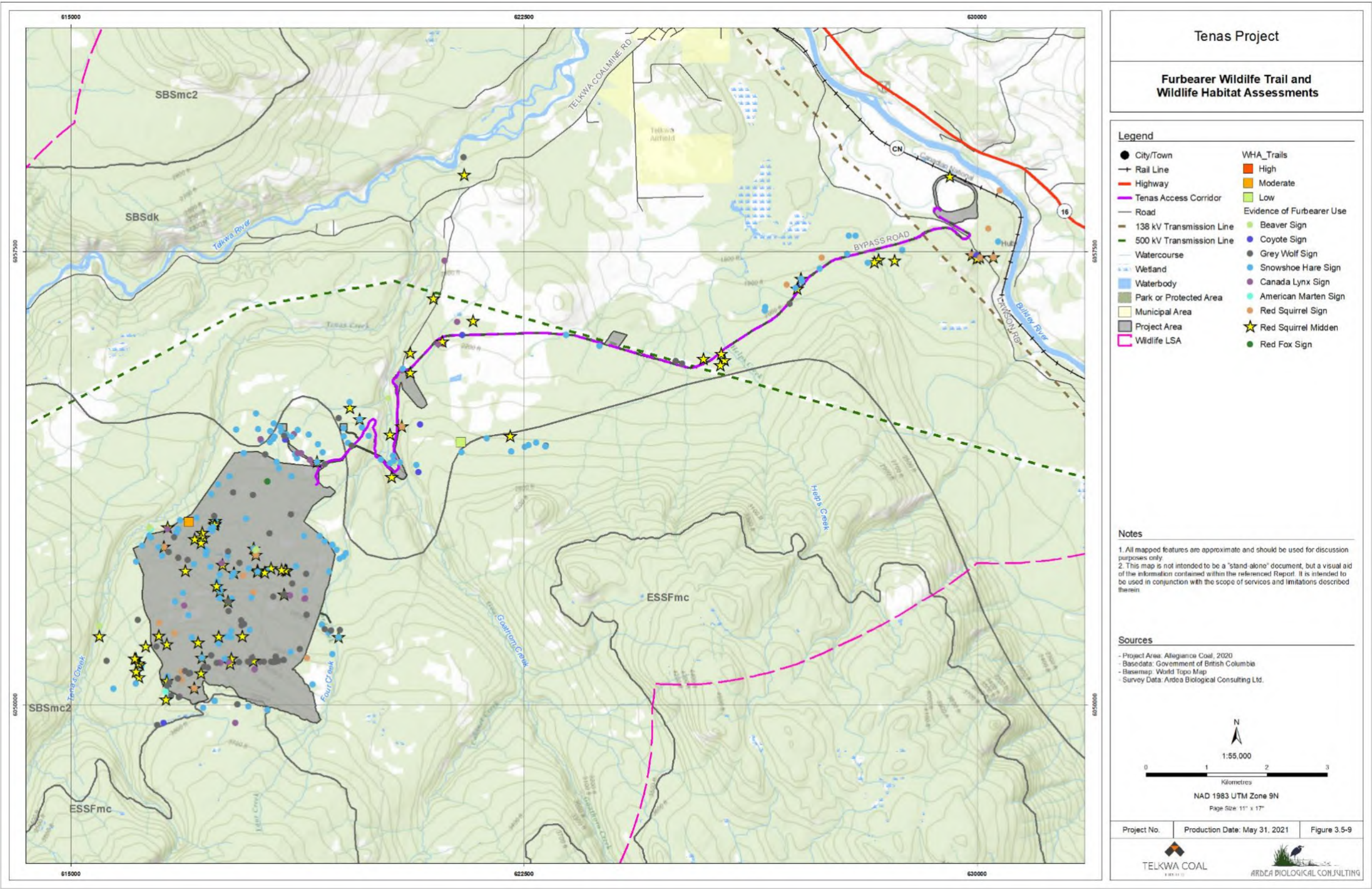


Figure 3.5-10: Distribution of furbearer sign observed within the W-LSA from 2017 to 2019

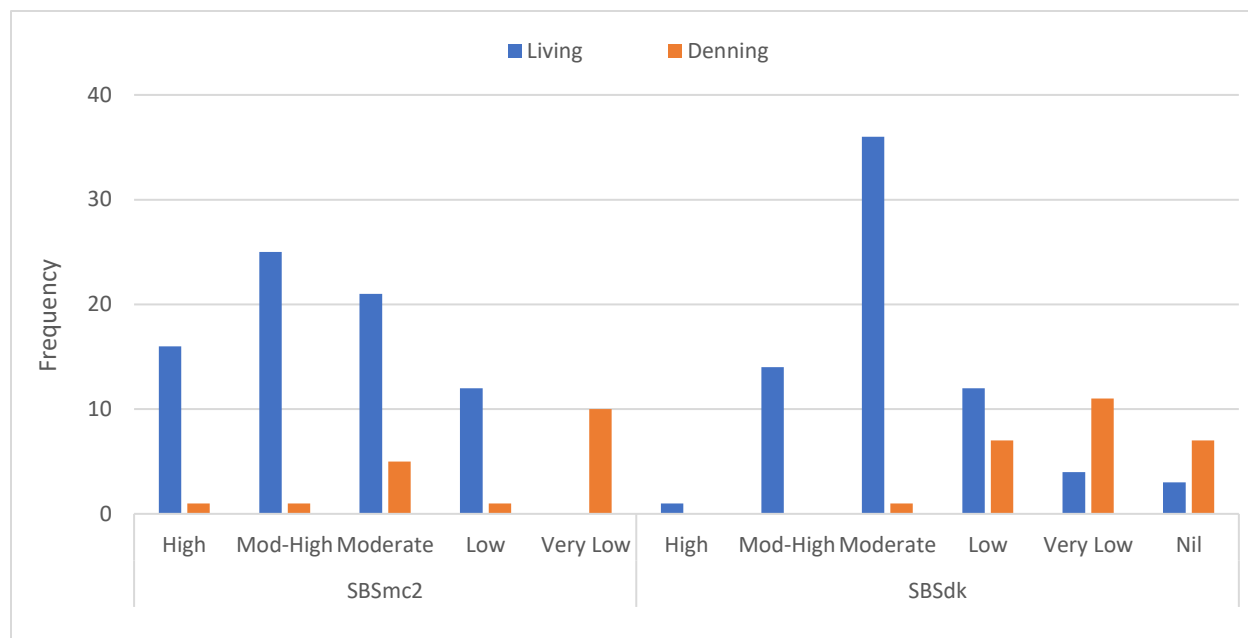


Figure 3.5-11: Suitability ratings for American marten Living and Denning habitats within the W-LSA from 2017 to 2019.

Habitats within the SBSmc2 BGC subzone for American marten assessed for Food, Security and Thermal habitat attributes were generally more often rated high than sites within the SBSdk subzone (Figure 3.5-9). This was primarily due to the higher proportion of mature conifer stands within the SBSmc2 than the SBSdk (Ardea 2021a) which provide more opportunities for coarse woody debris and sub-nivean habitats important for marten feeding, thermal and security (Andruskiw et al. 2008). This translated to higher overall ratings for Living habitat within the SBSmc2 subzone as well (Figure 3.5-11), while denning habitat ratings in general were lower overall in both subzones.

3.5.3 Habitat Suitability Model Summary

American marten are commonly found in mature, dense conifer, deciduous or mixed forests (Soutiere 1979) with younger age forests used less frequently unless habitat features such as large diameter coarse woody debris and snags are available (Mowat 2006, Porter et al. 2005). A species account is provided for American marten along with the habitat model completed by Steventon (2020) in Appendix D. The model uses forest attributes such as forest age, tree species, etc., important to marten to predict foraging and denning habitats as well as potential home ranges, allowing for determining potential marten densities. The model relies primarily on Vegetation Resource Inventory (VRI) data and was developed using the Spatially Explicit Landscape Event Simulator (SELES) engine and language (Fall and Fall 2001). The model outputs both suitability and capability ratings, with the suitability ratings results for the W-LSA and W-RSA outlined in Table 3.5-4 and mapped in Figure 3.5-12 and Figure 3.5-13.

Table 3.5-4: Area of American marten Living habitat suitability within the W-LSA and W-RSA.

Living Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wildlife RSA (ha)	Wildlife RSA (%)
High	3,825	11%	31,170	16%
Moderate	24,243	68%	121,483	62%
Low	2,873	8%	10,569	5%
Nil	4,794	13%	31,437	16%
Total	35,735	100%	194,659	100%

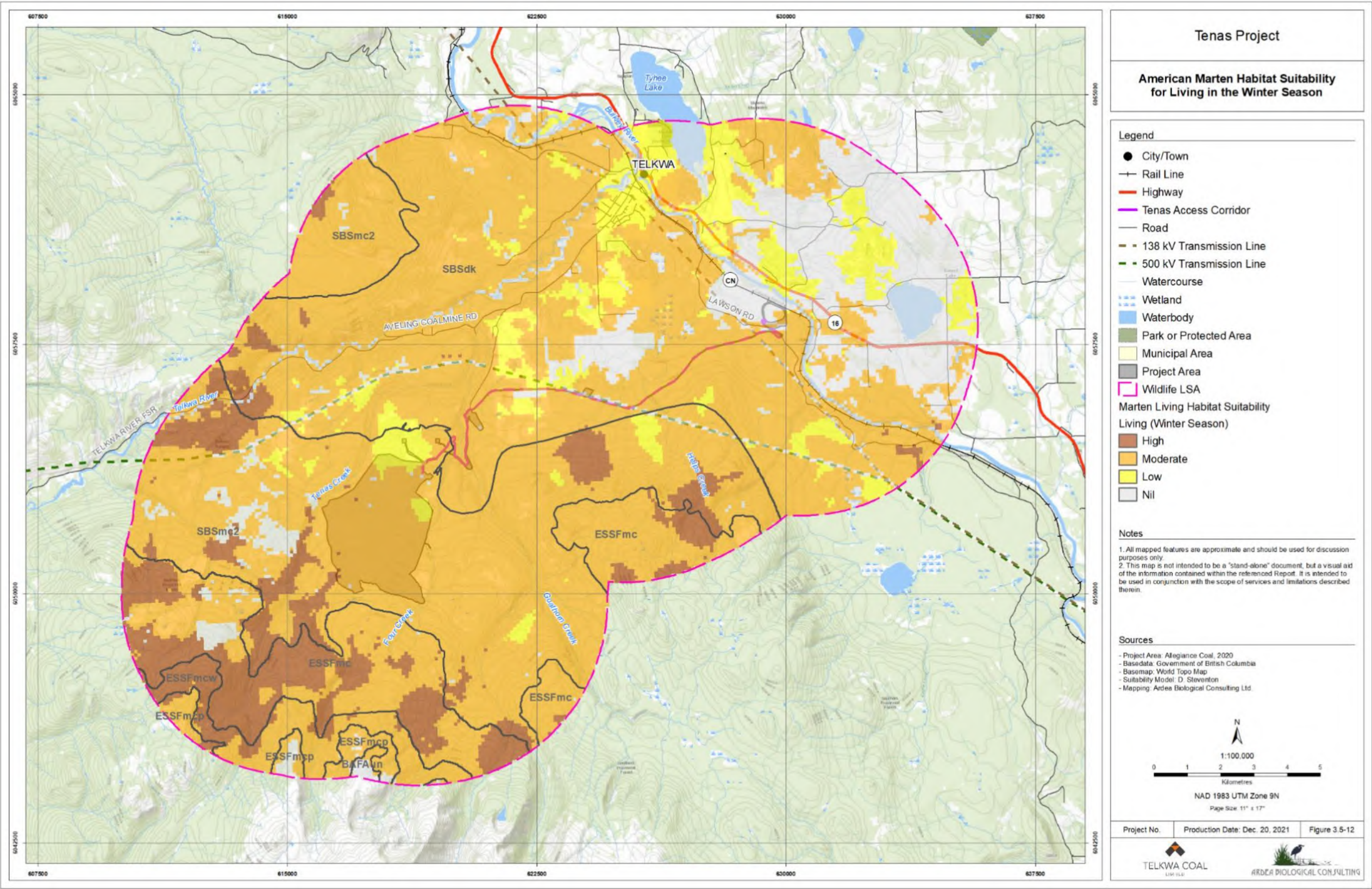


Figure 3.5-12: Habitat suitability model ratings for American marten Living within the W-LSA.

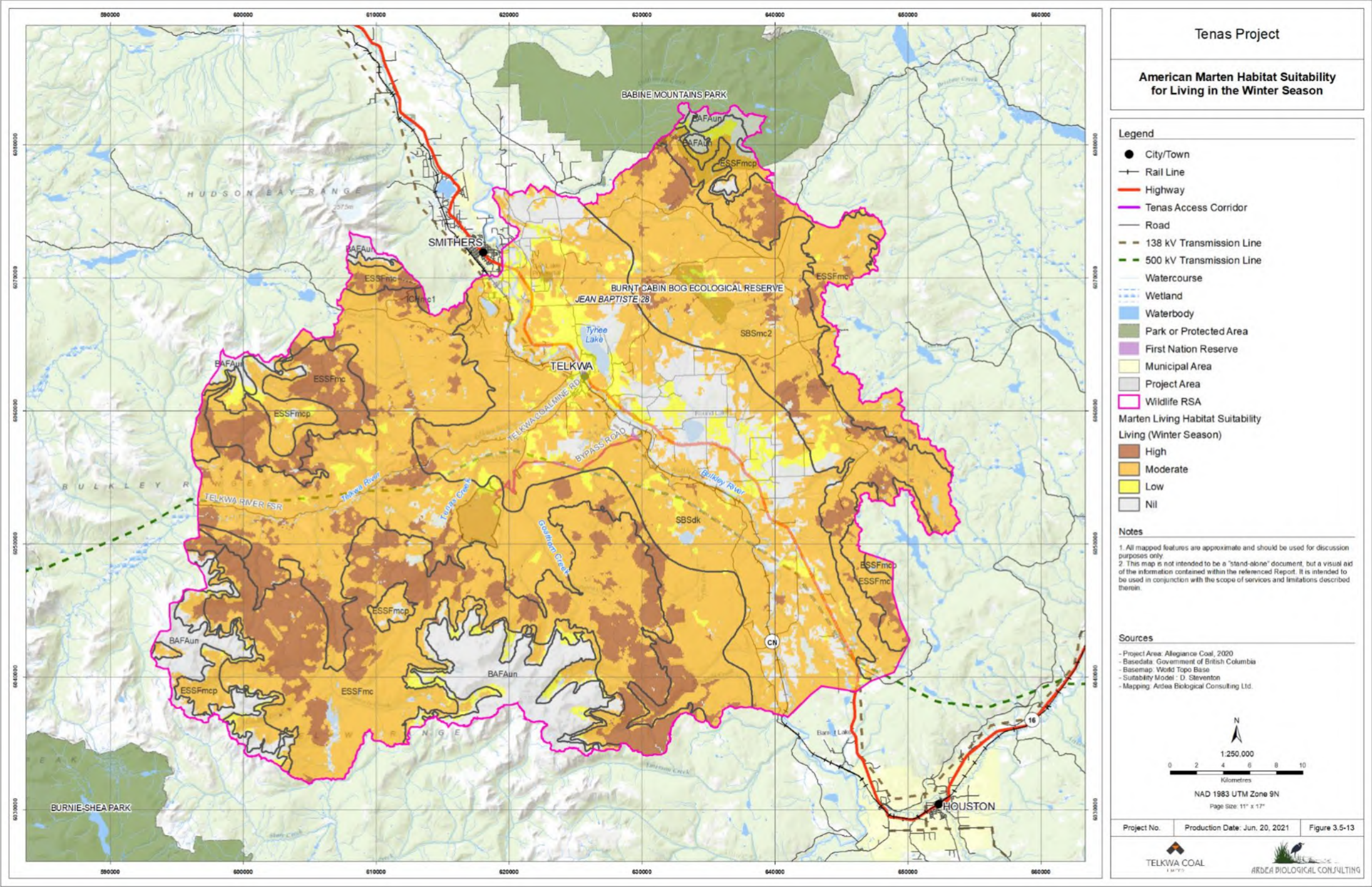


Figure 3.5-13: Habitat suitability model ratings for American marten Living within the W-RSA.

The model identified approximately 3,825 ha of high value and 24,243 ha of moderate value habitats in the W-LSA, which is 11% and 68% respectively of the W-LSA. These habitats are distributed primarily within the SBSmc2 and ESSFmc subzones (Figure 3.5-12). Within the W-RSA, the percentages of moderate and high suitability habitats are similar to the percentages within the W-LSA, although there is a higher percentage (16%) of high value in the W-RSA than in the W-LSA (Table 3.5-4). As with the W-LSA, high value habitats are found in the higher elevations, and outside of the valleys, due to more intact mature forests in those areas (Figure 3.5-12 and Figure 3.5-13).

The number of simulated American marten territories using the suitability ratings within the W-LSA was estimated to range from 37 to 48, while there were 262 to 277 territories estimated for the W-RSA (Stevenson 2020 and Appendix D).

3.6 Black and Grizzly Bear

3.6.1 Existing Information on Black and Grizzly Bears

Black bears are the smallest and most widely distributed bear species found in North America. Black bears are found in a wide variety of habitats from sea-level to alpine tundra and are found in virtually every part of the province with the exception of most urban city centres. Grizzly bears are the second largest bear species in North America and Historically grizzly bears have occurred throughout BC with the exception of some coastal islands (Blood 2002)

Generalizations about how black and grizzly bears use habitats for foraging, security, thermal, reproduction, and hibernation are difficult to make due to the flexibility in bear habitat use. It is important when looking at bear habitat use to understand that changes in social status, food availability, population, interactions with other bears and humans, and natural disturbance can all affect the use of a particular habitat.

Both black and grizzly bears are wide-ranging and use a variety of ecosystems, occurring in most well-connected ecosystem units and across a large gradient of elevations, from sea level to alpine tundra (MWLAP 2004, Hamilton et al. 2018). Bears are mostly solitary omnivores that have large seasonal and annual home ranges. Home range size varies with food availability, with home ranges in productive habitats smaller than in less productive habitats.

Conservation Context

Grizzly bear habitat is at risk from expanding industrial, residential and recreational developments (COSEWIC 2012). Habitat and population fragmentation are underway in the southern part of the bear's distribution. The life history characteristics of this bear make it particularly sensitive to human-caused mortality (including hunting, poaching, accidents and nuisance kills). Its behaviour frequently brings it into conflict with people, leading to increased mortality where human activities expand. Although it has disappeared from a substantial part of its historic range, there are still over 26,000 grizzly bears in Canada. The area occupied by the grizzly bear has not decreased substantially over the past 20 years; however, the future of several isolated populations is highly uncertain and dependent on conservation (COSEWIC 2012).

The black bear is considered common, widespread, and abundant throughout BC and populations were considered to be stable at an estimated 120,000 to 160,000 animals in 2001 (BC MOELP 2001), the latest date available for black bear populations.

Conservation classifications for black and grizzly bears are listed in Table 3.6-1.

Table 3.6-1: Conservation status of black and grizzly bears within the WRW-RSA.

Species Name		Conservation Status ¹		
		Provincial	Federal	
Common	Scientific	BC CDC	COSEWIC	SARA Schedule 1
American Black Bear	<i>Ursus americanus</i>	Yellow	Not at Risk	Not Assessed
Grizzly Bear (Western Population)	<i>Ursus arctos</i>	Blue	Special Concern	Special Concern

Notes: 1) See Table 2.1-2 in Section 2.1.1 for status definitions.

Management Initiatives

Provincially, BC has few initiatives for the maintenance of black bear populations. As human induced conflicts are the greatest threat to black bear populations, measures have been taken to reduce human-bear interactions in an effort to eliminate the need for destruction of bears by conservation officers. Conservation officers kill up to 1,000 black bears a year because of serious conflicts with people (Blood 2001). Local initiatives such as implementing programs to decrease the amount of improperly handled garbage can help for managing conditions that attract bears into situations which increase bear-human interactions (Blood 2001).

BC's *Grizzly Bear Conservation Strategy* (MELP 1995a) contains the following goals:

- ▶ To maintain in perpetuity the diversity and abundance of grizzly bears and the ecosystems on which they depend throughout BC; and
- ▶ To improve the management of grizzly bears and their interactions with humans

The *Grizzly Bear Management Procedure* under the *Wildlife Act* provided direction to wildlife managers on management of grizzly bears and the setting of harvest quota. In December, 2017, due concerns regarding population declines, the Province of BC announced a ban on the hunting of grizzly bears in BC. Since the ban, one of the key requirements for grizzly bear management is to determine grizzly bear population unit (GBPU) rankings. This ranking exercise was initiated in 2017 and completed in 2020 and ranked the Bulkley-Lakes GBPU, which encompasses the WRW-RSA, as being a moderate concern due to potential threats and low population density (Morgan et al. 2020).

The *Bulkley Valley Sustainable Resource Management Plan* (SRMP; BC MAL 2005) was finalized in 2005. The plan applies to an area within the 1998 Bulkley LRMP planning region (BVCRB and IRT 1998). The SRMP area is the low elevation terrain of the Bulkley Valley. Accordingly, the plan's directions are related to Bulkley-Lakes GBPU are specific to the lower elevation grizzly bear habitats. The plan provides strategies focussed on the forest management practices to ensure adequate security areas, winter forage, and large areas with little human activity. Recommendations include seasonal restrictions to forest harvesting activities and access management by BGC zone.

The *Morice LRMP* (BC MAL 2007) was finalized in 2007 to direct management of public land and resources with key stakeholders, including a new emphasis on the inclusion of First Nation values and knowledge in the planning process. Most of the planning area is at least used occasionally by grizzly bears, although exact size and trend of area populates remain unknown. The plan focuses on the maintaining the availability of denning and foraging habitat and the management of road access and human actions to reduce the risk of grizzly bear displacement and human induced mortality.

Distribution and Habitat Use

Bears are found throughout BC, in a wide range of habitat, but primarily inhabit forests and nearby openings, including forested wetlands. Bears are an opportunistic omnivore, with a variable diet of plants and animals (vertebrates and invertebrates), commonly including fruits, insects, and carrion. Black bears prefer mixed

deciduous-coniferous forests with a thick understory but may occur in various situations. When inactive, they occupy dens under fallen trees, ground-level or above-ground tree cavities or hollow logs. In winter black bears hibernate in hollowed out dens in tree cavities, under logs or rocks, in banks, caves, culverts, and in shallow depressions (Hatler et al. 2008).

Grizzly bears prefer dense coniferous stands as they provide the best security habitat when compared to mixed or deciduous stands (Simpson 1992). Open, highly suitable feeding habitat where cover is limited can be used during the night. In these cases, darkness provides the security cover to bears using these habitats (Mattson et al. 1987, Gibeau et al. 2002). Security cover is extremely important for sub-adults and sows with cubs, which will often use lower quality foraging habitat in order to ensure the security values are sufficient (McClellan and Shackleton 1988). Sows with cubs often forage in rugged, isolated terrain within forested habitats that are older than pole/sapling and that have dense understory development, or in alpine areas in early summer with a good line of sight, to avoid aggressive male bears (Pearson 1975).

Both black and grizzly bear are known to use habitat in the W-LSA (Hatler 1990). Hatler documented bear sign during May 1990 transects, including one suspected to be grizzly bear. He indicates the importance of high, south-facing slopes and benches that green-up early in the spring, and mesic sites that provide summer and fall forage, but notes that most of the sign observed in transects was associated with “damp, lush sites along the gas pipeline and adjacent wetlands.” The suspected grizzly bear sign was located in meadow habitat.

Abundance

There are an estimated half a million black bears in Canada with about a quarter of those living in BC. Black bear numbers tend to increase in wetter and coastal zones where food and vegetation is more plentiful. Although habitat is shrinking due to land development, black bear abundance is not considered to be suffering (Blood 2001).

In 2018, the BC grizzly bear population was estimated to be 14,925 (BC MFLNRORD 2020). The estimate is based on predictive population densities by GBPU, using all available inventory data supplemented by expert-based knowledge where inventory data is lacking. Grizzly bear range in BC is divided into 55 Grizzly Bear Population Units (GBPUs) which help to identify local conservation concerns, track population trends and apply specific management practices. GBPUs are assigned one of five conservation rankings from Very Low to Extreme based on population size and isolation, population trend, and level of threat to bears or bear habitat. Of the 55 GBPUs, three are assigned a conservation ranking of Extreme, 14 are High, 14 are Moderate and the remainder of lower conservation rank (Environmental Reporting BC 2020).

The W-RSA overlaps with the Bulkley-Lakes and Babine GBPUs which are both assigned a Moderate conservation ranking (Morgan et al. 2019). The population within the Bulkley-Lakes GBPU is currently estimated at 439 with an estimated density of 19.7 grizzly bears/1000 km² (BC MFLNRORD 2020). The Bulkley-Lakes GBPU is an estimated 23,884 km² in size with 22,554 km² of useable grizzly bear habitat (BC MFLNRO 2012). The grizzly bear population within the Babine GBPU is estimated at 313 with an estimated population density of 22.8 grizzly bears/1000 km² (BC MFLNRORD 2020). The Babine GBPU measures approximately 14,323 km² and encompasses an estimated 13,805 km² of useable grizzly bear habitat (BC MFLNRO 2012).

Harvesting

Black bear hunting in BC generates revenue that contributes to wildlife management and habitat conservation programs. Black bears are commonly hunted in both MU 6-08 and MU 6-09, with very similar harvest hunter success rates in both areas. A total of 3,038 black bears have been killed and reported by hunters in the last 20 years peaking in 2018 with 235 animals killed in a single year. A total of 143 grizzly bears were harvested from 1999 to 2018, with a peak of 12 grizzly bears harvested in both 1999 and 2018 (Figure 3.6-1). No grizzly bears were harvested in 2018 following the ban on grizzly hunting (BC MFLNRORD 2021).

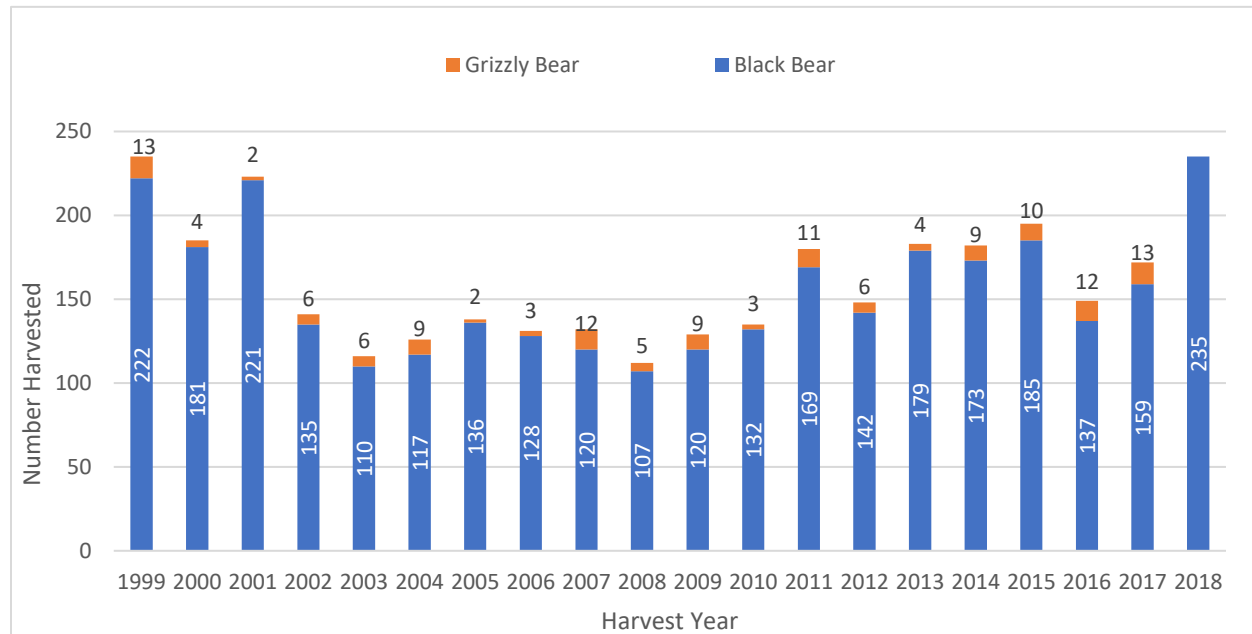


Figure 3.6-1: Total harvest (both resident and non-resident) of grizzly bears and black bears per year in MU 6-08 and 6-09 from 1998 to 2018

A review of the fur trapping harvest return data identified one black bear harvested by a trapline holder (TR609T016 see Figure 3.5-1) in the southern portion of the W-RSA in the last 20 years. No grizzly bears were reported harvested within the fur trapping harvest return data (BC MFLNRORD 2018).

Mortality and Human Interactions

The greatest risk for black and grizzly bears are conflicts with humans, which leads to the destruction of “problematic” bears. These conflicts arise when bears seek out food resources such as human garbage, bee hives, residential fruit trees, and camper’s foods (coolers etc.). Each year conservation officers in BC kill up to 1,000 black bears as a result of bear-human conflicts (Blood 2001).

The presence of roads has been linked to increased bear mortality due to direct mortality from road kill and indirect mortality as a result of increased access by hunters, poachers, and settlers (Gibeau and Heuer 1996, Jalkotzy et al. 1997). Research differs on the response of black bears to roads, although the size of the road and the intensity of use it receives seem to account for some of the differences. In Montana, researchers found that the bears used habitats within 274 m of open roads less than expected during the spring and habitats within 914 m of open roads less than expected in the fall (Kasworm and Manley 1990). In Idaho, researchers found that areas within 50 m of 1- and 2-lane gravel or forestry roads were used in proportion to their availability by feeding bears but were avoided by bedding bears (Unsworth et al. 1989). In New Hampshire, Meddleton and Litvaitis (1990) found that adult female and subadult black bears used roads and powerline right-of-ways more than expected but that the bears were more likely to use gated commercial logging roads than gravel roads or highways. The proximity of bears to logging roads noted in this study was thought to be related to bear feeding in cutblocks along these roads and on the roadside vegetation. Freisen (2016) found that grizzly bears feeding selection for along railways increased in spring and fall and powerlines were selected for more in summer.

Numerous studies have looked at the effect of roads on grizzly bears, with the presence of roads linked to increased bear mortality due to increased access by hunters, poachers, and settlers (McLellan 1989b, McLellan and Shackleton 1988, Kasworm and Manley 1990, Mace *et al.* 1996). As well, in most cases, areas adjacent to roads show a reduction in day use by grizzly bears; the area avoided by the bears ranged from within 100 m in southeastern BC and adjacent parts of Montana to within 914 m in northwest Montana

(Mattson *et al.* 1987, McLellan and Shackleton 1988, Kasworm and Manley 1990, Mace *et al.* 1996). Grizzly bears may continue to use feeding habitats that are close to roads (within 150 m) when there is sufficient vegetation cover to conceal them (McClellan and Shackleton 1988). Roadside cover is also important in areas where roads are used by bears as travel routes. Proctor *et al.* (2020) reported that the majority of grizzly bears under 2 years old which live in areas of human-bear overlap will eventually be killed by people and almost all are killed near roads.

3.6.2 Assessment and Survey Results

Wildlife Trail Cameras

Wildlife trail cameras were deployed in seven locations within the W-LSA (Figure 2.11-1) from April 11, 2017 to Sept 12, 2018 for a total of 921 camera days. Camera Site 1 was the only site which collected data between September 26, 2017 and May 2018. Of the 2,154 wildlife photo images collected, a total of 449 were of black bears, with 143 identified as unique observations of black bears (e.g. triggered at different times and sites). Unfortunately, we could not determine an estimated population as we were unable to identify unique individuals due to lack of individual markings on the bears.

Photo images of black bears were collected on 40 days in 2017 and 35 days in 2018, with Camera Site 7 capturing the largest amount of black bear photos (35 photos/100 camera days) followed by Camera Site 6 (25 photos/100 camera days) (Figure 3.6-3). Camera Site 7 is an old road between an old BI/Sx forest and a 15-year-old harvested area. Camera Site 6 is on an old road, within a 45-year-old harvested PI/At forest.

Black bear activity within the minesite area was observed to peak in the summer months of June, July and August with a decline in activity during September (Figure 3.6-3). This peak in abundance can be attributed to their omnivorous foraging habits with an emphasis on feeding on fruits and berries observed in mid July through August (Noyce and Coy 1990). During the fall months black bears continue their search for food in mid to low elevations, including feeding on salmon in the valley bottoms (Appleton 2006) and grains in agricultural areas (Ditmer *et al.* 2015, L. Turney unpublished data). The reduction of photos in September could be attributed to this change in foraging habits and the lack of these food sources at the camera sites.

Black bears were observed primarily at dawn and dusk (Figure 3.6-4), becoming most active (i.e. images captured more frequently) in the mornings and evenings of each day. Notably, no images of bears were observed between midnight and 5 AM.

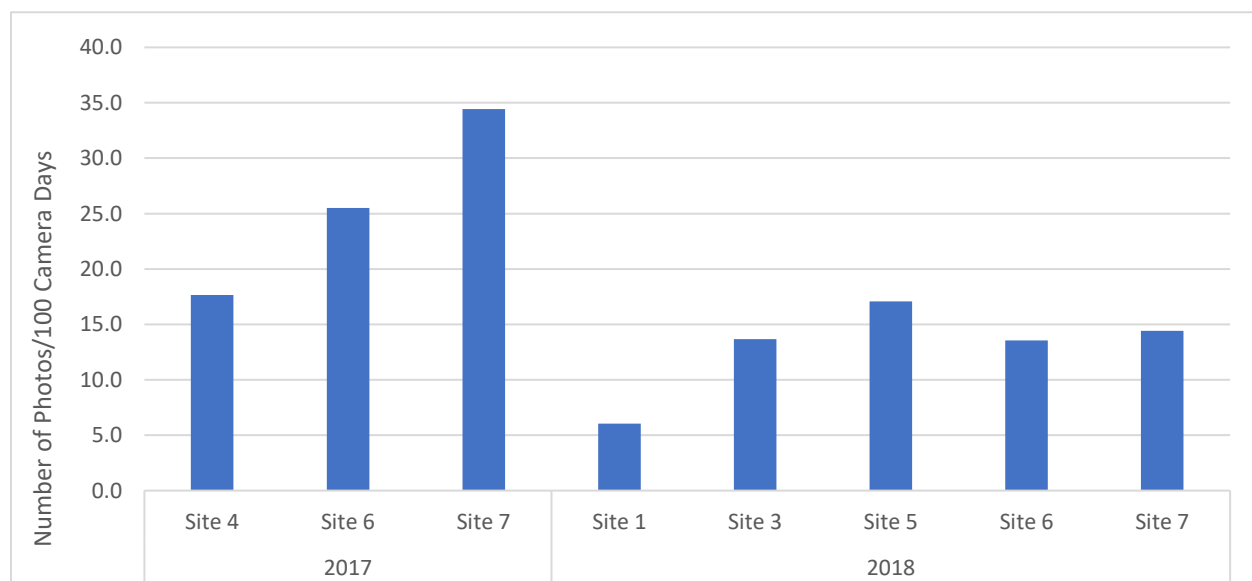


Figure 3.6-2: Total number of new images of black bear at each camera site within the LSA in 2017 and 2018.

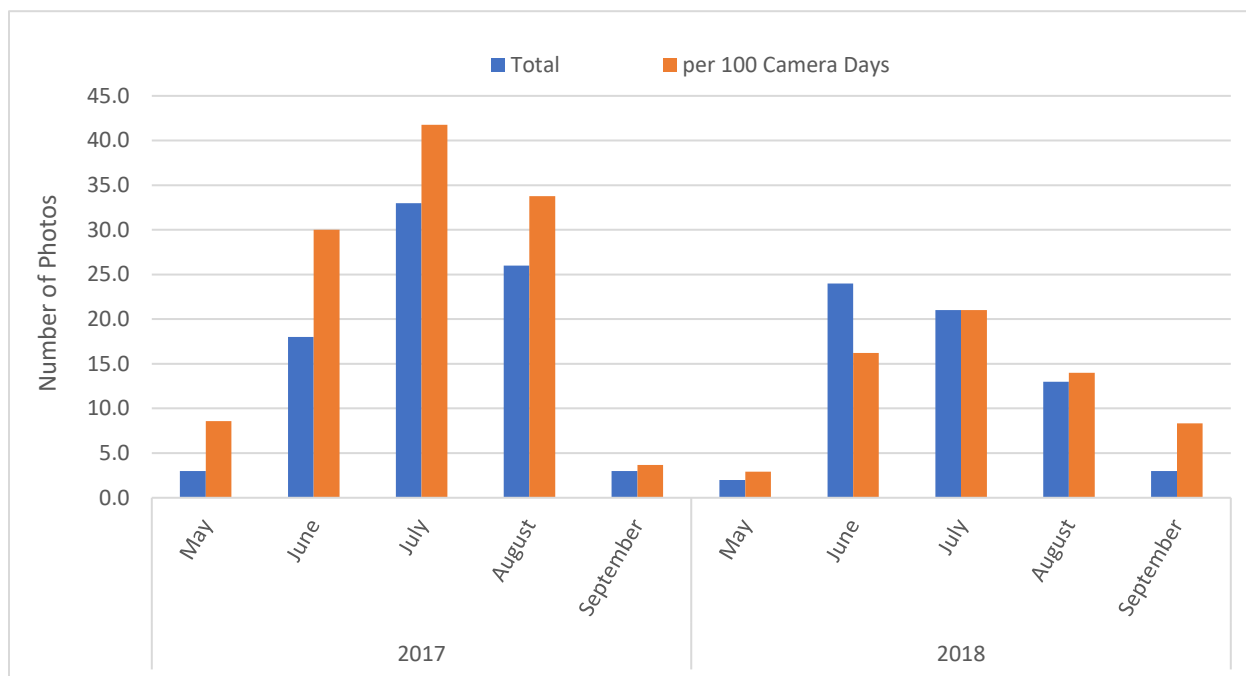


Figure 3.6-3: Number of new black bear images captured each month within the W-LSA in 2017 and 2018.

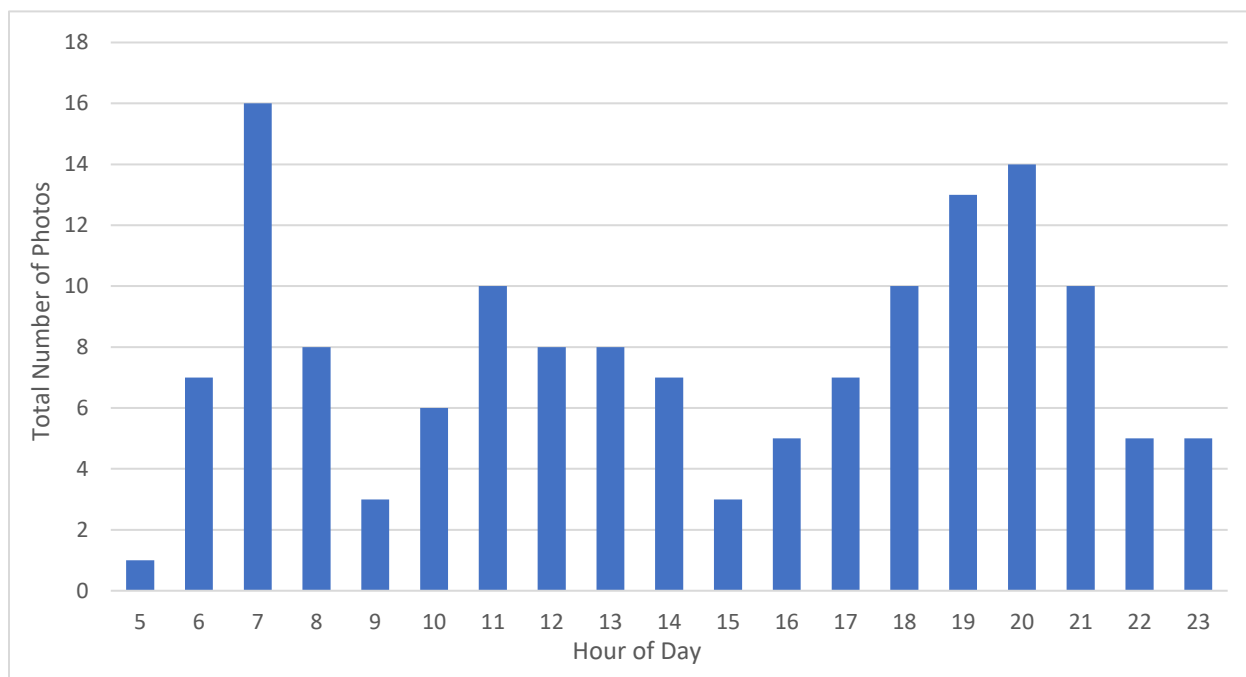


Figure 3.6-4: Total number of new black bear images captured each hour of the day within the LSA in 2017 and 2018.

An adult female black bear with two cubs was photographed several times at Camera Site 5 (Plate 3.6-1), while three photos of a single grizzly bear were obtained at Camera Site 7 on July 17, 2017 (Plate 3.6-2).



Plate 3.6-1: Adult female black bear and two cubs observed on July 11, 2017 at Camera Site 5.



Plate 3.6-2: Adult grizzly bear observed on July 17, 2018 at Camera Site 7.

Wildlife Trail Assessments and Incidental Observations

During the wildlife trail assessments, black bear sign (tracks and scat) was recorded on 30% of the wildlife trails (n = 45) that bisected the access corridor. Grizzly bear sign was not observed during wildlife trail assessments in 2019. Habitat use and incidental observation data collected during various surveys is outlined in Table 3.6-2. Within the W-LSA, a total of 234 observations of black bear sign, 24 observations of grizzly bear sign and 73 unidentified bear sign were recorded. Six incidental sightings of black bears were recorded in the W-LSA during field surveys, two in 2017 and four in 2018. One grizzly bear sighting from helicopter was recorded in 2017 within the W-LSA. Figure 3.6-6 outlines the distribution and types of bear sign observed during the baseline program from 2017 to 2019.

Table 3.6-2: Summary of observations of bear sign and activity from WHA plots, wildlife trail assessments and incidental observations within the W-LSA from 2017 to 2019.

Sign Age/Type	Type of Sign / Activity / Use								
	Excrement	Body Part ¹	Feeding	Denning	Territoriality	Disturbed ²	Tracks	Bedding	Living ³
Black Bear									
Visual						2	1		3
Fresh/Young	108		40	4	8		30	11	10
Unknown/Old	6	1	1		2				4
Winter				2					
Total	114	1	41	6	10	2	31	11	17
Grizzly Bear									
Visual							1		
Fresh/Young	1		1		4		16		
Unknown/Old					1				
Total	1		1		5		17		
Unknown Bear									
Fresh/Young	20		28		1			5	7
Unknown/Old	3		2						5
Total	23		30		1			5	12
Grand Total	138	1	72	5	16	2	48	16	29

Notes: 1) Body Part: portions of an animal's body which are left behind but do not indicate the animal is dead (e.g. antler sheds, hair)

2) Disturbed: Behaviour for the purpose of avoiding the observer, activity before disturbance unknown

3) Living: Activity ambiguous or could not be specified

There were 114 observations of black bear scat and 41 of black bear feeding (ant/wasp nest feeding, browse on herbs etc.), and 23 were black bear tracks (Table 3.6-2). A total of five active black bear den sites were observed within the W-LSA (Figure 3.6-6), with some examples of bear dens provided in Plate 3.6-3 and Plate 3.6-4. Black bear sign was found to be more abundant within the SBSmc2 subzone, although overall, black bear was found fairly uniformly throughout the W-LSA (Figure 3.6-6).



Plate 3.6-3: Potential bear den observed along the access corridor (UTM 9, 627194, 6057195).



Plate 3.6-4: Potential bear den observed along the access corridor (UTM 9, 620807, 6055729).

Wildlife Habitat Assessments

Habitat suitability ratings were collected for both black and grizzly bear within the W-LSA for use in the development of potential wildlife habitat suitability models.

The habitat suitable ratings for black bear foraging habitats is provided in Figure 3.6-5 for the spring, summer and fall seasons while habitat suitability ratings for grizzly bear are outlined in Figure 3.6-5.

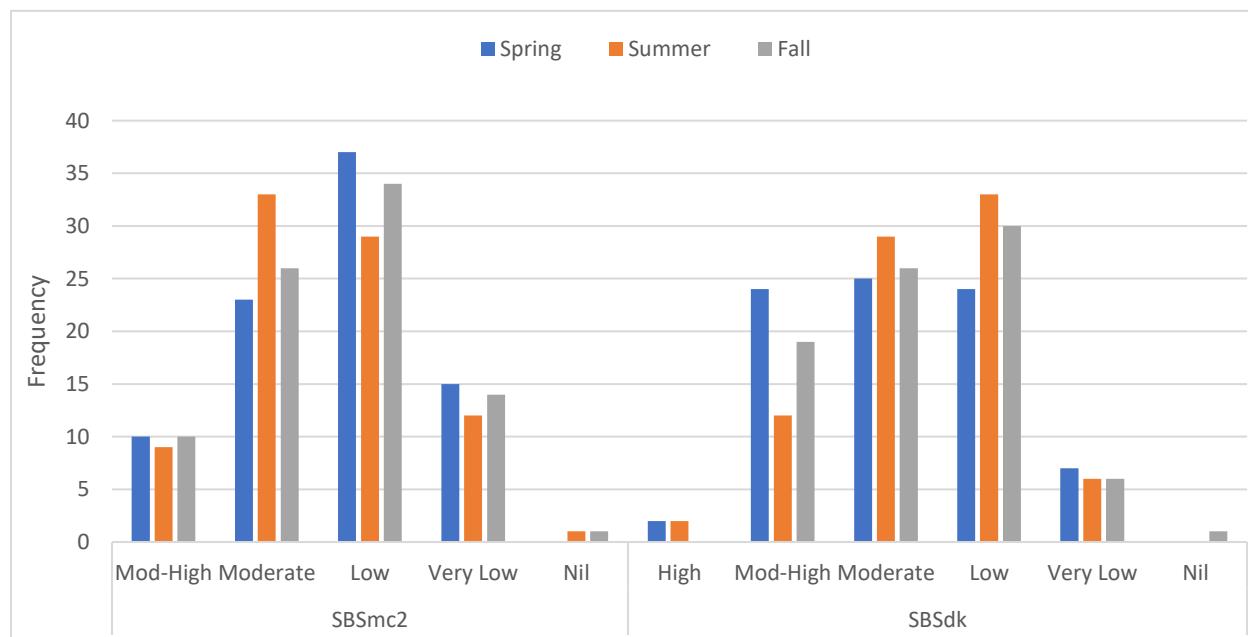


Figure 3.6-5: Distribution of black bear habitat suitability ratings obtained during WHA plots within the LSA in 2017 and 2018.

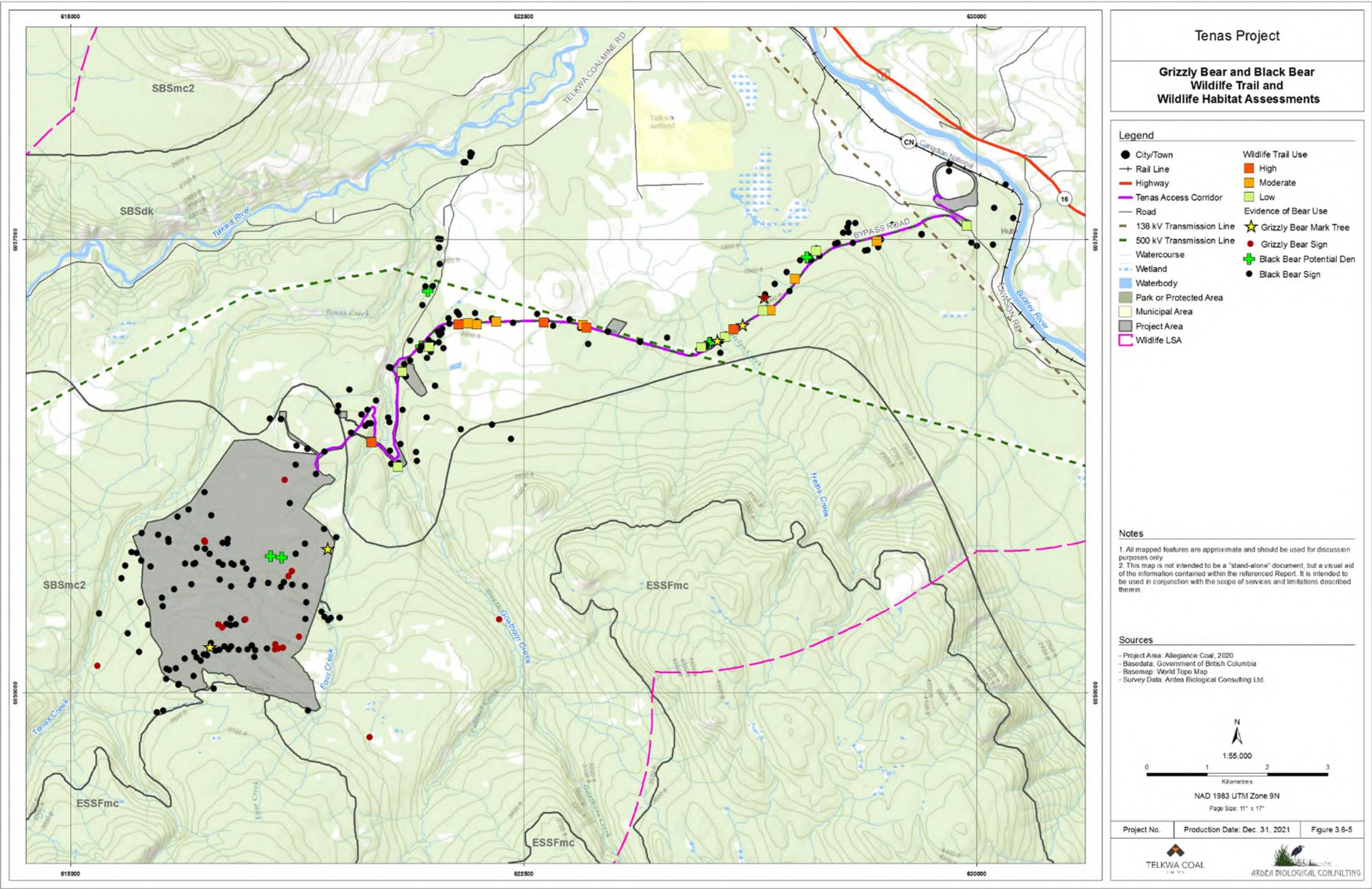


Figure 3.6-6: Distribution of wildlife trails, potential bear dens and grizzly and black bear sign observed within the W-LSA from 2017 to 2019.

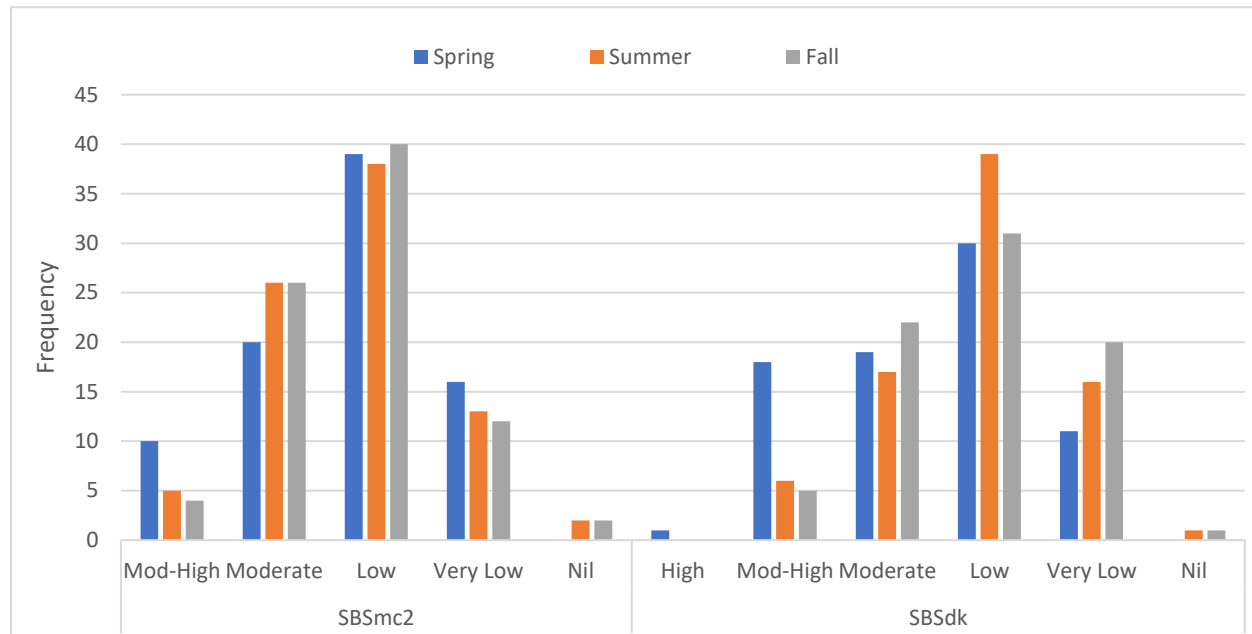


Figure 3.6-7: Distribution of grizzly bear habitat suitability ratings obtained during WHA plots within the LSA in 2017 and 2018.

For black bear within the SBSmc2 BGC subzone, there were no habitats identified as high value, for any season, while a small number of plots were rated high within the SBSdk subzone. The majority of plots were rated moderate or low value within the SBSmc2, while in the SBSdk, the distribution was relatively even across most seasons for plots rated moderate-high, moderate and low. Very few plots for grizzly bear were rated as high value for either the spring or summer and they were only located within the SBSdk subzone. The majority of the ratings were moderate to low for all seasons in both subzones.

3.6.3 Habitat Suitability Model Summary

The grizzly bear habitat suitability model results are outlined below based on the species account and model developed as part of the baseline program (Appendix E). The output from the spring, summer and fall grizzly bear suitability models are provided in Table 3.6 3 and Figure 3.6 7 to Figure 3.6 12. Overall, the results of the modelling identified that relatively more high, moderately high, and moderate rated habitat was present in the WRW-RSA than the W-LSA. No moderate to high rated suitable spring habitat was modelled within the W-LSA and limited amounts (<3%) were modelled in the western portion of the WRW-RSA. The summer habitat model indicated that most moderate to high rated habitat was located at mid to upper elevations, with concentrations in the centre and western portions of the WRW-RSA. Some moderate and moderately high habitat was also present at lower elevations, although impressions from field visits and satellite imagery suggest that less habitat may be present than indicated in the model. Some of the overestimation may be due to the difficulty in mapping all anthropogenic disturbances within the WRW-RSA. Mapping of suitable fall habitat indicated that most moderate to moderately high suitable habitat was located in the western portion of the WRW-RSA in the Telkwa River valley and along other known salmon-bearing rivers and creeks. A few other patches of moderate rated habitat were located throughout the lower elevations of the WRW-RSA, and less was located at upper elevations compared to the other seasons

Table 3.6-3: Summary of the results of the baseline grizzly bear habitat suitability model by season within the W-LSA and the WRW-RSA.

Season	Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wide-Ranging Wildlife RSA (ha)	Wide Ranging Wildlife RSA (%)
Spring	High	0.0	0.0	537.0	0.2
	Moderately High	0.0	0.0	387.4	0.1
	Moderate	54.4	0.2	8,096.4	2.3
	Low	4,254.8	11.9	76,833.5	21.5
	Very Low	25,024.7	70.1	230,000.0	64.3
	Nil	6,392.1	17.9	41,732.8	11.7
	Total	35,725.9	100.0	357,587.0	100.0
Summer	High	5.2	0.0	4,024.2	1.1
	Moderately High	355.7	1.0	8,861.6	2.5
	Moderate	4,317.1	12.1	65,196.1	18.2
	Low	10,246.9	28.7	113,475.2	31.7
	Very Low	14,724.5	41.2	130,851.0	36.6
	Nil	6,076.5	17.0	35,178.9	9.8
	Total	35,725.9	100.0	357,587.0	100.0
Fall	High	0.0	0.0	0.0	0.00
	Moderately High	606.6	1.7	3,104.1	0.9
	Moderate	2,411.3	6.8	19,343.3	5.4
	Low	8,205.9	23.0	138,717.7	38.8
	Very Low	18,114.5	50.7	154,807.3	43.3
	Nil	6,387.6	17.9	41,614.6	11.6
	Total	35,725.9	100.0	357,587.9	100.0

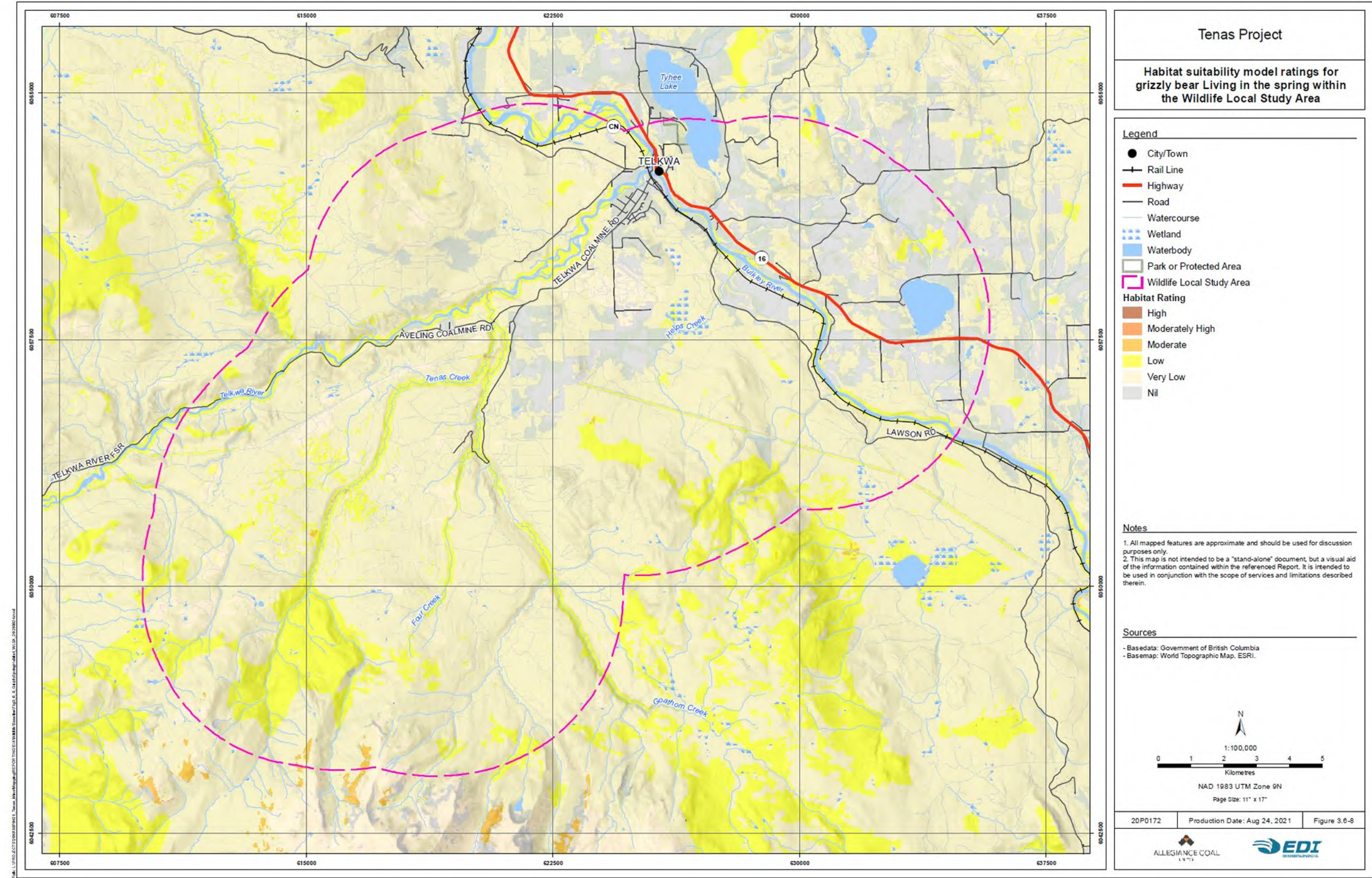


Figure 3.6-8: Habitat suitability model ratings for grizzly bear Living in the spring within the W-LSA.

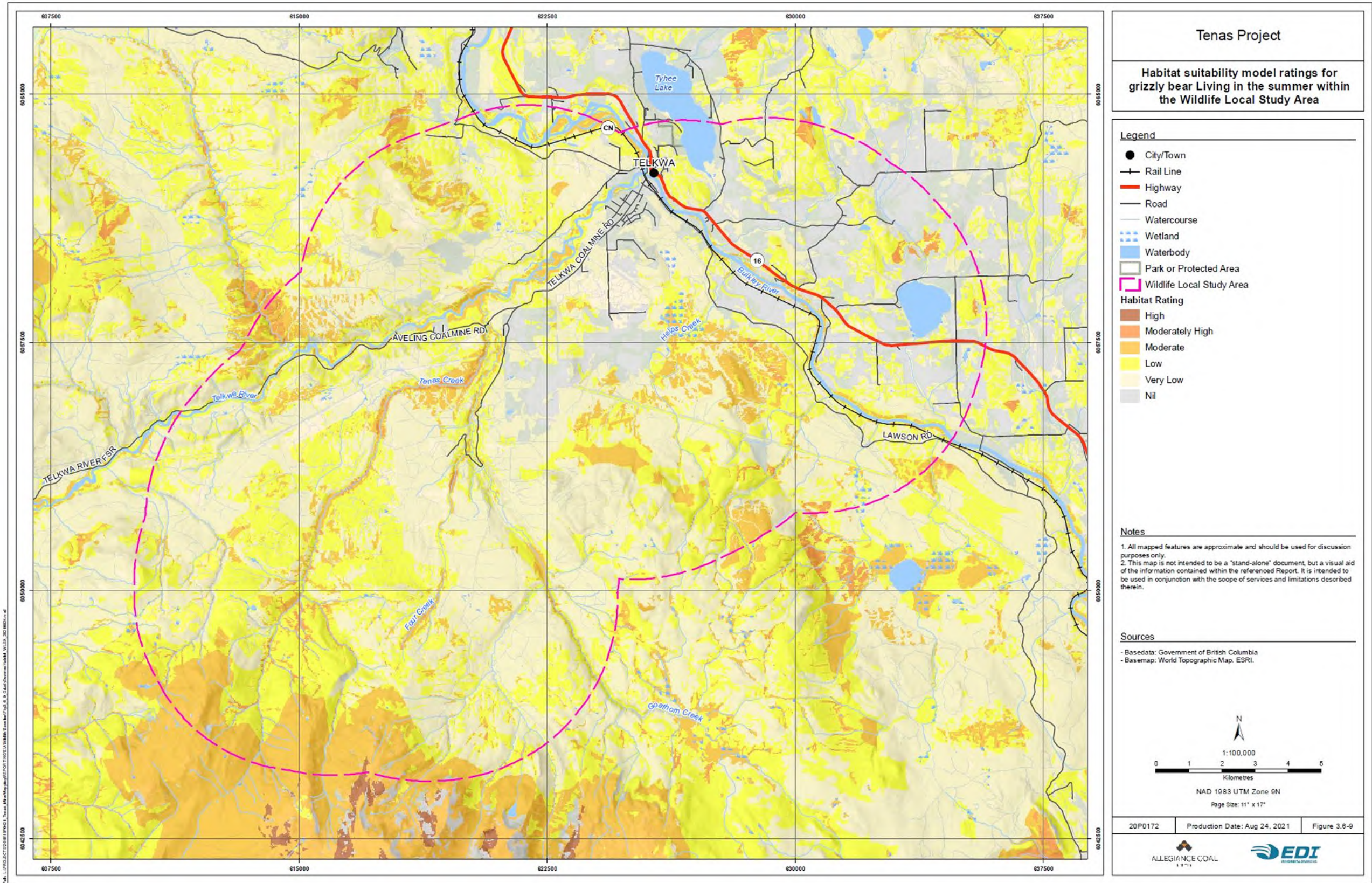


Figure 3.6-9: Habitat suitability model ratings for grizzly bear Living in the summer within the W-LSA.



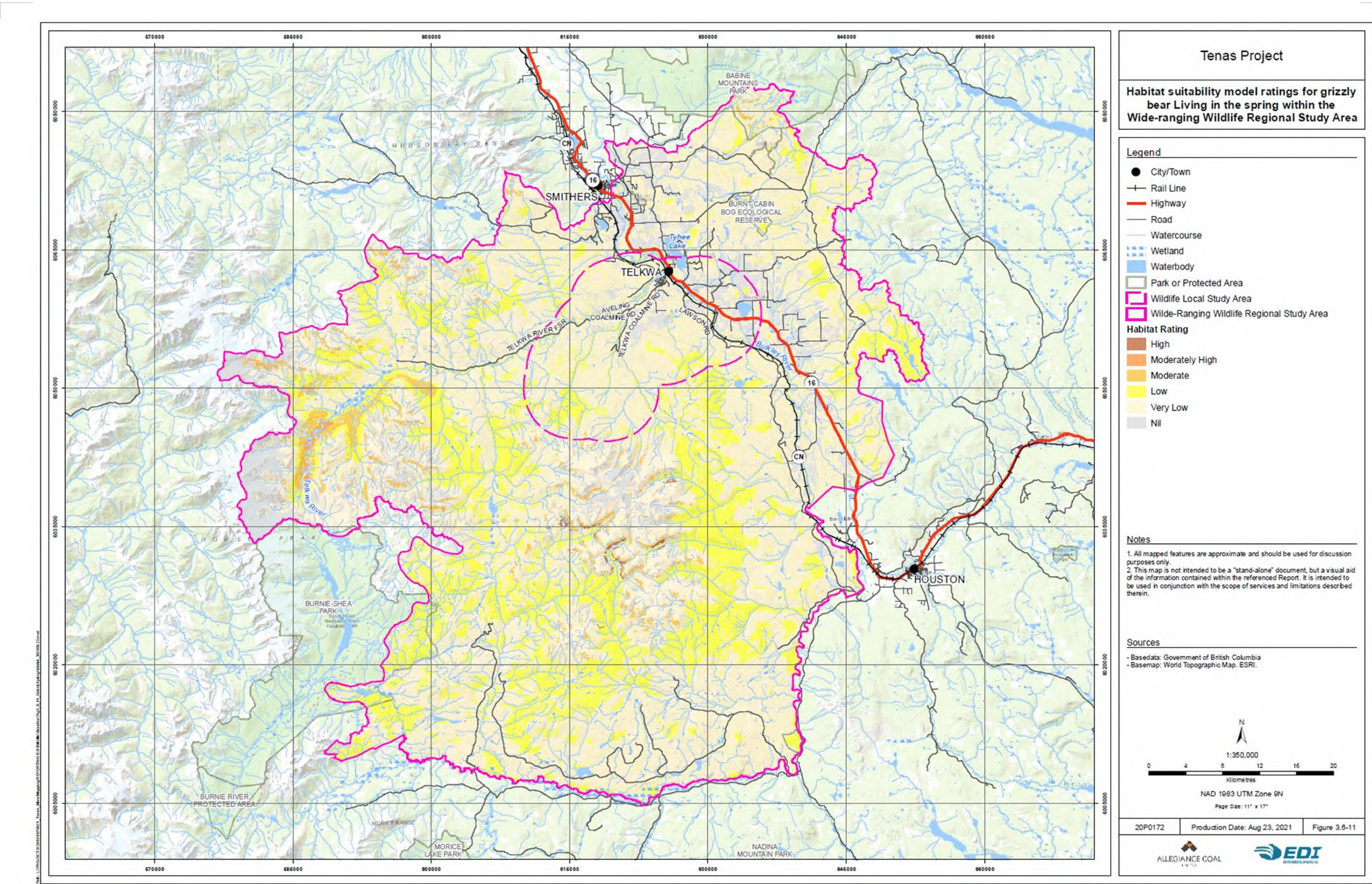


Figure 3.6-11: Habitat suitability model ratings for grizzly bear Living in the spring within the WRW-RSA.



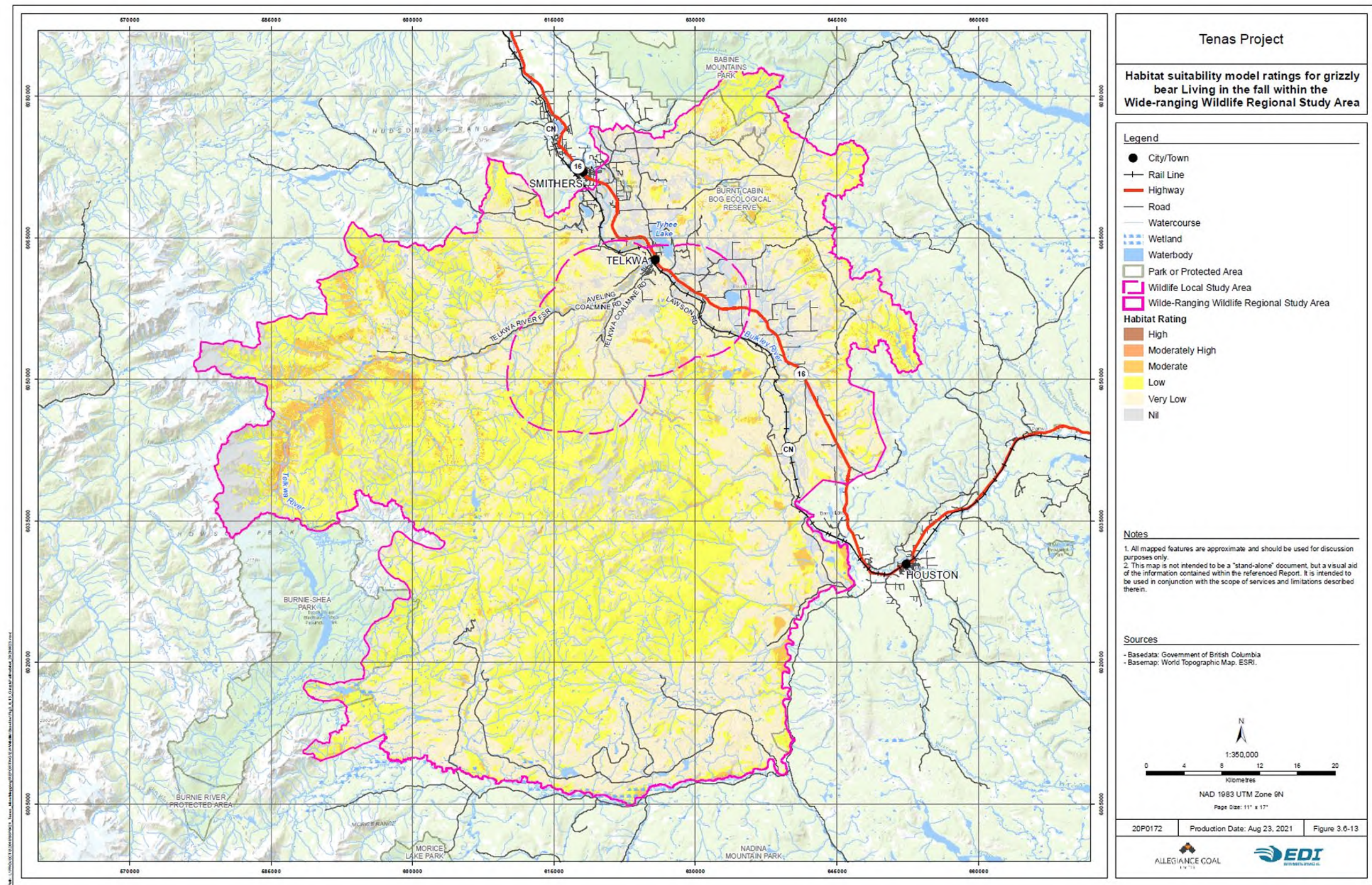


Figure 3.6-13: Habitat suitability model ratings for grizzly bear Living in the fall within the WRW-RSA.

3.7 Caribou

The following section describes the ecology and management of the Telkwa Caribou Herd based on the historical information, recent management information, and results of the analyses described in Section 2.8. The herd has been a focus of management efforts in the region since the 1950s due to low numbers of caribou. Efforts to recover the herd have had temporary successes, but the herd has remained in a perpetual state of conservation concern.

Telkwa caribou are woodland caribou (*Rangifer tarandus caribou*) and considered part of Canada's Northern Mountain population since 2011 (COSEWIC 2011). Northern Mountain caribou are distributed from central BC to central Yukon, and the mountainous in the western Northwest Territories. Herds tend to be small, isolated and sedentary compared to the migratory barren-ground caribou. Woodland caribou exist at lower density than the larger migratory herds and are generally more dispersed within their annual ranges. The Telkwa Caribou Herd was originally classified as part of the Southern Mountain caribou population by COSEWIC in 2002 because the herd occurs within the Southern Mountain National Ecological Area (COSEWIC 2002). The Telkwa Caribou Herd was included in the Northern Group of the Southern Mountain population. The Southern Mountain population of woodland caribou was assessed as threatened in 2002 (COSEWIC 2002) and listed on Schedule 1 of SARA in 2003. As required under SARA for species listed as threatened, a recovery strategy was developed, then approved in 2014. The Recovery Strategy for the Woodland Caribou, Southern Mountain population in Canada (Environment Canada 2014) identifies population targets with the overall purpose of making sure that each of the subpopulations within the Southern Mountain population are self-sustaining. The federal Recovery Strategy (Environment Canada 2014) remains the guiding document for the Telkwa Caribou Herd recovery and management until they are officially relisted as part of the Northern Mountain population.

The Telkwa Caribou Herd is a relatively isolated herd near the southern extent of the Northern Mountain population range. The herd's range is centred on the Telkwa and the Howson ranges, and bounded by three broad river valleys that isolate the range from adjacent alpine terrain. The Telkwa, Bulkley, and Morice river valleys are the main landscape features that bound the herd in the north, east, and south, respectively. The low elevation river valleys currently limit caribou use through a combination of lack of caribou habitat in the valley bottoms, higher predation risk in forested areas, and the extensive human use of the areas; particularly the Bulkley River valley which includes Smithers, Telkwa, and Houston. Major human developments and infrastructure that border the herd's range include the Houston airport, agricultural lots, a ski hill, a railroad, the Yellowhead Highway, a pipeline, and a large transmission line. Other extensive human land uses and associated land cover changes within the region include forestry and forestry roads, rural residential, secondary and tertiary roads, and recreational trails.

3.7.1 Existing Information on Caribou

The following documents were reviewed and are the primary source of background information for the Telkwa Caribou Herd:

- ▶ *Telkwa Caribou Population Status and Background Information Summary 2014* (Cichowski 2014).
- ▶ *COSEWIC Assessment and Status Report on the Caribou (Rangifer tarandus) Northern Mountain Population, Central Mountain Population, Southern Mountain Population in Canada* (COSEWIC 2014).
- ▶ *Recovery Strategy for the Woodland Caribou, Southern Mountain Population (Rangifer tarandus caribou) in Canada* (Environment Canada 2014).
- ▶ *DRAFT Telkwa Subpopulation, Telkwa Local Population Unit. Woodland Caribou Plan* (Government of BC n.d.).

- ▶ *Spatial Factors Influencing Northern Mountain Caribou (*Rangifer tarandus*) Survival and Distribution in the Telkwa Range* (Grant 2017).
- ▶ *Telkwa Caribou Rut Count: October 1, 2018* (Hoffman and Grant 2019a).
- ▶ *Telkwa Caribou Recruitment Survey: March 25, 2019* (Hoffman and Grant 2019b).
- ▶ *Telkwa Mountains Caribou Herd Recovery Plan* (BC MOELP 1998)
- ▶ *Home Range and Habitat Selection of Female Caribou in the Telkwa Mountain Range, British Columbia* (Roberts et al. 2003).
- ▶ *Habitat Selection and Calf Survival in the Telkwa Caribou Herd, British Columbia, 1997-2000* (Stronen 2000).
- ▶ *Telkwa Caribou Monitoring: April 2013 - March 2014* (Thiessen 2014).
- ▶ *Telkwa Caribou Rut Count: October 18, 2016* (Thiessen and Grant 2016).

The existing conditions of the Telkwa Caribou Herd are summarized below.

Classification

There have been various approaches to classify woodland caribou into distinct groups resulting in some confusion when describing the status of herds. All woodland caribou are described as a forest-dwelling subspecies of caribou that exist across forested environments in Canada. Distinct populations of woodland caribou were nationally delineated in 2002 to assist in the assessment of woodland caribou conservation status in Canada. Canada's extant woodland caribou were designated into Northern Mountain, Southern Mountain, Boreal, Newfoundland, and Gaspésie populations (COSEWIC 2002). The designations of the populations were required to assess the conservation status of woodland caribou at the scale Canada; however, the boundaries of the populations were debated and jurisdictions tended to stick to the designations within their provinces (COSEWIC 2011). Sticking with the local designations made practical sense as they were consistent with the local knowledge of the population's ecology and management history. COSEWIC recognized the problems associated with the 2002 population designations, so they reassessed the delineation and created a list of twelve designatable units (COSEWIC 2011). Four designatable units of existing woodland caribou populations occupy various parts of BC: Boreal unit (DU6) occupies the north eastern portion; the Northern Mountain unit (DU7) occupies the northern and western parts of BC, the Central Mountain unit (DU8) occupies the mountains along the central Alberta-BC border, and Southern Mountain unit (DU9) occupies the central and southeastern BC (COSEWIC 2011). In accordance with this classification, the Telkwa Caribou Herd is part of the Northern Mountain DU7 and is referred to as belonging to the Northern Mountain population throughout this document.

Conservation Context

Caribou herds have been declining across Canada with few exceptions. The declining numbers have led to management and conservation efforts across Canada to reduce and reverse the declines; in BC there have been intensive efforts to recover herds (Serrouva et al. 2019). Currently, all of Canada's caribou populations are assessed by COSEWIC as having some level of conservation concern.

Nationally, the conservation status of the Telkwa Caribou Herd is complicated by the changes to the classification of woodland caribou designatable units in 2011 (see above). Currently, the Telkwa Caribou Herd is assessed as part of the Northern Mountain population with a conservation status of special concern (COSEWIC 2014), but listed on Species at Risk Act (SARA) as threatened as within the Southern Mountain population (based on their previous classification). Within the federal Recovery Strategy (Environment Canada 2014), the Telkwa Caribou Herd belongs in the 'Northern Group' of the Southern Mountain population. This difference is because SARA has not yet adopted the designatable unit terms (COSEWIC 2011) or the latest COSEWIC classification for the Telkwa Caribou Herd (COSEWIC 2014).

Provincially, the Telkwa Caribou Herd is part of the Northern Mountain population that was designated as blue listed (special concern) by the BC CDC in 2017. The provincial conservation status is S2S3, which indicates a subnational rank (S) with a modifier of imperiled (2) to special concern (3). The inclusion of the imperiled rank reflects some of the uncertainty in the trends and high threats to some subpopulations within the Northern Mountain population (BC CDC 2020).

Regardless of the national or provincial conservation status, the Telkwa Caribou Herd has existed in a state of considerable local conservation concern for decades.

Management Initiatives

The Telkwa Caribou Herd has been managed and monitored since the 1950s. Various management plans, habitat protection policies, regulations on human activities, and recovery programs have been developed and implemented to recover the Telkwa caribou population and its habitat. The following summarizes in chronological order the most influential Telkwa Caribou Herd management initiatives.

The Province of British Columbia closed hunting of the Telkwa Caribou Herd with a change to regulations under the *Wildlife Act* in 1946. Hunting of Telkwa caribou was banned 1946 to 1955, concurrent with a regional wolf reduction program that included the Telkwa area. The Telkwa Caribou Herd increased in size during the following years, but low numbers again required a hunting closure in 1973 and the ban on Telkwa caribou hunting remains in effect today.

The Bulkley LRMP (BVCRB and IRT 1998) provides directions specific to the management of the Telkwa Caribou Herd and its habitat for Planning Unit 11, the portion of the planning area partly overlaps the herd's annual range. Caribou are an important value for Planning Unit 11 of the Bulkley LRMP (BVCRB and IRT 1998), as evidenced by their inclusion in many of the directions provided for the unit. The Bulkley LRMP (BVCRB and IRT 1998) is the first document that identifies recreational activity as a risk to the Telkwa Caribou Herd. The most important outcome of the Bulkley LRMP (BVCRB and IRT 1998) for the Telkwa Caribou Herd was the direction to "develop a comprehensive plan [recovery plan] to enhance and sustain a viable caribou population".

The *Telkwa Mountains Caribou Herd Recovery Plan* (BC MOELP 1998) was developed by the Province of BC in response to the direction from the Bulkley LRMP. The plan focussed on: 1) population augmentation through a transplant program, 2) studies to understand the factors influencing the herd's population ecology, and 3) habitat protection (BC MOELP 1998). A large caribou translocation and monitoring program was the most substantial outcome of the plan and provided the information used to describe the Telkwa Caribou Herd ecology and conservation issues (see Abundance section below).

The Bulkley SRMP (BC MAL 2005) was finalized in 2005. The plan applies to an area within the 1998 Bulkley LRMP planning region. The SRMP area is the low elevation terrain of the Bulkley Valley and, consequently, the plan's directions related to Telkwa caribou are specific to the lower elevation caribou habitats. The plan provides strategies focussed on the forest management practices to ensure adequate security areas, winter forage, and large areas with little human activity. Recommendations include seasonal restrictions to forest harvesting activities and access management by BGC zone.

The Morice LRMP (BC MAL 2007) was finalized in 2007 to direct management of public land and resources with key stakeholders, including a new emphasis on the inclusion of First Nation values and knowledge in the planning process. The planning area overlaps the southern portion of the Telkwa Caribou Herd range. The focus of the plan related to Telkwa Caribou Herd management includes management of calving and post calving habitat and recreational access management; however, the plan acknowledges the federal conservation status of the herd and provides a direction to comply with the outcome of the future recovery plan as required under SARA.

The *Recovery Strategy for the Woodland Caribou, Southern Mountain population in Canada* (Environmental Canada 2014) is the plan currently guiding management of the Telkwa Caribou Herd. The 2014 Recovery Strategy provides a specific critical habitat target of 65% undisturbed habitat within a herd's

low elevation winter and matrix habitat. Other than the disturbed habitat target, the 2014 Recovery Strategy provides general strategies to achieve the objectives of maintaining the distribution and reversing the declines of the caribou herds. The recovery strategy identifies and prioritizes various threats to the Southern Mountain population and provides recovery strategies for addressing the threats. Strategies to address the most urgent threats include: management of predators and their primary prey, landscape level protection and planning that considers caribou habitat requirements, habitat management, recreational activity management, and addressing information gaps in caribou ecology.

A Wildlife Habitat Area 6-333 (WHA 6-333) for the Telkwa Caribou Herd was established as a legal order under BC's *Government Actions Regulation* in 2015 and amended in 2018 (Government of BC 2004). The WHA prescribes thresholds for forestry and associated activities. The focus of the prescriptions is retention of caribou habitat and limitations to access within the WHA. In addition, the WHA provides general wildlife measures that apply to mineral and coal exploration and development.

A draft management plan for the *Telkwa Subpopulation, Telkwa Caribou Local Population Unit* (LPU) (Government of BC n.d.) was developed by the Province of BC in 2017. The plan identified recommendations at various timelines to acquire information and management actions to support the recovery of the herd. The plan is not finalized as it is described as a living document, but some items within the plan have been implemented. The plan identifies the closure of parts of the Telkwa range to motorized recreational vehicles under the *Wildlife Act* as an action item, an item first identified in the 1998 Bulkley LRMP. Today, motorized vehicles are restricted from using the Telkwa Mountains Area Management Unit 6-9 (MU 6-9), with the exception of the Grizzly Plateau and Meat Cache areas that are open to motor vehicles from Nov 1 to Apr 30 and Dec 14 to Apr 1, respectively. Other recommended actions listed in the plan, such as maternal penning and supplemental feeding, have not been implemented to date.

Historical Range and Distribution

The current Telkwa Caribou Herd annual range is the Telkwa Mountains and eastern portion of the Howson Mountain Range. The herd's range is bounded by large river valleys to the north, east, and south, and rugged high elevation coastal mountains that get heavy snowfall to the west. The Telkwa Caribou Herd range is near the southern extent of the Northern Mountain Population's range. In contrast to other Northern Mountain caribou ranges, the Telkwa Caribou Herd range is more isolated and smaller. The current Telkwa Caribou Herd range likely reflects a contraction compared to the herd's historical ranges. Early observations of the Telkwa caribou suggests that the herd's range included the Hudson Bay and Babine mountains, and possibly ranged as far north as Hazelton (Cichowski 2014). The contraction of the caribou range likely occurred sometime during the early 1900s (Cichowski 2014).

Northern Mountain caribou seasonally use different parts of their range. Seasonal changes in range use are driven by forage availability, climate (notably snow), and avoidance of predators (COSEWIC 2014). Movements between seasonal ranges are commonly altitudinal and sometimes referred to as migrations because they may occur regularly across years. A common pattern of seasonal range use in central and northern BC, is use of alpine areas through the growing season (pre-calving to rut) and movement to lower elevation, forest dominated areas in winter. The distances between seasonal ranges can be relatively large for herds that move between discrete low elevation forested winter range and high elevation summer and fall ranges (Kuzyk et al. 1999); for example, the Nahanni Caribou Herd moves a mean distance of 142 km between winter and summer ranges (Gullickson and Manseau 2000). However, seasonal range shifts are not observed in all Northern Mountain caribou herds and there is considerable variation in how caribou herds use their range (COSEWIC 2014).

Seasonal ranges are not defined for the Telkwa Caribou Herd. The lack of seasonal ranges is partly due to the fact that the herd is distributed throughout its annual range during all seasons. Roberts et al. (2003) analyzed seasonal range use by VHF collared female caribou during 1997 to 2002 and found caribou ranges generally overlapped; caribou occupied the largest range during summers (898 km²), followed by spring, calving, and winter (range: 370 km² to 384 km²), then fall/rut (238 km²). The lack of clear seasonal

ranges is consistent with other Northern Mountain caribou subpopulations at the southern extent of the population's range; for example, Poole et al. (2000) documented a lack of change in seasonal range use for the Takla Caribou Herd. Changes in range use are generally associated with unfavourable winter conditions when snowpack makes movement and access to winter forage more difficult (Kuzyk et al. 1999).

Habitat Use

Winter is the season when access to and the quality of forage is most limited for caribou and habitat use is most constrained by nutritional needs. In winter, the seasonal changes in range and habitat use are generally associated with winter snow depth and conditions (i.e., hardness) that limit caribou access to winter forage (Kuzyk et al. 1999). Lichens, both terrestrial and arboreal, are the principle winter forage for caribou (Thompson et al. 2015). Northern Mountain caribou prefer terrestrial lichens and access them in areas with lower snow depth, such as lower elevation forested habitats or wind scoured slopes, while arboreal lichens are consumed less often (Heard and Vagt 1996). Higher quality winter habitat is typically found in old forests because of greater snow interception by the trees and greater lichen biomass; however, Northern Mountain caribou continue to use the alpine during winter where snow conditions are suitable (Kuzyk et al. 1999).

Northern Mountain caribou typically move to higher elevation habitat as the snow melts and remain at higher elevations throughout the calving season, summer, and fall to avoid predation risk (Bergerud et al. 1984). During the growing season, caribou diets expand to include a greater diversity of plants, such as forbs and shrubs (Thompson et al. 2015). They occupy higher elevation habitats where they are spatially separated from other prey species and their predators. Northern Mountain caribou distribution is driven by predator avoidance by occupying habitats where wolves and other large prey species are not abundant (Bergerud et al. 1984). Their selection of habitat during the growing seasons is assumed to be driven more by predation risk than forage because they forgo more productive lower elevation habitats in favour of poorer quality habitats that has fewer predators (COSEWIC 2014).

The Telkwa caribou have been documented selecting both alpine and subalpine habitats during the entire year (Cichowski 2014), and historically selecting forested habitats during some years and seasons (Stronen 2000, Roberts et al. 2003). Early studies of Telkwa caribou habitat use included primarily collar locations of translocated caribou. Stronen (2000) reported that translocated caribou selected elevations above 1700 m, on moderate slopes, and aspects that receive more solar radiation (NW to SE, 136-315 degrees), and old growth forests (>250 years old) when using forested habitats. Roberts et al. (2003) reported that Telkwa caribou selected alpine habitat and used forested habitats during some winters. Grant (2017) was the first to provide habitat-based analysis using the GPS collar locations and reported the Telkwa caribou summer and winter habitat selection of translocated and resident caribou separately. The results showed that resident caribou selected high elevation terrain during summer and winter, while translocated animals selected higher elevation terrain during summer and lower elevation during winter.

Abundance

The most recent survey of the Telkwa Caribou Herd counted 25 caribou (Hoffman and Grant 2019a). The earliest estimates of the herd indicated that the herd may have included up to 250 caribou but documentation included anecdotes and few details, consequently, the results are not comparable to recent work. The first aerial survey was completed in the winter of 1955/56 (Government of BC n.d.). Subsequent aerial surveys were completed sporadically during the next three decades, followed by regular aerial monitoring and reporting from 2004 to 2019 (Cichowski 2014, Hoffman and Grant 2019a). The results of the aerial surveys completed during the last 64 years document a series of declines and recoveries in abundance.

The first decline of the Telkwa Caribou Herd was in the mid-1950s when caribou were thought to have declined significantly based on the lack of ground observations (Cichowski 2014). The decline coincided with a suspected regional decline in caribou and moose across northern BC (Bergerud and Elliot 1986).

Hunting of the Telkwa Caribou Herd was restricted in 1946 to 1955 for the region due to concerns about broader declines (Cichowski 2014) and an effective wolf control program was initiated to recover the regional ungulate population (Bergerud and Elliot 1986). Caribou numbers before and during this first documented decline are uncertain, but the aerial surveys following the recovery efforts indicate that the caribou herd increased to more than 200 caribou by the mid-1960s (Cichowski 2014). The caribou herd declined a second time to 40 animals by 1968, possibly from harvest pressure or landscape changes, and continued a slow downward trajectory for the next three decades. By the mid-1990s, aerial surveys never documented more than 13 caribou per survey (Government of BC n.d.). A translocation program that transplanted 32 caribou from the Chase-Sustut caribou herd was conducted during the winters of 1997 to 1999 (Stronen 2000) and resulted in an increase in Telkwa Caribou Herd numbers which peaked again in 2007 when the herd was estimated to include more than 100 caribou (Government of BC n.d.). After 2007, the caribou herd experienced a precipitous decline and has remained at very low numbers since (Figure 3.7-1).

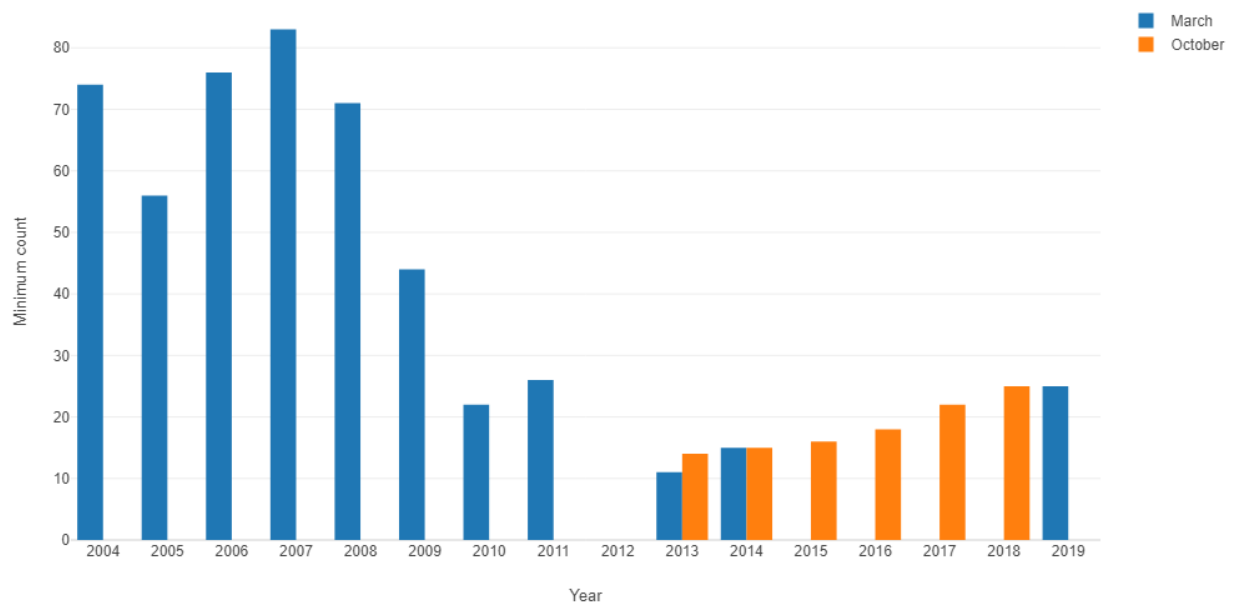


Figure 3.7-1: Telkwa Caribou Herd minimum counts from late-winter (March) and rut (October) recruitment surveys, 2004-2019. The sources of the data are as provided in Error! Reference source not found. Table 3.7-1.

The Telkwa Caribou Herd population size is regulated by additions to the herd through recruitment and losses through mortality. The herd is far enough from other herds that it can be considered a closed population, so natural immigration and emigration do not contribute to changes in the herds numbers. The small size of the herd makes it vulnerable to changes as small subpopulations are unable to buffer against poor recruitment, survival, and stochastic events, such as the Banff caribou herd getting extirpated by an avalanche in 2009 (Environment Canada 2014).

Recruitment

Caribou herds increase when there is good calf recruitment (25 to 35 calves:100 cows as described below) and low mortality. Recruitment, often measured as the number of calves per 100 cows, is used as an indicator of caribou population growth because it is an easier and cheaper measure to acquire than to estimate total numbers of animals in larger caribou herds.

Recruitment rates for the Telkwa Caribou Herd are available from 2004 to 2019 (and ranged from 9 to 88 calves per 100 cows (Table 3.7-1 and Figure 3.7-2). There is variable guidance regarding what recruitment

rate is needed to maintain Northern Mountain caribou herds. The *Management Plan for the Northern Mountain Population of Woodland Caribou* (Environment Canada 2012) categorizes recruitment at the end of winter as poor (<25 calves:100 cows), good (25 to 35 calves:100 cows), or excellent (>35 calves:100 cows), with each category typically associated with declining, stable, or increasing populations, respectively. Yukon Environment (2016) suggests Northern Mountain caribou herds are stable when recruitment is 20 to 25 calves per 100 cows. Hoffman and Grant (2019b) state that calf recruitment above 28 calves per 100 cows is needed for herd growth in this region. However, recruitment rates do not function independently in affecting population growth – adult survival can also be an important factor.

Calf recruitment rates are highly variable as calf survival is dependent on several stochastic factors such as severe weather events and predation (Gaillard et al. 1998, Hegel et al. 2010). In addition to the expected variation in recruitment rates, the small number of caribou in the Telkwa herd during 2004 to 2019 causes recruitment values to be more variable because the loss or addition of one calf can cause large changes in the recruitment rate.

During the documented decline in 2008 to 2010, the survey observations indicated poor recruitment in consecutive years and the number of caribou in the population dropped from about 80 to 22 caribou during this period (Table 3.7-1). While recruitment during this period was poor, a substantial reduction in the number of adults is also required for the population to decline so quickly. Most of the loss of adults during this period of decline is assumed to be due to mortality. Recent surveys have documented relatively good recruitment of calves since 2010, the only exception was 2015 when only one calf was observed. This information suggests that both recruitment and adult mortality are important factors affecting herd's population growth rate.

Table 3.7-1: Numbers of caribou observed from aerial surveys, 2004 to 2019.

Year	Season	Count					Recruitment (calves per 100 cows)	Reference
		Total	Cow	Bull	Calf	Unk.		
2004	March	74	34		21	19	62	(Cichowski 2014)
2005	March	56	35		10	11	29	(Cichowski 2014)
2006	March	76	42	12	22		52	(Cichowski 2014)
2007	March	83	51	13	19		37	(Cichowski 2014)
2008	March	71	48	16	7		15	(Cichowski 2014)
2009	March	44	35	4	5		14	(Cichowski 2014)
2010	March	22	15	3	4		27	(Cichowski 2014)
2011	March	26	14	4	8		57	(Cichowski 2014)
2013	March	11	6		3	2	50	(Cichowski 2014)
2013	October	14	6	4	4		67	(Thiessen and Grant 2016)
2014	March	15	8		2	5	25	(Cichowski 2014)
2014	October	15	7	5	3		43	(Thiessen and Grant 2016)
2015	October	16	11	4	1		9	(Thiessen and Grant 2016)
2016	October	18	9	6	3		33	(Thiessen and Grant 2016)
2017	October	22					NA	(Hoffman and Grant 2019a)
2018	October	25	10	7	8		80	(Hoffman and Grant 2019a)
2019	March	25	8	7	7	3	88	(Hoffman and Grant 2019a)

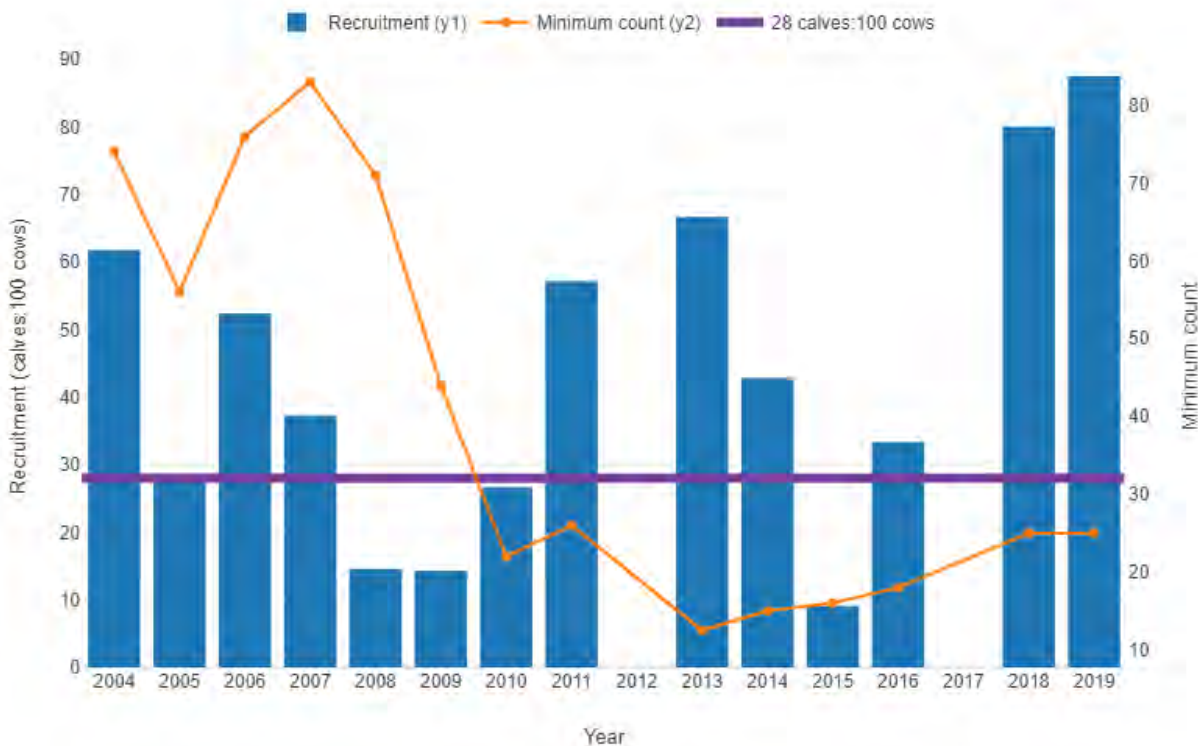


Figure 3.7-2: Telkwa Caribou Herd recruitment (bars, calves:100 cows) relative to minimum survey counts (solid line, total minimum count), 2004 to 2019. Recruitment of 28 calves per 100 cows (purple line) is needed to maintain a stable population (Hoffman and Grant 2019b). Recruitment reported here is the maximum within a calendar year. The sources of the data are provided in Table 3.7-1.

Mortality

Telkwa caribou mortality has mostly been attributed to predation because harvest and other risks of mortality are assumed to be negligible for the herd, and because the mortality of collared caribou have mostly been attributed to documented predation events. Reducing predation by wolves is a focus of caribou management actions across Canada. However, predation is considered the proximate cause of population declines while the ultimate cause of declines is landscape change resulting in increased predation on caribou (Festa-Bianchet et al. 2011). Telkwa caribou mortality risk is likely affected through two processes: apparent competition with more productive alternative prey species and 2) facilitated predation by wolves.

Woodland caribou populations are protected from predators by their scarcity (i.e., low density) and through reducing spatial overlap with wolves and their prey by selecting lower quality habitat or using higher elevation terrain. However, when more productive prey species increase in density in areas where caribou live, then predators also increase in numbers and the caribou experience greater predation risk. In this situation, the wolf population is independent of the caribou population, so reductions in caribou numbers does not cause a numeric response to wolf density. The process of one prey species affecting another through a shared predator is referred to as apparent competition.

Apparent competition between caribou and other large ungulates is the most widely hypothesized explanation for high caribou mortality (DeCesare et al. 2009, Festa-Bianchet et al. 2011, Serrouya et al. 2017, Mumma et al. 2018). Apparent competition is defined as “an indirect negative interaction between individuals, populations, species, or entire functional groups, mediated through the action of one or more species of shared natural enemies” (Holt and Bonsall 2017). In the context of the Telkwa Caribou Herd the

most likely explanation is habitat-mediated apparent competition, which is the situation where landscape changes support a greater density of moose and deer that directly cause an increase in wolf densities, that in turn cause an increase in wolf predation on caribou.

Currently, the main prey species of wolves in the Telkwa region are moose and deer (*Odocoileus sp.*). Recent studies in Alberta, driven by a declining number of the boreal caribou population and continued anthropogenic landscape changes, have found that wolves are targeting primarily deer and moose (Wasser et al. 2011). Moose and deer are a much more productive prey species than caribou, as they commonly have twins. Moose were absent or existed at low densities across much of central and western BC during the late 1800s (Bergerud and Elliot 1986). Moose in the Skeena region Game Management Zone that includes the Telkwa Caribou Herd's range (GMZ 6C) increased from very low densities in the early 20th century to a mean density of 526 moose per 1000 km² during 1996 to 2015 (Kuzyk et al. 2018). Prior to the moose range expansion and increase in density, caribou were reported regularly using low elevation habitats (Santomauro et al. 2012, Cichowski 2014), while today, caribou use almost exclusively higher elevation habitats (see Section 3.7.2). Moose are most abundant in cutblocks that are 20 years old, but Grant (2017) detected a significant increase in caribou mortality in cutblocks 26 to 40 years old. Grant (2017) speculated that there may be a time lag in the mechanisms driving apparent competition that result in caribou mortality. The time scales that likely resulted in higher caribou mortality demonstrate how the landscape management decisions made decades ago are affecting caribou today and reversing these effects will require long-term commitments.

Deer distribution and density are not well documented for this region. Deer are an important prey species for wolves within parts of the boreal forest, possibly more important than moose (Wasser et al. 2011). White-tailed deer (*Odocoileus virginianus*) are continuing to expand their range north (Dawe and Boutin 2016), but locally there is no information on changing deer ranges during the same period as the documented moose expansion into the BC interior.

The creation of linear feature networks, and how humans use those features may increase mortality to the Telkwa Caribou Herd via facilitated predation (Grant 2017). Several studies have shown that wolves use linear features (e.g., roads, trails) to access caribou habitat, resulting in increased mortality risk for caribou (Whittington et al. 2011, Apps et al. 2013). The characteristics of the linear features seem to determine wolf movements. Latham et al. (2011) found that wolves were indifferent to seismic lines during winter but strongly selected them during summers. The authors suggested that deeper snow on the seismic lines made the features difficult for wolves to use relative to forested areas where trees intercepted snow and reduced snow depth. However, recent studies of wolf movement using GPS collars with high fix rates (5 minute intervals) found that wolves move two to three times faster on linear features regardless of season (Dickie et al. 2017). The magnitude of the increase seems to be related to human activity as the movement benefit (indicated by speed) of wolves on the linear feature was greater at night than during the day (Dickie et al. 2020). In northeastern BC, wolves were documented selecting linear features during winter that had packed snow, but were indifferent to linear features that were not packed (Keim et al. 2019a) and started to avoid linear features that had greater than five vehicle passes per day (Keim et al. 2019b). Consequently, human activity on roads and trails, not simply the presence of the features on the landscape, influences how wolves use these features and ultimately increase the risk of caribou mortality.

The Telkwa Caribou Herd is limited primarily by mortality from predation. Telkwa caribou have significantly higher risk of mortality compared to caribou from neighbouring herds. Overall, collared Telkwa caribou were 1.5 times more likely to die than collared caribou from neighbouring herds during 1991 to 2012 (Grant 2017). The two processes known to affect caribou predation (apparent competition and facilitated predation) are the most reasonable explanation for the higher mortality rates for Telkwa caribou.

Harvest

Licensed harvest of the Telkwa Caribou Herd was closed from 1946 to 1954, then again as of 1973 and remains closed today (Cichowski 2014). Mortality from unlicensed subsistence harvesters remains a limited

but unlikely risk, because the local Indigenous communities have been involved in the recent recovery efforts and have an interest in growing the herd so future generations have traditional harvest opportunities.

Although human harvest is currently not affecting the Telkwa Caribou Herd, harvest likely contributed to the original decline of the herd through the mid 20th century. Licensed hunters actively harvested caribou from the Telkwa herd from 1955-1972. The combination of close proximity to human settlements, an extensive trail network that provides hunter access to caribou range, permitted use of helicopters for hunting, and inclusion of the Telkwa Caribou Herd within a larger regional caribou quota, likely resulted in unsustainably high harvest levels on the herd (Thiessen 2013, Cichowski 2014).

3.7.2 Habitat Selection, Distribution and Movement

Habitat Selection

Habitat use was analyzed for the TCH-RSA1 to quantify the relative habitat selection among seasons and years by collared caribou. Habitat categories included in the analysis are the BGC variant groups described in Table 2.8-1.

Seasonal Habitat Selection

Across all seasons, resident Telkwa caribou selected alpine habitat (BAFA) more than the habitat is available in the TCH-RSA1. The study area is comprised of 10% alpine habitat, while the proportion of caribou collar locations within this habitat type exceeded 50% during all seasons (Table 3.7-2). The strength of selection for alpine habitat shows that caribou used the habitat type 5 to 8 times more than the habitat is available within the study area. The highest selection values are for the winter and spring seasons indicating that caribou are targeting alpine habitat types more during seasons that have snow cover.

The selection of subalpine habitats BGC variants (ESSF-parkland) was dependent on season. Telkwa caribou used the subalpine ESSF-parkland during calving through fall; but exhibited weak avoidance of the habitat during spring (Table 3.7-3). Caribou selected the subalpine ESSF-parkland at about twice the habitat type's availability during the snow free seasons (calving through fall). The weak selection and avoidance during winter and spring, respectively, are reflected in the stronger selection of alpine habitat during these seasons.

All forested habitat types (ESSF forested and SBS) and Coastal BGC variants were used less than expected relative to their availability within the study area or not used at all (Table 3.7-3). A large proportion (77%) of the study area is forested habitat. The proportion of collar locations that occurred within the forested habitats ranged from 5.9% during spring to 16.5% during calving (Table 3.7-2). The majority of caribou seasonal use of forested habitat was of the ESSF forested variants, though still strongly avoided. The SBS variants were almost unused with a maximum of 2% of seasonal collar location occurring within the SBS variants. The Coastal BGC variants were never used by collared caribou, but the habitat type is only a very small portion of the study area. The interpretation of very strong avoidance of the SBS and Coastal BGC variants may not reflect the situation accurately due to a lack of caribou locations within the variants (Table 3.7-2) and a small percentage of Coastal BGC habitats within study area (i.e., 0.8% of TCH-RSA1). However, it is clear that these two habitat types were not preferred by collared resident Telkwa caribou.

The pattern of selection for higher elevation habitats during winter and spring is reflected in the observed changes in elevation of collared caribou. Caribou used increasingly higher elevation as the winter progressed and occupied the highest mean elevation terrain through the spring (Figure 3.7-3). Telkwa caribou started the calving season at higher elevation but quickly dropped to the lower elevation terrain by the end of calving and remained at relatively lower elevation through the summer. The differences between the mean weekly highest and lowest elevations are relatively small (200 m) compared to the range elevation within the TCH-RSA1 (735 m to 2,339 m); however, a difference of 250 to 300 m reflects the mean elevation difference between the alpine, ESSF-parkland, and ESSF-forested BGC variant groups. Consequently,

changes in elevation of this scale are equivalent to a change in use of BGC variants, which is precisely what was observed in habitat selection analysis of the BGC variant groups.

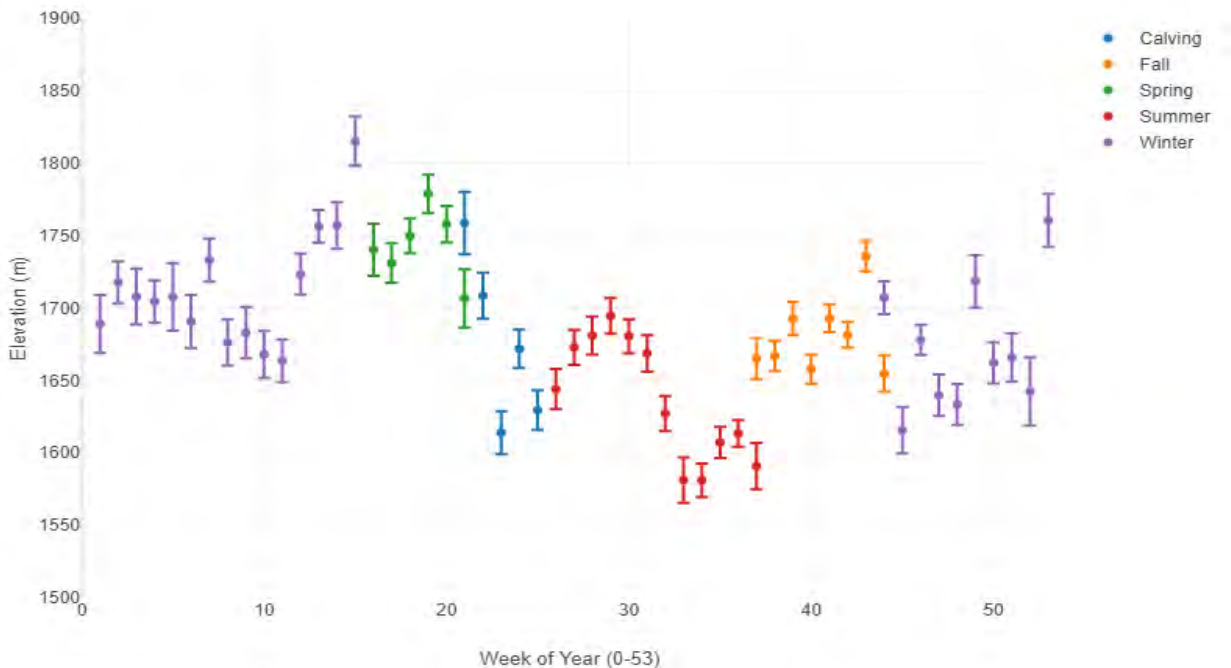


Figure 3.7-3: Mean weekly elevation of caribou collar locations within TCH-RSA1 coloured by season. Veridical bars indicate standard error. GPS collar data were rarified to include only one location per caribou per day.

Annual Habitat Selection

The annual selection of habitat during winter was analyzed to explore variation in caribou habitat selection across years. The analysis was restricted to the winter season for simplicity and the winter season includes the largest number of collar locations. During winter caribou collar data were disproportionately located in the higher elevation alpine and subalpine habitat types, and infrequently located or absent in the lower elevation forested habitat types (Table 3.7-4). Similar to seasonal habitat selection results, caribou clearly selected the alpine and subalpine habitats during winter each winter, a notable difference in habitat selection was observed during the winter of 1997/98 and is discussed below (Table 3.7-5).

Caribou strongly selected alpine habitat during winter and commonly used the habitat five to ten times more than the habitat is available within the study area. The annual selection of the subalpine ESSF-parkland variants during winter was inconsistent among years. The subalpine habitat was avoided during 4 of the 15 years analyzed. Forested BGC variants were either avoided or not used during all years by collared caribou.

The anomaly in habitat selection during the winter of 1997-98 coincides within the start of the translocation program to augment the Telkwa Caribou Herd. The results from the winter of 1997/98 show selection for the SBSdk and ESSF-forest variants (Table 3.7-5). That winter was the only year when the forested habitats were ever selected by caribou. The explanation for the use of forested habitat by translocated caribou is unknown; however, given that the selection for lower elevation habitat occurred the first year after the translocation program, it seems plausible that the caribou were selecting the habitat based on experience from their natal herd range. The translocated caribou came from the Chance-Sustut caribou herd (Stronen et al. 2007). Similar to Telkwa caribou, the Chance-Sustut caribou select alpine habitat during most seasons, though start to use forested BGC variants in late winter and select forested area during spring (Wood and Terry 1999), so the translocated caribou may have been looking for suitable forested winter habitat.

Table 3.7-2: Telkwa caribou relative seasonal use (% of collar locations) as a function of habitat within the TCH-RSA1.

BGC Variant Group	Total Available	Winter	Spring	Calving	Summer	Fall
Alpine	9.7%	72.6%	82.9%	58.2%	52.5%	59.1%
Engelmann spruce - subalpine Fir parkland	13.4%	16.1%	11.3%	25.3%	33.6%	32.7%
Engelmann spruce - subalpine fir forest	35.9%	9.4%	3.1%	14.5%	13.1%	8.1%
Sub-boreal spruce - moist cold	9.8%	0.9%	1.5%	2.0%	0.9%	-
Sub-boreal spruce - dry cool	30.5%	1.0%	1.3%	-	-	0.1%
Coastal BEC	0.8%	-	-	-	-	-

Note: “-” = habitats and seasons that did not have collar locations.

Table 3.7-3: Telkwa caribou relative seasonal habitat selection as a function of habitat within the TCH-RSA1.

BGC Variant Group	Winter	Spring	Calving	Summer	Fall
Alpine	7.51	8.58	6.02	5.43	6.11
Engelmann spruce - subalpine fir parkland	1.20	-1.18	1.89	2.51	2.45
Engelmann spruce - subalpine fir forest	-3.81	-11.66	-2.47	-2.75	-4.42
Sub-boreal spruce - moist cold	-10.63	-6.74	-4.92	-11.09	-
Sub-boreal spruce - dry cool	-30.10	-23.73	-	-	-426.91
Coastal BEC	-	-	-	-	-

Note: “-” = habitats and seasons that did not have collar locations.

Shading indicates selection of the BGC variant group

Habitat Selection Summary

Telkwa caribou used alpine habitat during all seasons and years more than expected based on habitat availability within the TCH-RSA1. The selection of the subalpine ESSF-parkland varied by year and season and was always selected less than the alpine habitat within a season and year. The selection index used for the seasonal and annual habitat use does not provide measures of uncertainty or statistical significance. However, the relative values of selection and the patterns observed strongly support that caribou were selecting primarily alpine and secondarily subalpine habitat types, and avoided forested areas. The seasonal patterns of habitat selection are consistent with results of more detailed habitat analyses conducted by Grant (2017).

Telkwa caribou do not currently move to lower elevation forested habitat during winters to access winter forage, unlike many Mountain caribou herds; however, there is evidence that this might be a more recent observation. Traditional Knowledge documented that caribou occurred near the treeline in winters because caribou had a harder time finding food in the alpine habitat types (Cichowski 2014). A 1985 to 1986 collaring program included four cow caribou and found that caribou used subalpine and pine forests from December through February (Cichowski 2014). Roberts et al. (2003) reported that Telkwa caribou were selecting the

Table 3.7-4: Telkwa caribou relative annual winter use (% of collar locations) as a function of BGC variant groups within TCH-RSA1.

BGC Variant Groups	Total Available	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2005-2006	2006-2007	2007-2008	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Alpine	9.7%	9.2%	40.8%	72.1%	58.2%	91.7%	71.7%	84.7%	82.7%	82.2%	72.0%	98.1%	74.7%	73.9%	93.1%	53.3%
Engelmann spruce - subalpine fir parkland	13.4%	10.4%	39.0%	21.5%	11.2%	6.8%	20.9%	15.3%	16.0%	17.8%	22.0%	1.9%	25.3%	15.0%	6.9%	31.3%
Engelmann spruce - subalpine fir forest	35.9%	50.9%	12.7%	6.2%	28.1%	1.3%	7.1%	-	1.3%	-	6.1%	-	-	11.1%	-	15.4%
Sub-boreal spruce - moist cold	9.8%	11.0%	2.3%	0.2%	2.6%	0.2%	0.3%	-	-	-	-	-	-	-	-	-
Sub-boreal spruce - dry cool	30.5%	18.5%	5.2%	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: “-” = habitats and seasons that did not have collar locations.

Table 3.7-5: Telkwa caribou relative annual winter habitat selection as a function of BGC variant groups within TCH-RSA1.

BGC Variant Groups	1997-1998 ¹	1998-1999	1999-2000	2000-2001	2001-2002 ²	2002-2003 ²	2003-2004 ²	2005-2006	2006-2007	2007-2008	2012-2013 ³	2013-2014 ³	2014-2015 ³	2015-2016 ³	2016-2017 ³
Alpine	-1.04	4.23	7.46	6.02	9.49	7.42	8.76	8.55	8.50	7.45	10.15	7.73	7.65	9.64	5.52
Engelmann spruce - Subalpine fir parkland	-1.28	2.92	1.61	-1.19	-1.96	1.56	1.15	1.20	1.33	1.65	-7.03	1.89	1.12	-1.95	2.34
Engelmann spruce - Subalpine fir forest	1.42	-2.83	-5.82	-1.28	-27.74	-5.08	-	-26.93	-	-5.92	-	-	-3.24	-	-2.33
Sub-boreal spruce - moist cold	-2.77	-12.97	-123.32	-11.81	-188.18	-88.31	-	-	-	-	-	-	-	-	-
Sub-boreal spruce - dry cool	1.89	-1.90	-	-	-	-	-	-	-	-	-	-	-	-	-
Coastal BEC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes “-” = habitats and seasons that did not have collar locations.

Shading indicates selection of the BGC variant group

1) A program to translocate caribou to the Telkwa range started winter 1997-1998. The last locations of translocated caribou were acquired in winter 2006-2007.

2) Both VHF and GPS collars were deployed on caribou during 2002 to 2004.

3) Only GPS collars were deployed on caribou 2012 to 2017.

alpine habitat during most of the winter and that some subalpine forested habitats were selected during some years, suggesting that caribou target terrestrial lichen but can switch to foraging on arboreal lichen if needed. When in forests, translocated caribou were found to use forests older than 250 years (Stronen et al. 2007). However, neither study had access to the quantity or number of years of caribou locations included in this analysis. The current habitat selection analysis for the TCH-RSA1 clearly shows that Telkwa caribou are almost exclusively selecting alpine habitats during the winter, so presumably the higher elevation habitat contains adequate winter forage (i.e., terrestrial lichen) to support the herd.

Distribution

The Telkwa caribou collar data show that caribou consistently used similar areas within their range during all seasons and their distribution is concentrated within alpine and subalpine habitats (Table 3.7-6). The annual distribution of Telkwa caribou collar locations indicates that caribou are most concentrated on the northern parts of the Telkwa and Howson ranges, and cover much of the alpine and subalpine habitat in the area. Caribou use of areas beyond the current 'normal' annual distribution may have been a common occurrence when there was a greater density of caribou in the region. There are historical records of caribou using lower elevation forested habitats during some seasons (see section 0 Habitat Use). In addition, collar data show a small number of locations in areas outside the herd's current range. Collar locations were primarily concentrated within the TCH-RSA1 and TCH-RSA2 Core study areas (Table 3.7-6). Locations in TCH-RSA2 Matrix or outside of the study areas are almost exclusively locations of translocated caribou acquired during 1998 to 2002, with only 0.2% of resident caribou collar location occurring in the TCH-RSA2 Matrix and none outside of the study areas (Table 3.7-6).

Table 3.7-6: Percentage of all Telkwa caribou collar locations that overlap with W-LSA, TCH-RSA1, and TCH-RSA2 Core and Matrix for resident and translocated caribou.

Study Area	Resident Caribou Locations	Translocated Caribou Locations
W-LSA	1.7%	10.3%
TCH-RSA1	99.8%	92.16%
TCH-RSA2 Core	99.8%	88.0%
TCH-RSA2 Matrix	0.2%	6.8%
Outside of Study Areas	0.0%	5.3%
Total Number of Locations	29,785	3,239

The seasonal patterns of caribou distribution show little variation, however, there is a noticeable increase in range use during the summer compared to other seasons. The increased range use during summer is shown by the more widespread distribution of caribou using more of the subalpine habitat across their range, including areas that are not used during other seasons. An increased distribution of caribou during summers is expected because summer is the season when caribou movements are not limited by snow cover and there is more abundant forage available. The increase in distribution is similar to results from Roberts et. al. (2003) who found that the Telkwa Caribou Herd summer range was more than twice the size of other seasonal ranges.

The more restricted distribution during all other seasons is mostly likely driven by seasonal changes in forage availability, environmental conditions, and reproductive behaviours. The concentrated distributions of collar locations during the winter and spring seasons are likely due to reduced forage availability and more difficult movement through deep snow. A more concentrated distribution of caribou in during winter and spring can be explained by their selection of higher elevation habitats, and the fact that terrain becomes less available with increasing elevation across landscapes. The more concentrated distribution during calving is unexpected because caribou are not as limited by snow compared to winter and spring, there is increasing available forage, and Northern Mountain caribou are known for dispersing across their range as a form of predator avoidance while calving (Bergerud et al. 1984). The reduced distribution of caribou collar locations during fall is expected because the animals concentrate in mixed-sex groups during the rut.

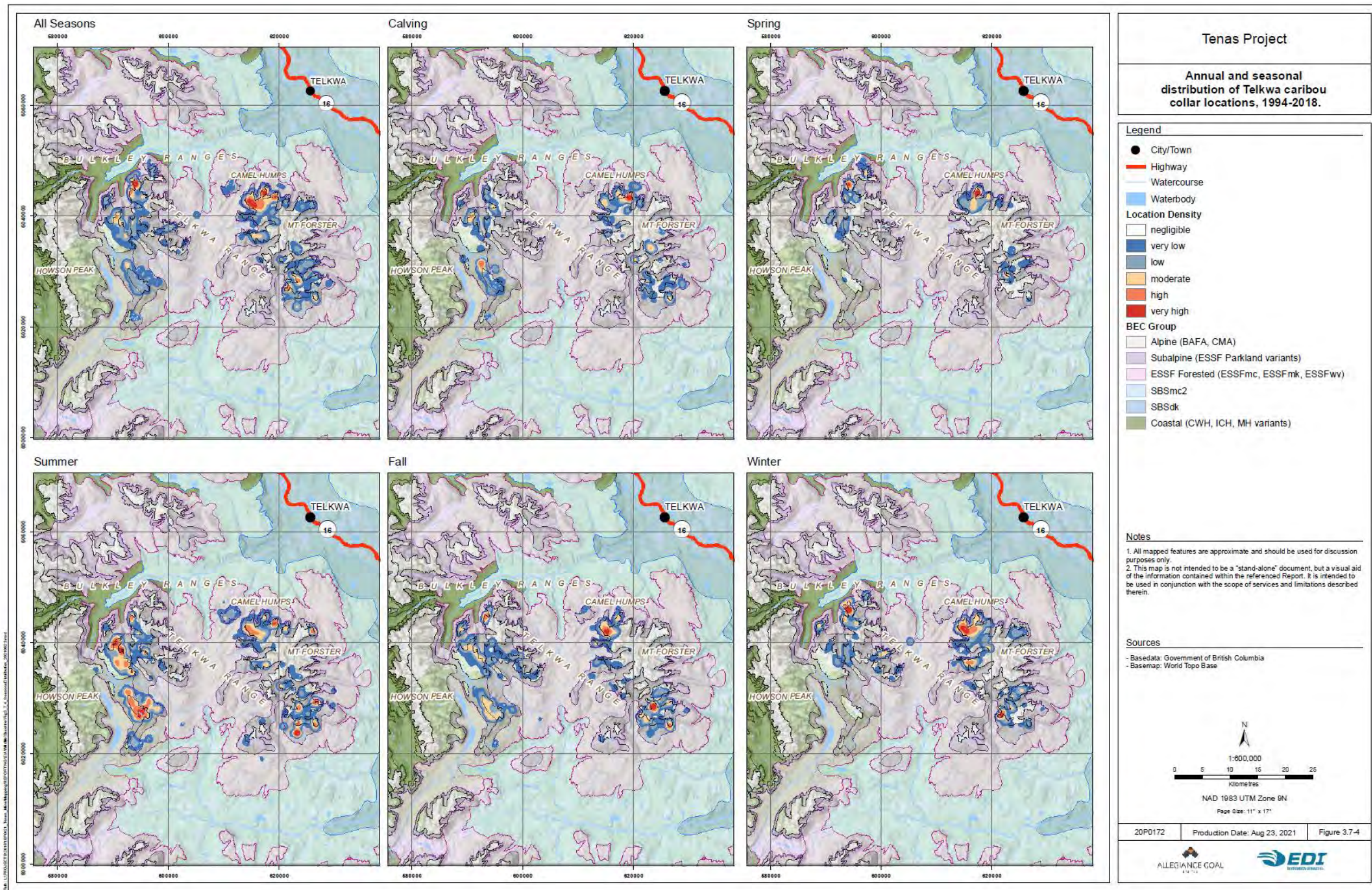


Figure 3.7-4: Annual and seasonal distribution of Telkwa caribou collar locations, 1994-2018.

Movement

Telkwa caribou did not exhibit any clear patterns of regular movement between seasonal habitats based on either the qualitative or quantitative analysis we conducted of GPS collar locations.

In terms of the qualitative analysis, caribou movement indicated a high degree of overlap of seasonal ranges and use of primarily alpine and subalpine BGC variants, consistent with the habitat selection and distribution analyses discussed above. Movements within seasons exhibited a variety of patterns. Individual caribou used various locations at different times and there were no predictable fast directional movements within or across seasons or years. Some caribou showed movement patterns that changed within seasons, and sometimes the movements would consist of gradual shifts over several days or weeks. In other cases, movements were more abrupt and occurred over one or a few days.

Generally, movements within seasons occurred throughout the alpine and subalpine BGC variants of the Telkwa and Howson mountains. However, two exceptions were evident. The first was that there was little caribou movement through the highest and most rugged mountain peaks and ridgelines in the Telkwa Mountains. The second exception was the observed movement pattern in the area of the forested pass (ESSFmc), at the headwaters of Thautil River and Howson Creek, which separates the Telkwa and Howson mountains (Figure 3.7-5). The timing and spatial pattern of most caribou paths in the Howson-Thautil pass corresponded to faster movements. However, the density of telemetry locations was much lower in the pass than on either of the adjacent plateaus indicating that caribou were moving quickly and not spending much time in this area. No obvious movement 'corridor' (area of concentrated movements within the overall Howson-Thautil pass area) was evident from a qualitative assessment of the movement data. However, the overall Howson-Thautil pass is the one forested area that the Telkwa Caribou Herd regularly travel across between seasonal use areas in the Telkwa and Howson plateaus.

For the quantitative analysis, patterns of movements appear to be more related to snow accumulation and melt than seasonal movements. Caribou movement shows a clear pattern of greater daily movement relative to snow melt starting in May until snowpack accumulation in December (Figure 3.7-5). Caribou movement was fastest during July through November, which corresponds to a period with little to no snow. The median daily movement rate was fastest during October, a time of the year when bull caribou are moving extensively through their range in search of mating opportunities. Caribou movement dropped during December through April, when the snowpack has typically reached a point that inhibits fast movements. Caribou often use somewhat isolated high elevation ridges during this period, where wind scouring reduces snow depths to facilitate foraging and movement. These ridge lines are separated by areas of non-scoured and drifted snow, which impedes travel. This is consistent with the pattern in Figure 3.7-6, which shows caribou moving to the highest elevations, on average, during winter and spring.

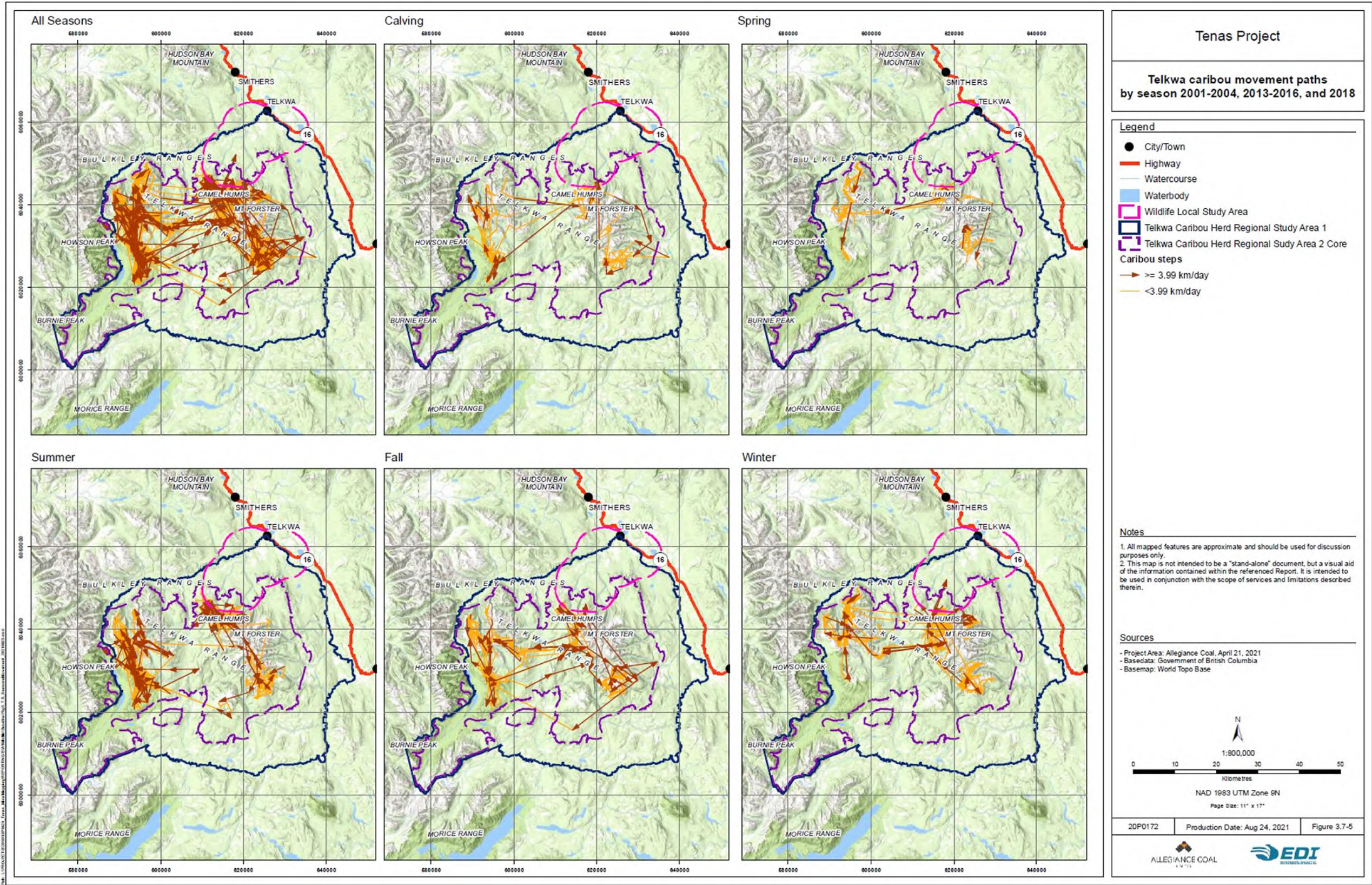


Figure 3.7-5: Telkwa caribou movement paths by season of GPS collared caribou 2001-2004, 2013-2016, and 2018.

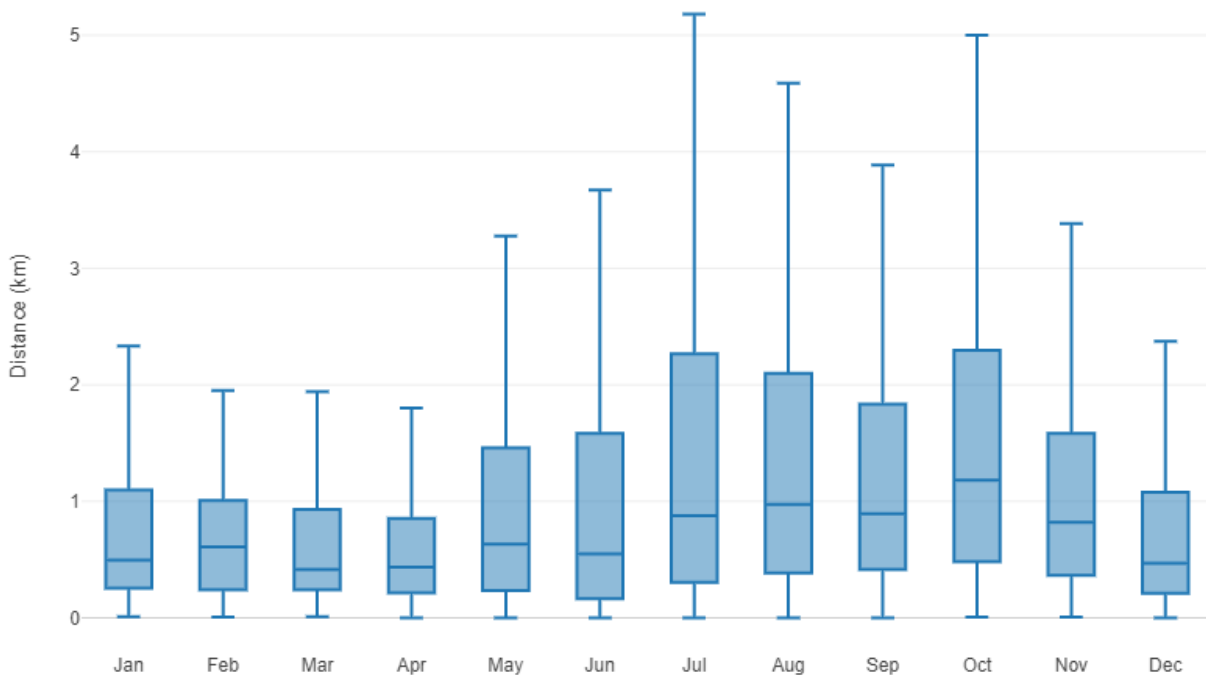


Figure 3.7-6: Boxplot of daily distance travelled by GPS collared Telkwa caribou by month. The horizontal line inside the box indicates the median, boxes show the middle 50% of the data, and vertical lines indicate the upper and lower 25% of the daily distance travelled by caribou.

3.7.3 Mortality

As described in Section 0, Telkwa caribou mortality from predation is the main factor limiting herd growth. To assess the mortality risk for caribou in relation to BGC variant groups that occur within the caribou study areas, we compared the locations where VHF collars were recovered (i.e., mortality locations) to the locations acquired while those caribou were alive.

Mortality rates differed greatly across BGC variant groups (Table 3.7-7). Mortality rates were lowest in alpine habitat and increased across BGC variant groups corresponding to decreasing elevation. In the lowest elevation BGC variant, SBSdk, the mortality rate was 46 times what it was in the alpine BGC variant. Combined across BGC variant groups, 59% of the caribou mortalities occurred in forested variants relative to 22% of the overall telemetry locations of these animals.

The pattern of higher mortality rates in lower elevation BGC groups is consistent with predicted outcomes associated with apparent competition and facilitated predation, because the amounts of early seral habitats (favored by moose and deer) and linear features increase from ESSFmc to SBSmc2 to SBSdk (see Appendix F). This pattern of mortality rates may, at least partly, explain the pattern of relative distribution, where caribou selected for alpine and subalpine BGC variant groups and avoided the forested BGC groups.

Table 3.7-7: Telkwa caribou mortality rates by BGC variant groups, for 34 collared caribou from 1996 to 2012.

Habitat type	Locations While Alive	Mortality	Mortality rate	Relative Mortality
Alpine	1,230	3	0.002439	1
Engelmann spruce - Subalpine fir parkland	568	11	0.019366	7.94
Engelmann spruce - Subalpine fir forest	449	14	0.03118	12.78
Sub-boreal spruce - moist cold	51	4	0.078431	32.16
Sub-boreal spruce - dry cool	18	2	0.111111	45.56
Coastal BEC	14	0		
Total	2,330	34		

3.7.4 Summary of the Disturbed Habitat Analysis

The detailed results of the Disturbed Habitat Analysis are provided in Appendix F. The following paragraphs provide a summary of the results. The amount of disturbed habitat, as defined in the *Recovery Strategy for the Woodland Caribou, Southern Mountain Population (Rangifer tarandus caribou) in Canada* (Environment Canada 2014), currently exceeds the 35% disturbance threshold at the scale of the TCH-RSA1 and TCH-RSA2 Matrix, but not the TCH-RSA2 Core (Table 3.7-8). Two types of human features accounted for the majority of the disturbed habitat: roads/trails and forestry cutblocks. These features were extensively distributed throughout each of the study areas, but most concentrated in the lower elevation forested BGC variant groups. Together roads/trails and cutblocks accounted for more than 60% of the human disturbance in each study area.

Within the TCH-RSA2 Core, the study area that best represents the annual range of the Telkwa Caribou Herd, the primary human disturbances were roads/trails, followed by recreational snowmobiling then cutblocks. Cutblocks account for proportionately less disturbance in TCH-RSA2 Core because this study area is mostly defined by the alpine and subalpine BGC variant groups and it contains fewer forest stand compared to other study areas. Disturbance associated with recreational snowmobiling affects nearly one third of this study area. Snowmobiling is a seasonal activity, so the effects are temporary as they only occur during winter and do not cause long-term changes to the landscape; however, trails packed are known to facilitate predator movement and thus increase predation risk for prey species.

The two primary human disturbance features within the study areas are the two most likely features to influence caribou mortality through facilitated predator movements and apparent competition with alternative prey species. Roads and trails are known to facilitate predator movement across landscapes. The benefits of linear features, such as roads and trails, to predators are most pronounced on intermittently used features during the winter (Dickie et al. 2020) when the lack of regular human activity does not deter use of the features by predators and the activity packs snow making movement easier (Keim et al. 2019b). Areal disturbances, such as forestry cutblocks, create early seral forests that provide high quality forage supporting higher densities of other prey species, particularly moose (Anderson et al. 2018). There is increasing evidence that relatively higher moose numbers drive down caribou populations through apparent

Table 3.7-8: Total anthropogenic disturbance within the W-LSA, the TCH-RSA1, and TCH-RSA2 Core and Matrix study areas.

	W- LSA	TCH-RSA1	TCH-RSA2-Core	TCH-RSA2-Matrix
Total Area (ha)	35,382.1	260,610.6	160,272.4	531,706.3
Total Disturbed Area (%)	90.1	48.3	22.9	58.5

competition (Serrouya et al. 2017). Within the Telkwa Caribou Herd range, these two processes are a likely strongly influenced by human disturbances and indirectly affecting Telkwa caribou mortality.

3.7.5 Assessment and Survey Results

No caribou sign or observations of caribou were obtained during any of the field assessments conducted as part of the baseline program. The results of assessments for arboreal and terrestrial lichens and wildlife habitat suitability ratings are reported on below.

Arboreal and Terrestrial Lichen Assessments

Depending on habitats caribou are foraging in and the season, lichens (both arboreal and terrestrial varieties) make up between 7 and 45% of the non-winter diet of caribou (Denryter et al. 2018) and up to 80% of the winter diet (Cichowski 1993). As lichens are important to caribou a review of available arboreal and terrestrial lichen abundance data was completed to map potential lichen distributions within the Telkwa Caribou Herd study areas. Arboreal lichen assessments completed in the Telkwa Caribou Herd study areas including Houwers (1996), Edie (1998b), Roberts (2000 and 2001) and G. Cushon (unpublished data). In 2018 arboreal lichen assessments were completed as part of the wildlife baseline program during the bat roost assessments in the W-LSA. Data from 546 assessment plots were pooled and summarized for an analysis of arboreal lichen abundance by BGC subzone.

Arboreal lichen abundance is outlined in Figure 3.7-7 and show differences between the BGC subzones sampled and a general trend that the ESSFmc had higher values than the SBSmc2, which were both much higher than the amounts found in the SBSdk subzone. The ESSFmc had the highest arboreal lichen abundances; with a maximum of 347.5 kg/ha, mean of 35.3 kg/ha and a median of 14.4 kg/ha; the SBSmc2 had a maximum of 230 kg/ha, mean of 22.7 kg/ha and a median of 4.5 kg/ha, while the SBSdk subzone had a maximum of 62.5 kg/ha, mean of 6.4 kg/ha and a median of 0.3 kg/ha. The distribution of arboreal lichen abundance from the assessment plots (Figure 3.7-8) show that for the ESSFmc subzone over 90% of the plots had less than 100 kg/ha, over 90% of the plots in the SBSmc2 had less than 50 kg/ha, while in the SBSdk subzone 90% of the plots were below 25 kg/ha.

The locations of 501 arboreal lichen assessment plots and 20 transects that contained sufficient location data are outlined in Figure 3.7-9. Arboreal lichen locations with lichen abundance greater than 250 kg/ha are limited in number and distributed widely within the ESSFmc and SBSmc2 subzones, while those plots with less than 250 kg/ha are the majority of the plots and are located within all subzones and have a broad distribution across the Telkwa Caribou study areas.

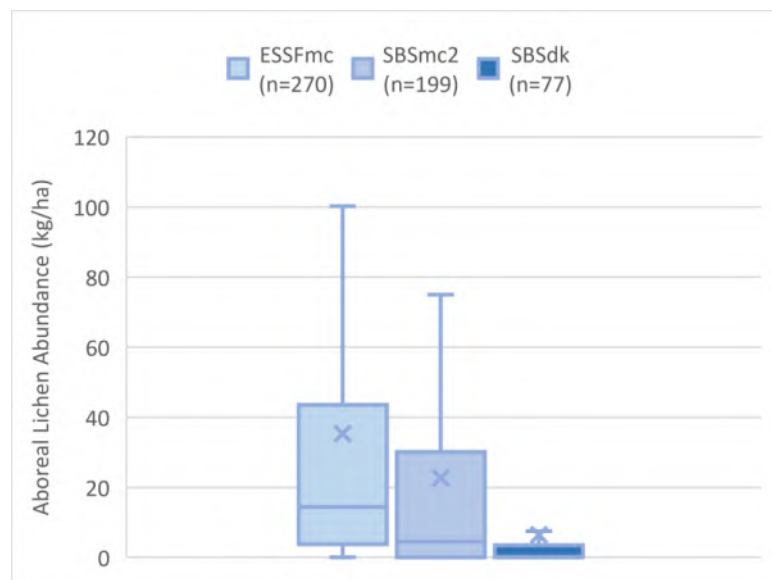


Figure 3.7-7: Boxplot of arboreal lichen abundance within the ESSFmc, SBSmc2 and SBSdk subzones in the Telkwa caribou study areas. The horizontal line inside the box indicates the median, the 'X' indicates the mean, boxes show the middle 50% of the data, and vertical lines indicate the upper and lower 25% of the arboreal lichen abundance.

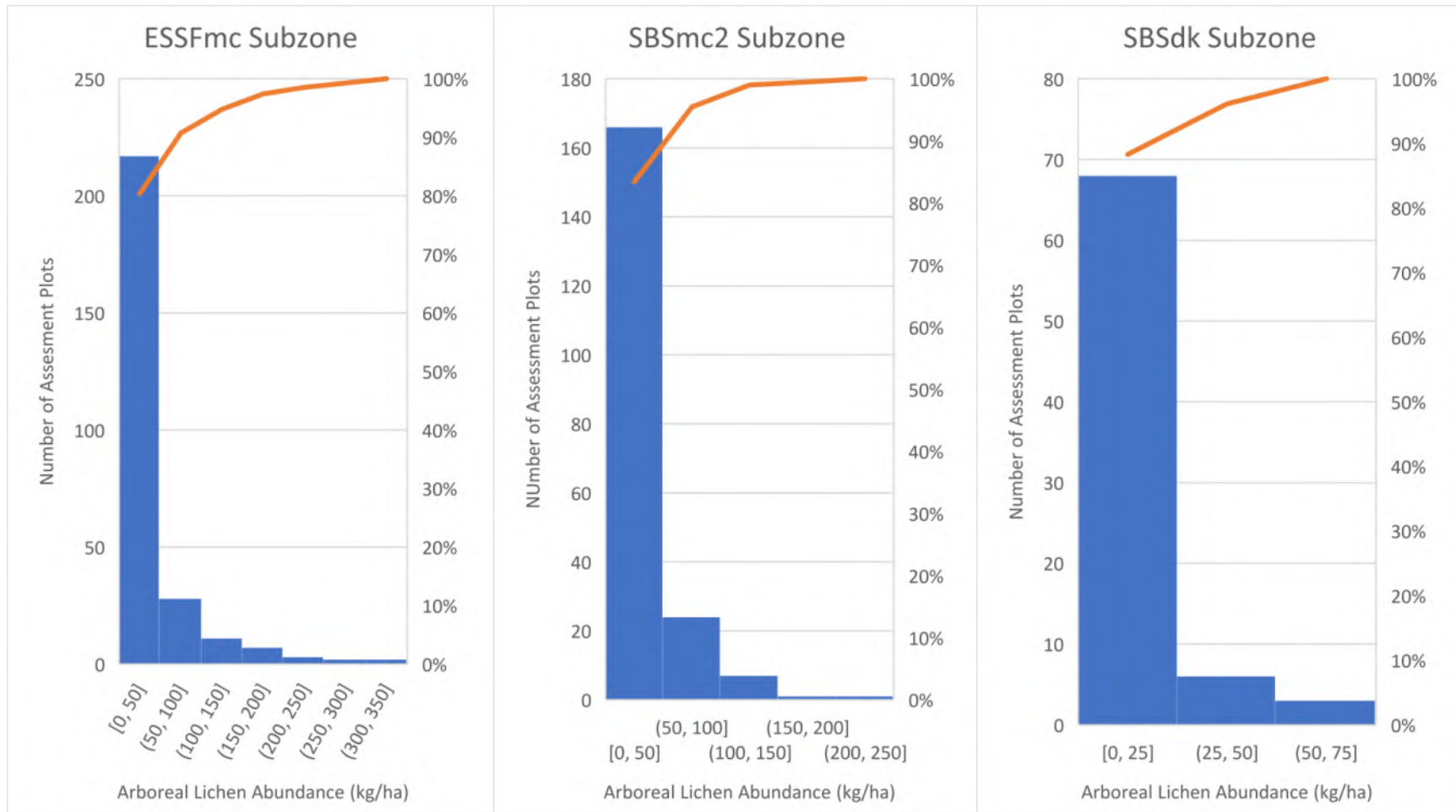
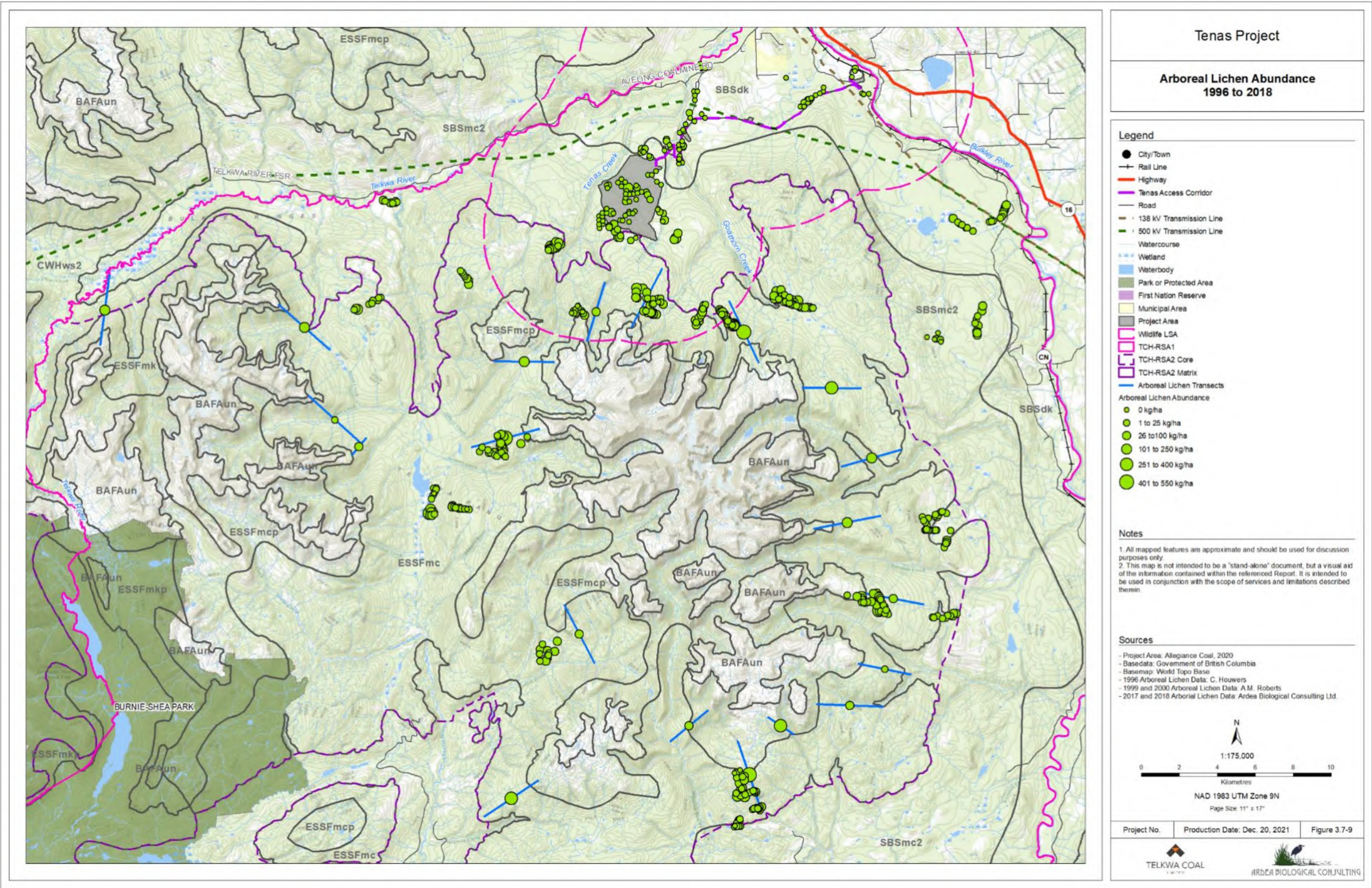


Figure 3.7-8 : Histograms of arboreal lichen abundance (kg/ha) from assessment plots within BGC subzones in the Telkwa caribou study areas.



Terrestrial lichen data was collected by Houwers (1996), Edie (1998b), and Roberts (2000 and 2001) within the Telkwa Caribou study areas and within the W-LSA during the vegetation plots completed for the current Project TEM baseline studies. Data from 552 assessment plots were pooled and summarized for an analysis of terrestrial lichen abundance by BGC subzone. Figure 3.7-10 shows a boxplot of the available terrestrial lichen data. The terrestrial lichen data follows a similar pattern to the arboreal lichen with higher terrestrial lichen abundance in the ESSFmc than the SBSmc2 and limited terrestrial lichens in the SBSdk subzone. Terrestrial lichen abundance however is over 20 times higher than the abundance of arboreal lichens per hectare. The terrestrial lichen abundance for the ESSFmc subzone had a maximum of 5,466 kg/ha, a mean of 855 kg/ha and a median of 364 kg/ha, while the

SBSmc2 has a maximum of 3,577 kg/ha, a mean of 329 kg/ha and a median of 24 kg/ha. The terrestrial lichen abundance within the SBSdk subzone is quite low, with a maximum of 2,473 kg/ha, a mean 89 kg/ha, and a median of less than 1 kg/ha. Terrestrial lichen abundance histograms from the assessment plots (Figure 3.7-11) Figure 3.7-8 show that for the ESSFmc subzone approximately 90% of the plots had less than 2000 kg/ha, 90% of the plots in the SBSmc2 had less than 1000 kg/ha, while in the SBSdk subzone 95% of the plots were below 500 kg/ha.

The locations of 552 terrestrial lichen assessments plots and 20 transects that contained sufficient location data is shown in Figure 3.7-12. Assessment plot locations with lichen abundance greater than 3,000 kg/ha are limited in number and distributed widely within the ESSFmc subzone, with very few locations in the SBSmc2 subzone. The majority of the terrestrial lichen plots within the SBSmc2 and SBSdk subzones had lichen abundances less than 1,000 kg/ha, are located within all subzones and have a broad distribution across the Telkwa Caribou study areas.

Wildlife Habitat and Wildlife Trail Assessments

A total of 194 WHA plots were completed to assess caribou habitat suitability, with no evidence of habitat use within any of those plots. An additional 428 plots were completed for various ecological and wildlife surveys that also did not have any evidence of caribou sign during the baseline program from 2017 to 2019.

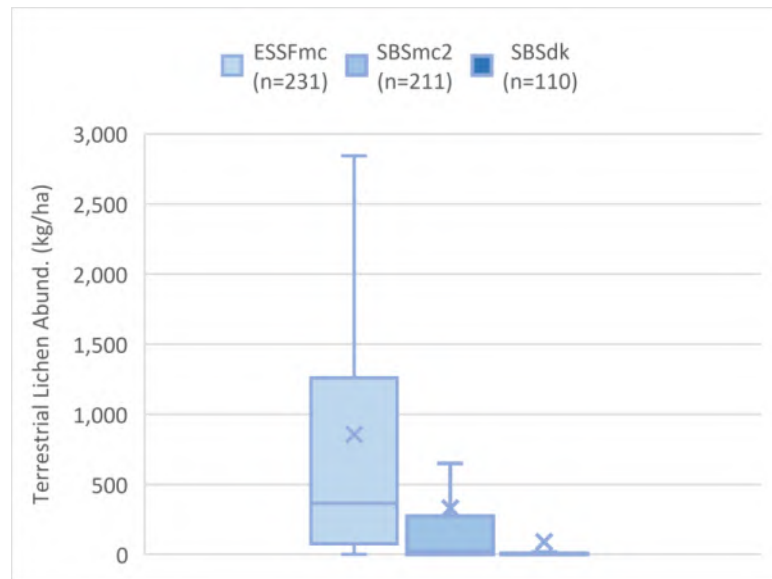


Figure 3.7-10: Boxplot of terrestrial lichen abundance within the ESSFmc, SBSmc2 and SBSdk subzones in the Telkwa caribou study areas. The horizontal line inside the box indicates the median, the 'X' indicates the mean, boxes show the middle 50% of the data, and vertical lines indicate the upper and lower 25% of the arboreal lichen abundance.

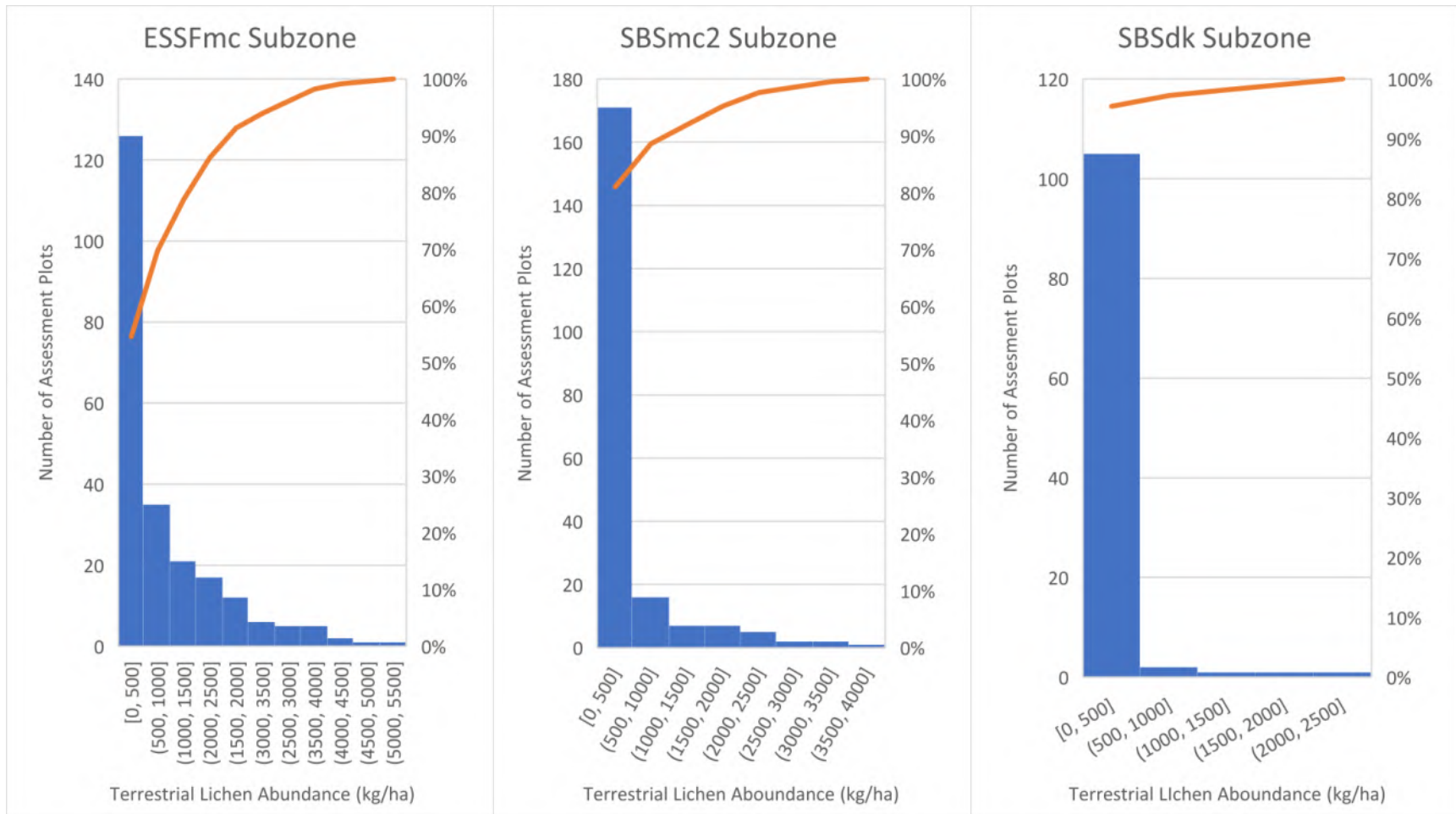


Figure 3.7-11: Histograms of terrestrial lichen abundance (kg/ha) from assessment plots within BGC subzones in the Telkwa caribou study areas.

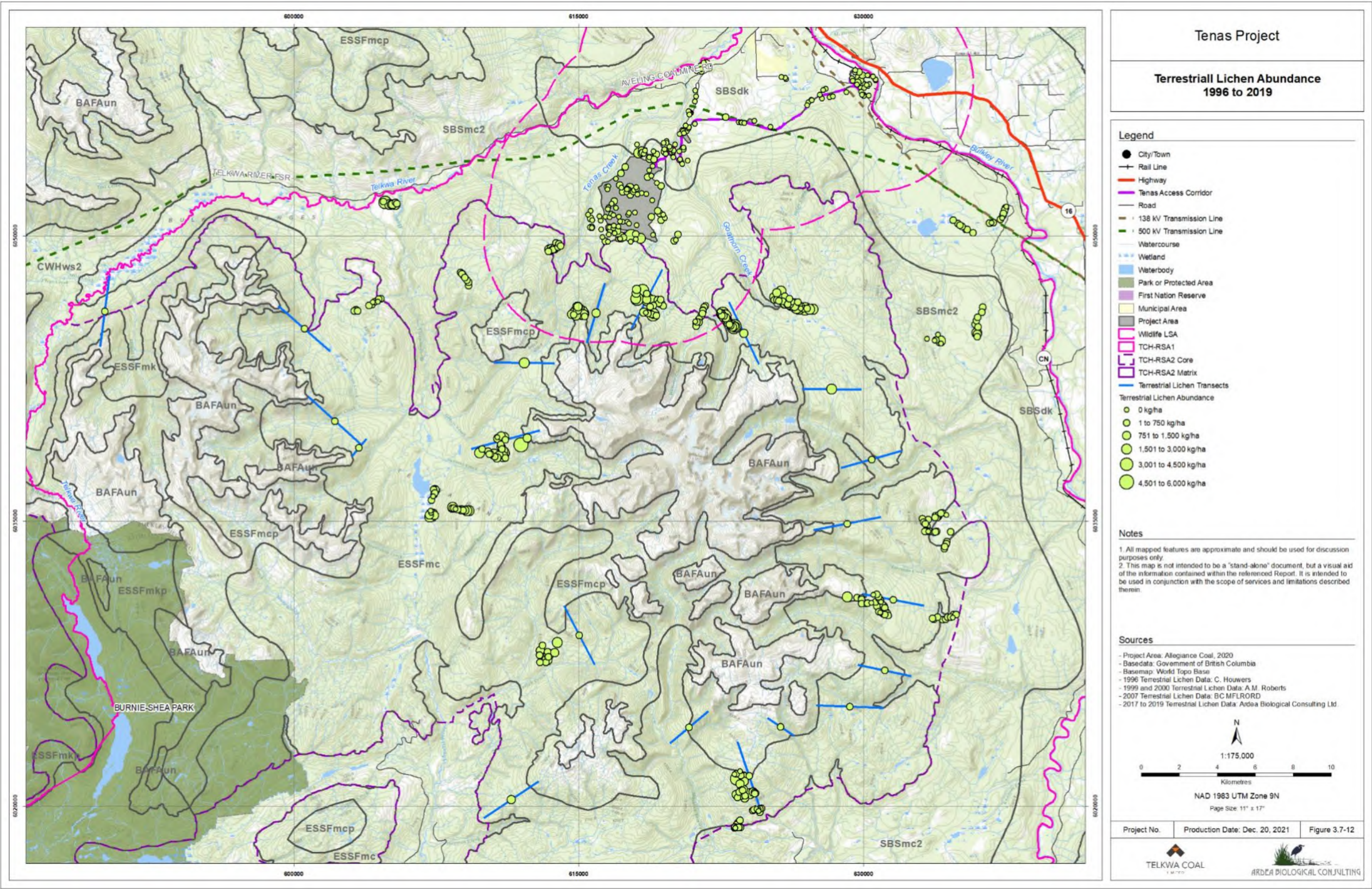


Figure 3.7-12: Terrestrial lichen abundance within the Telkwa caribou study areas.

3.8 Moose

The following section describes the ecology and management of moose (*Alces americanus*) within BC in general and the Bulkley Valley in relation to the Project area using historic information, recent management and results of baseline studies specific to the species.

3.8.1 Existing Information on Moose

The following documents were reviewed and were a source of background information for moose in the Project area:

- ▶ *Telkwa Project, Vegetation - Forestry - Wildlife* (TAESCO 1985)
- ▶ *Results of Two Aerial Wildlife Surveys in the Lower Telkwa River Area, Winter 1990* (Hatler 1990)
- ▶ *Moose Habitat Capability/Suitability Mapping, Telkwa Coal Project* (Edie 1998a)
- ▶ *Wildlife Program Plan* (BC MOE n.d.)
- ▶ *Provincial Framework for Moose Management in British Columbia* (BC MFLNRO 2015)
- ▶ *A Strategy to Help Restore Moose Populations in British Columbia* (Gorley 2016)
- ▶ *Provincial Population and Harvest Estimates of Moose in British Columbia* (Kuzyk 2016)
- ▶ *Determining Factors Affecting Moose Population Change in British Columbia: Testing the Landscape Change Hypothesis*. (Kuzyk et al. 2019b)
- ▶ *Factors Affecting Moose Population Change in British Columbia* (Procter et al. 2020)
- ▶ *Determining Factors that Affect Survival of Moose in Central British Columbia* (Mumma and Gillingham 2019)
- ▶ *Bulkley Valley/Lakes District Moose Population Density and Composition Survey: January 2018; Version 1.2, October 2019*. (Schindler et al. 2019)

The existing conditions for moose within the project area and the WRW-RSA are summarized below.

Conservation Context and Management Initiatives

Moose are designated as a Yellow-listed species (see Table 2.1-2) in BC by the BC Conservation Data Centre (BC CDC 2020) and have not been assessed as a species of conservation concern by COSEWIC or listed under SARA. They are classified as wildlife under the *Wildlife Act* and harvesting of moose is managed through regulations under that Act. A *Provincial Framework for Moose Management in BC* (BC MFLNRO 2015) provides a framework and harvest management procedures for the management of moose harvesting in BC.

The *Forest and Range Practices Act* (FRPA, Government of BC 2002) provides for the management of moose through the establishment of Ungulate Winter Range (UWR) for species like moose, but at this time, no UWRs have been established for moose within the WRW-RSA.

Concerns regarding declining moose populations within central BC initiated a research program to determine the potential factors influencing the declines (see Kuzyk and Heard 2014, Kuzyk et al. 2019a and 2019b). A review of the results of the research program and continued moose population declines in many regions, even with decreased hunting pressures (Kuzyk et al. 2018a) have prompted the researchers to suggest that monitoring of cow moose survival in relation to other environmental factors be maintained indefinitely as a long-term research and monitoring project (Kuzyk et al. 2019a). Although the research studies are occurring outside of the WRW-RSA, one of the study areas, east of the WRW-RSA contains SBSdk habitats that are similar to those found in the WRW-RSA.

Moose have been an important food and cultural species for the public and the Wet'suwet'en; and an important economically for guide outfitters (Warner 1983, Rescan 2008, Santamauro et al. 2012, Ardea 2014, Budhwa et al. 2020). Land use planning has recognized the importance of managing for moose since the completion of the Bulkley LRMP (BVCRB and IRT 1998) in 1998 and its acceptance in 2006 to establish Land Use Objectives identified within the Bulkley LRMP (ILMB 2006). These include objectives for forest planners to provide for woody browse, visual screening, security, thermal and snow-interception cover for moose within moose winter range mapped in the document when conducting forest harvest planning. The Telkwa LUP (BCFD 1999), the Bulkley SRMP (BC MAL 2005) and the Morice LRMP (BC MAL 2007) all provide objectives to manage for foraging habitats and winter thermal habitats.

A number of best management practices (BMPs), guidelines and protocols for moose have been developed to help to complete effective surveys/sampling (RIC 1998a). There are also several guidelines related to industrial, rural and urban development that have been developed to reduce impacts to moose populations and their habitats including the *A Compendium of Wildlife Guidelines for Industrial Projects in the North Area, British Columbia* (BC MFLNRO 2014a) and *Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia* (BC MFLNRO 2014b).

Distribution and Habitat Use

Moose are widely distributed in BC, and found in a variety of BGC subzones across the province, successfully occupying a wide variety of habitats including boreal forest, mixed forests, flood plains, wetlands, riparian valley bottoms and alpine meadows (Shackleton 1999). Moose feed on a wide variety of shrubs and plant species over their range in North America (Peek 1974), with moose in north-central BC feeding primarily on willows (*Salix* spp.), birches (*Betula* spp.), and aspens (*Populus* spp.) (Kelsall and Telfer 1974, Schwab 1985). Other species such as red osier dogwood (*Cornus stolonifera*), and sub-alpine fir (*Abies lasiocarpa*) have also been found to be important during the winter (Eastman 1977, Hodder et al. 2013, Rea 2014). During the growing season, along with the above listed plant species, alders (*Alnus* spp.), maples (*Acer* spp.), grasses, ferns, sedges, horsetails, and aquatic plants are also eaten (Peek 1974, Eastman 1977). Winter thermal habitat is provided by closed-canopy coniferous forests, which intercept snow and allow forage opportunities on edges (Coady 1974, Eastman 1974, Peek et al. 1976, McNicol and Gilbert 1980, Thompson and Vukelich 1981, Schwab 1985, Hundertmark et al. 1990). Mature closed canopy forests also provide shelter from wind, with even residual stands of trees providing important wind shelter (McNicol and Gilbert 1978).

Natural disturbances (e.g. fire, wind and landslides) as well as human disturbances (e.g. roads, trails and forest harvesting) provide for the development of early successional shrubs and herbaceous plants that moose eat (Eastman 1974, Schwab 1985, Scheideman 2018). Moose also appear to use mature forests for security and thermal shelter both in the summer and the winter, with the use of edges between these early and mature habitats also observed (Eastman 1974). Studies of moose habitat use are quite varied in their interpretation of how moose utilize disturbed areas in relation to mature forests, with ranges of preferred opening sizes, ages of openings, and how the mature forests are interspersed with the openings may affect use (Schwab 1985, Scheideman 2018, Francis 2020).

Due to the range of habitats that can be used by moose, seasonal movements between these habitats are common, with higher movement rates occurring during the summer than in the winter (Gillingham and Parker 2008, Scheideman 2018). Home range sizes for moose are highly variable and can be quite different depending on the age and sex of the animal as well as topography, the distribution habitats within the landscape at a variety of spatial scales and predators. Comparisons of home range sizes between studies is further complicated by the number of methods for calculating home ranges (Worton 1995, Seaman and Powell 1996, Mitchell 2006, Walter et al. 2015) and the amount and type of the location data used in the calculations (Seaman et al. 1999, Powell 2000, Moser and Garton 2007).

Within the WRW-RSA, the only study related to moose movements and habitat use are based on an analysis of the Coffin Lake moose telemetry data (BC MOE 2018) completed by MacLean et al. (2008).

They completed seasonal kernel home range and habitat selection analysis for the collared animals, identifying that moist-shrub habitats, mature forests and wetland habitats within the SBSdk were selected during the winter. Population surveys reports could provide some indication of mid to late winter use areas based on where moose were observed during the surveys, but no analysis appears to have been completed using the that survey data, possibly due to the challenges in accurately mapping the locations of the animals and variability in the recording of habitat attributes during the surveys.

Aerial and ground-based surveys completed for ungulates during 1985 and 1990 for the Telkwa Coal project by TAESCO (1985) and Hatler (1990) found that moose sign were the most common species identified during the ground transects both south (TAESCO 1985) and north of the Telkwa River (Hatler 1990). Moose sign (pellets and evidence of feeding) were found within almost all habitats surveyed, with TAESCO (1985) indicating that recently cleared areas, Scrub-Steppe-Meadow, Spruce-Pine-Aspen and Spruce-Balsam-Aspen types were most often used. Hatler (1990) did not stratify the ground-based transect results by habitat types, but did note that moose sign density was high over most of the areas north of the Telkwa River. Aerial surveys by TAESCO (1985) were limited to flights along the Telkwa River and Goathorn Creek, with moose more commonly observed in the riparian areas along the Telkwa River in April 1983, while in February 1984 they were found within the Telkwa River and Goathorn Creek floodplains as well as in upland areas east of Goathorn Creek, possibly due to lower snow levels in 1984. Hatler (1990) only completed aerial surveys along the Telkwa River and the upland areas north of the Telkwa in February and March 1990. Both surveys observed moose within the Telkwa River floodplain and in the upland areas, with little difference observed in concentrations within specific habitats.

Abundance

Since 1983, seven Stratified Random Block (SRB) moose surveys have been undertaken by the provincial government within the Bulkley Valley (BV) and Lakes District (LD) areas, which include portions of MUs 6-04, 6-05, 6-06, 6-08 and 6-09 (van Drimmelen 1985, Steventon 1988, Marshall 1993, 1998, 2003 and 2012, Schindler *et al.* 2019). The Tenas Coal Project occurs within the Bulkley Valley area, in MU 6-09, with the WRW-RSA containing portions of MU 6-08 and MU 6-09. The SRB moose surveys took place in January and/or February, to best capture the time after the resident hunting season and prior to calving, when population size and calf recruitment estimates are most reliable (RIC 2002). This period is also when weather conditions in the BV/LD are most likely conducive for aerial survey. In other intervening years since 1983, additional composition surveys and population estimates have been undertaken by the province in this general area, within the January through March period. Schindler *et al.* (2019) have collected and integrated the data into a summary report that accounts for variations in the survey years in terms of survey area, design and methods, allowing an investigation into moose estimates, densities, and bull:cow:calf ratios over the last 35-years.

In the overall BV/LD area, population estimates have varied since 1983, with populations peaks occurring in 1992 and 2004 surveys, and lows occurring in 1983, 1997 and 2018 surveys (Schindler *et al.* 2019). Sightability and thus confidence in results (including population estimates) was low during the 1997 SRB survey (Marshall 1998), but in all other years, confidence in the results has been reported as strong owing to good weather and good observation conditions during surveys. Across the survey years since 1983, populations have fluctuated, but since 2004 the overall BV/LD trend has been downward (Figure 3.8-1). This decline has been noted across many populations in central BC and correlates with an extensive mountain pine beetle (MPB) infestation in BC's interior, with intensive road-building and salvage logging to harvest the stands. In response to the moose population declines a provincially coordinated moose research project was initiated to determine if landscape change from the MPB infestation and harvesting had decreased cow survival and caused the population declines (Kuzyk and Heard 2014). The most recent progress report on this program (Kuzyk *et al.* 2019) suggests that the landscape change hypothesis affecting cow survival was not the issue as cow survival rates were relatively high indicating stable populations. Two factors that were identified for the potential declines were that 19% of cow mortalities

were health related and that calf survival to one year was low, which may have contributed to the moose population declines during this period (2004-2018) (Kuzyk et al. 2019b).

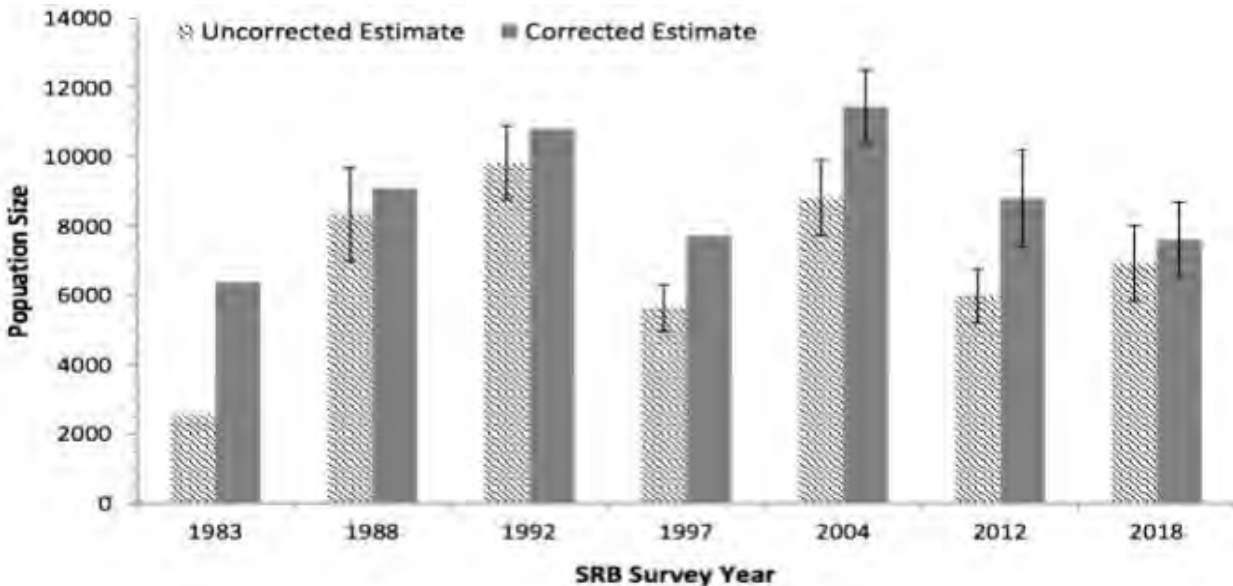


Figure 3.8-1: Moose population estimates for the combined BV/LD survey area during each of seven SRB surveys since 1983 from Schindler et al. (2019). (Error bars denote reported 90% confidence intervals, where provided).

Schindler et al. (2019) also summarizes the relationship between the populations within the BV and LD areas (Figure 3.8-2), showing how population estimates fluctuate between the survey areas between years. For the last two surveys (2012 and 2018), however the differences between the population estimates were within the 90% confidence intervals and not significantly different.

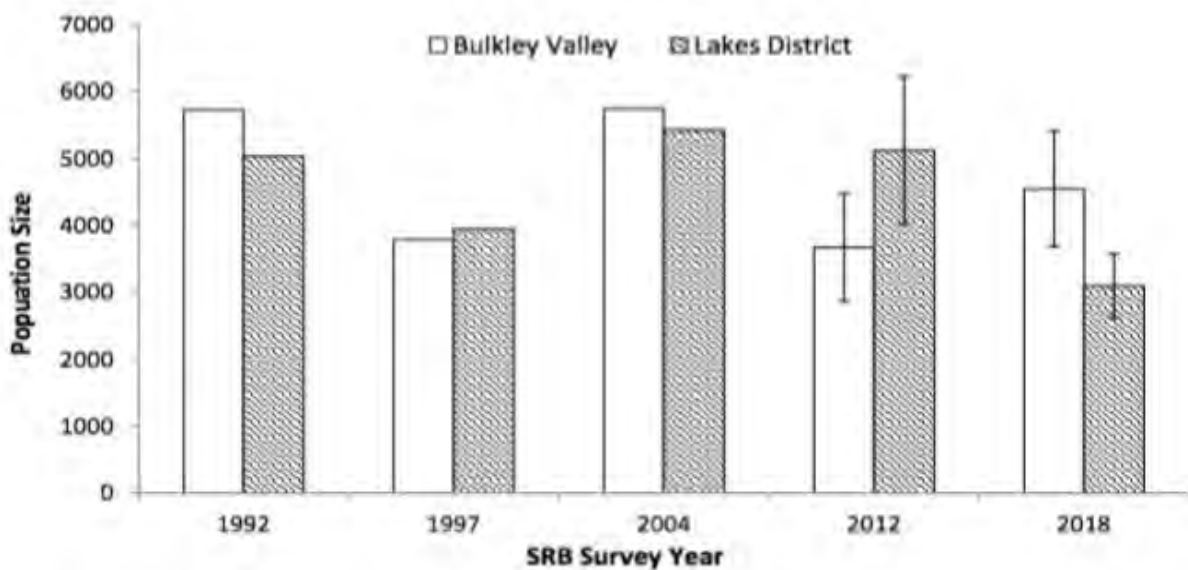


Figure 3.8-2: Moose population estimates for the BV and LD survey areas during each of seven SRB surveys since 1992 (from Schindler et al. 2019). (Error bars denote reported 90% confidence intervals, where provided).

Schindler et al. (2019) estimated the moose population for the BV area in 2018 was $4,071 \pm 882$ and the total for the BV/LD area was $7,679 \pm 1,079$ with an estimated density of 0.73 ± 0.14 moose/km² in the BV area and 0.59 ± 0.08 moose/km² in the BV/LD area. These numbers indicate that there was an overall estimated decrease in the moose population of $3,837 \pm 924$ since 2004 within the BV/LD area, which is a 33.5% decrease.

Bull and cow ratios for SRB surveys conducted within the BV/LD in 2018 show a general decrease since 2004, with the 2018 estimate of 24 bulls:100 cows (Schindler et al. 2019) falling below the provincial recommended minimum of 30 bulls:100 cows (BC MFLNRO 2015). Cow and calf ratios found during the 2018 SRB surveys were 31 calves:100 cows, which is also showing as decrease since 2004, but still within the range of 30 to 45 calves:100 cows estimated to be required to compensate for natural and hunting mortality (Hatter and Bergerud 1991).

The population surveys conducted by TAESCO (1985) and Hatler (1990) provided information on the number of moose using the surveyed area at the time of the survey. Since the surveys were several years apart and were conducted on different areas, they are not easily compared or able to be aggregated to identify a potential total population. Hatler (1990) attempted to compare the two surveys as well as compare them to the surveys conducted by the BC Ministry of Environment surveys in nearby MU's in 1988 and 1989. His conclusions were that the results obtained in his 1990 surveys indicated a relatively high count due to climatic conditions concentrating the animals at low elevations.

Harvesting and Mortality

Moose have been consistently hunted in the MU 6-08 and MU 6-09 within the WRW-RSA for the last 20 years with the harvest rates declining over time (Figure 3.8-3), which is consistent with declines observed within other areas in central BC (Kuzyk et al. 2018b). Total harvest levels for 2018 within MU 6-08 and MU 6-09 within the WRW-RSA was 261 animals (BC MFLNRORD 2021), which is a decline from the high levels in 2003 of 613 animals. Resident hunters harvested the majority of the animals in 2018 (208 animals) with non-resident hunters taking the remainder (53 animals).

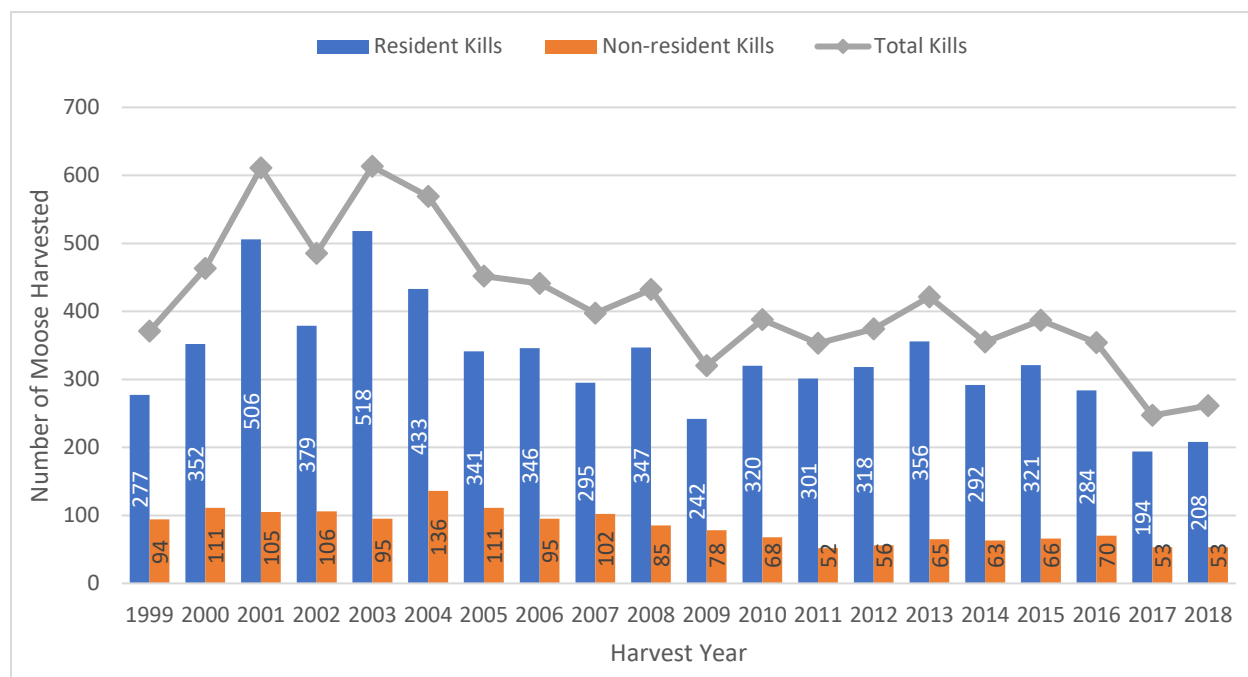


Figure 3.8-3: BC Big Game harvesting statistics for moose in the within MU 6-08 and MU 6-09 within the WRW-RSA from 1998 to 2018.

No information regarding harvest levels of moose by Indigenous communities are available, although the Provincial Framework for Moose Management adjusts resident and non-resident harvest levels to ensure adequate numbers of moose are available for Indigenous community harvesting (BC MFLNRO 2015). Illegal harvesting (i.e. poaching) levels were also not available, although data provided in Kuzyk et al. (2016), Mumma and Gillingham (2019) and Kuzyk et al. (2019b) in central BC suggest that it may be significant.

Procter et al. (2020) provides the latest information on mortality investigations on collared cow moose from the ongoing research project in five moose population study areas in central BC. From 2012 to 2020, a total of 139 of 510 collared cow moose died, with predation (57% of mortality) being the most common cause of death, followed by health issues (20% of mortality), hunting (14% of mortality), accidents (4% of mortality) and finally unknown causes (6% of mortality). Figure 3.8 4 summarizes the probable cause of death for the collared cow moose from Procter et al. (2020).

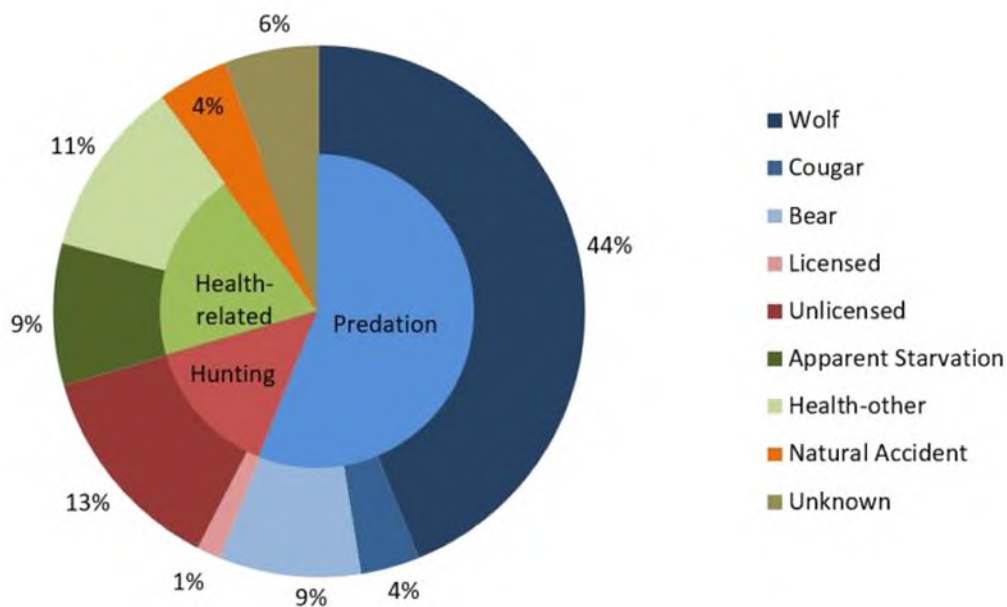


Figure 3.8-4: Probable cause of death of 139 radio-collared cow moose from February 2012 to April 2020 (from Procter et al. 2020).

The mortality rates of cows reported by Procter et al. (2020) indicate that the overall cow survival for the study areas was greater than 85%, which is considered an indication of stable moose populations. They suggest that calf survival and recruitment is the primary factor influencing moose population declines in central BC, and that long-term monitoring as outlined in Kuzyk et al. (2019a) is required to understand the dynamics of cow survival and recruitment in relation to other environmental factors. One of these environmental factors is that tick infestations on moose, possibly due to an increase in warmer winters, appear to have increased in recent years and this increase could affect moose health and increase mortality (Samuel 2007, Musante et al. 2007, Watt 2020).

Human caused mortality on moose not related to regulated hunting includes illegal hunting, vehicle collisions and train collisions. Both Mumma and Gillingham (2019) and Procter et al. (2020) identified unlicensed hunting as a significant mortality factor for cow moose during the ongoing long-term study in central BC, but were unable to determine how much of that hunting may have been illegal hunting (i.e. poaching). Mumma and Gillingham (2019) and Scheideman (2018) both suggested that increased road densities in relation to early seral cutblocks increased mortality risks for moose due to both human and predator access, and suggested that reducing road densities through road closures and increasing visual screening would reduce mortality.

Vehicle collisions with moose, pose a significant mortality risk for the species along highways within some areas of the province. The BC Ministry of Transportation and Infrastructure (BC MOTI) maintains a Wildlife Accident Reporting System (WARS) and since 1978 has tracked vehicle-wildlife collisions along the highways in BC. A summary report prepared in 2010 is the most recent information related to wildlife collisions and summarizes data from 1988 to 2007 (Seilecki 2010). Unfortunately, although reporting of wildlife-vehicle collisions appears to have been consistently completed between Burns Lake and Houston from 1988 to 2007, no data is available for the portion of Highway 16 from Houston to Kitwanga. As that portion of Highway 16 passes through similar habitats to those found in the Burns Lake to Houston section, it is reasonable to assume that the number of collisions is similar. Based on this assumption, it is likely that between 76 and 100 moose were killed in the period 1988 to 1997 and over 101 moose were killed in the period 1998 to 2007 (Seilecki 2010).

Since 2007 McElhaney Consulting Services Ltd. has been contracted by Canadian National (CN) and the Moose Rail Mortality Group to monitor and provide mitigation strategies to reduce rail-related moose mortality rates along the railway sections in northern BC and providing mitigation measures to attempt to reduce those mortalities. The most recent report from 2018 (Kerr 2018) outlines an increase in the number of collisions per mile during 2018 from the average number of collisions per mile on the railway sections within the WRW-RSA (Figure 3.8-5).

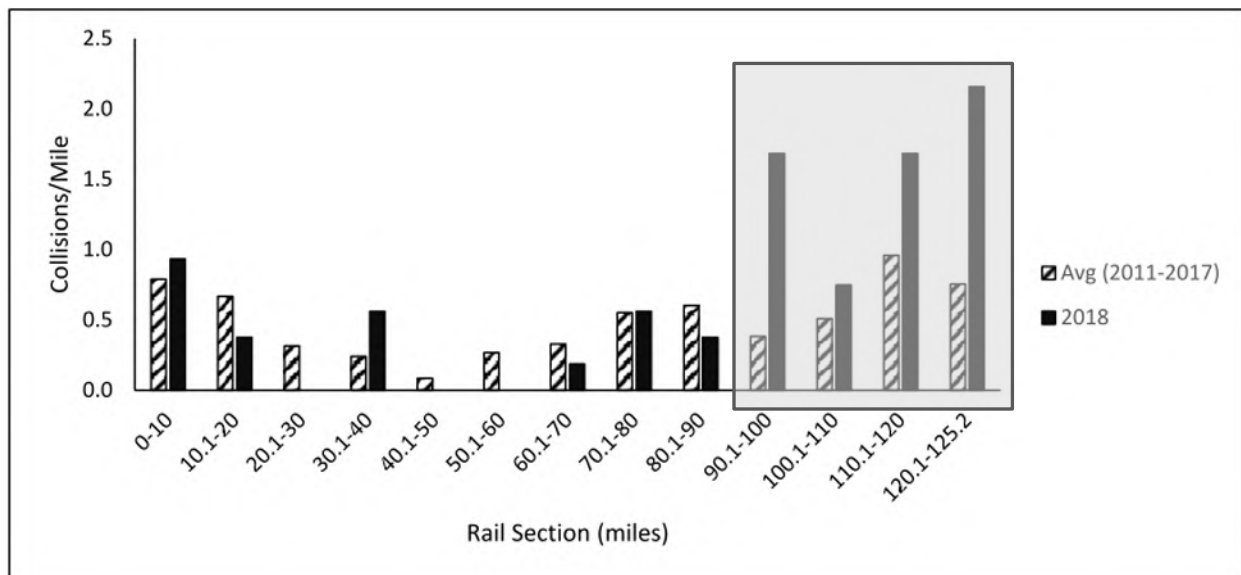


Figure 3.8-5: Moose collisions/mile averaged from 2011 to 2017 and observed in 2018 winter seasons along the Telkwa subdivision of the CN railway (from Kerr 2018). Shaded area represents the railway sections within the WRW-RSA.

A total of 44 moose carcasses were observed along the entire Telkwa subdivision of the CN railway during the 2018 survey, which was corrected for carcass persistence and search efficiency to provide an estimate of 82 ± 12 moose-train collisions in 2018 (Kerr 2018). Of the 44 moose carcasses recorded, 29 were recorded within the 90 mile to 125 mile section of the railway line within the WRW-RSA, which provides a corrected estimate of 54 ± 8 moose-train collisions. The mean number of moose killed by trains over the period 2011-2017 was 23 animals which translates to approximately 215 moose killed by trains from 2011 to 2018 within the WRW-RSA.

3.8.2 Habitat Selection, Distribution and Movements

Habitat Selection

Habitat use was analyzed to quantify the relative habitat selection during the growing and winter seasons and years by collared moose at the level of the BGC variant groups as described in Table 2.8-1. This type of analysis was chosen due to the limited number of collared moose and

Seasonal Habitat Selection

The collared moose information from a single collared moose with locations from 1998 to 2000 and eleven collared moose with locations from 2003 to 2004 were assessed for seasonal selection within the BGC subzones within the WRW-RSA and the W-LSA. The proportions of available BGC subzones and the moose locations within those habitats is provided in Table 3.8-1, with very few locations found within the higher elevation alpine (BAFA), or parkland (ESSFmcp, ESSFmcp) habitats in the WRW-RSA in either the growing (May to October) or Winter (November to April) seasons. Within the W-LSA only lower elevation BGC subzones are available (ESSFmc, SBSmc2 and SBSdk), with the highest proportion of collar locations within the SBSdk subzone. Selection within the WRW-RSA for the growing season was strongly towards the SBSdk subzone, with a weak positive selection in the SBSmc2 subzone (Table 3.8-2). In the winter and overall, the SBSdk subzone was strongly selected for in the WRW-RSA, and within the W-LSA, the SBSdk subzone was selected for in the growing and winter seasons as well as overall.

Table 3.8-1: Relative seasonal use (% of collar locations) for collared moose locations within BGC subzones in the WRW-RSA and W-LSA.

BGC Subzone	WRW-RSA				W-LSA			
	Available	Growing	Winter	Overall	Available	Growing	Winter	Overall
BAFAun	7.9%	0.15%	-	0.08%	-	-	-	-
ESSFmcp	7.0%	0.22%	0.04%	0.14%	-	-	-	-
ESSFmcp	1.2%	0.04%	-	0.02%	-	-	-	-
ESSFmc	25.8%	20.72%	3.22%	12.72%	2.2%	0.51%	0.67%	0.59%
SBSmc2	34.4%	35.72%	32.16%	34.09%	42.4%	31.34%	19.39%	25.32%
SBSdk	18.1%	43.16%	64.58%	52.95%	55.4%	68.15%	79.93%	74.09%

Note: "-" = habitats and seasons that did not have collar locations.

Table 3.8-2: Relative seasonal selection as a function of habitat for collared moose locations within BGC subzones in the WRW-RSA and W-LSA.

BGC Subzone	WRW-RSA			W-LSA		
	Growing	Winter	Overall	Growing	Winter	Overall
BAFAun	-53.60	-1	-98.70	-	-	-
ESSFmcp	-31.84	-160.77	-50.26	-	-	-
ESSFmcp	-31.85	-	-58.65	-	-	-
ESSFmc	-1.24	-7.99	-2.02	-4.32	-3.29	-3.73
SBSmc2	1.04	-1.07	-1.01	-1.77	-2.86	-2.19
SBSdk	2.38	3.56	2.92	1.61	1.89	1.75

Note: "-" = habitats and seasons that did not have collar locations.

Shading indicates selection of the BGC subzone

Annual Habitat Selection

We looked at the data collected for each year that collars were active on the moose to identify if there were any differences between years within the WRW-RSA habitat use patterns. Most of the collar locations were within the lower elevation SBSmc2 and SBSdk subzones for the single collared moose from 1998 to 2000, although some locations were within the ESSFmc subzone (Table 3.8-3). For the eleven moose that were collared in 2003 and 2005, most locations were within the SBSdk and SBSmc2 subzones, but some animals did move into the ESSFmc subzone and parkland (ESSFmcp and ESSFmkp) habitats in the growing season and in the early part of the winter of 2003. In 2004, two animals spent a significant portion of time in the ESSFmcp subzone and some time in the alpine (BAFA) during the growing season.

For the single moose that was active from 1998 to 2000, there was a strong selection for the SBSmc2 subzone in the growing season of 1998, a weak selection in the winter of 1998 and a moderate selection in the growing season of 1999 (Table 3.8-4). That same moose strongly selected for the SBSdk subzone in the winters of 1998 to 2000 as well as moderately selected the SBSdk subzone in the growing season of 1999. The eleven collared moose providing locations in 2003 and 2004 showed a strong selection for the SBSdk subzone in the growing and winter seasons of 2003 and a moderate selection in the growing season of 2004. The SBSmc2 subzone was weakly selected for by moose in the winter season in 2003 and the growing season in 2004, there was also a weak selection by some animals for the ESSFmcp during the growing season of 2004.

Table 3.8-3: Relative annual seasonal use (% of collar locations) for collared moose locations within BGC subzones in the WRW-RSA.

BGC Subzone	Available	1998		1999		2000	2003		2004
		Growing	Winter	Growing	Winter	Winter	Growing	Winter	Growing
BAFAun	7.9%	-	-	-	-	-	0.3%	-	0.1%
ESSFmcp	7.0%	-	-	-	-	-	6.2%	0.2%	8.0%
ESSFmkp	1.2%	-	-	0.0%	-	-	0.4%	-	0.2%
ESSFmc	25.8%	6.0%	3.0%	2.0%	-	-	18.2%	5.7%	21.3%
SBSmc2	34.4%	94.0%	37.3%	62.0%	1.9%	-	23.3%	42.5%	39.8%
SBSdk	18.1%	-	59.7%	36.0%	98.2%	100.0%	51.6%	51.7%	30.6%

Note: “-” = habitats and seasons that did not have collar locations.

Table 3.8-4: Relative annual seasonal selection as a function of habitat for collared moose locations within BGC subzones in the WRW-RSA.

BGC Subzone	1998		1999		2000	2003		2004
	Growing	Winter	Growing	Winter	Winter	Growing	Winter	Growing
BAFAun	-	-	-	-	-	-27.81	-	-55.70
ESSFmcp	-	-	-	-	-	-1.13	-36.95	1.14
ESSFmkp	-	-	-	-	-	-3.31	-	-5.52
ESSFmc	-4.27	-8.63	-12.88	-	-	-1.41	-4.53	-1.21
SBSmc2	2.73	1.09	1.80	-18.56	-	-1.47	1.24	1.16
SBSdk	-	3.29	1.99	5.41	5.51	2.85	2.85	1.69

Note: “-” = habitats and seasons that did not have collar locations.

Shading indicates selection of the BGC subzone

Analysis of the observed moose locations obtained during population surveys provides another opportunity to identify potential selection at the BGC subzone for winter habitat use over a longer timeframe. As outlined

in Table 3.8-5, the majority of moose locations obtained during the surveys for all years were found within the SBSdk subzone and show a strong selection for that subzone (Table 3.8-6).

Table 3.8-5: Relative annual seasonal use for moose locations during stratified random block surveys within BGC subzones in the WRW-RSA.

BGC Subzone	Available	Winter 1992	Winter 1997	Winter 2004	Winter 2012	Winter Overall
ESSFmc	10.2%	-	-	0.17%	-	0.06%
SBSmc2	37.3%	9.94%	14.94%	14.90%	9.36%	12.38%
SBSdk	44.0%	90.06%	85.06%	84.93%	90.64%	87.55%

Note: “-” = habitats and seasons that did not have collar locations.

Table 3.8-6: Relative annual seasonal selection as a function of habitat for moose locations during stratified random block surveys within BGC subzones in the WRW-RSA.

BGC Subzone	Winter 1992	Winter 1997	Winter 2004	Winter 2012	Winter Overall
ESSFmc	-	-	-59.37	-	-164.19
SBSmc2	-4.43	-2.95	-2.95	-4.70	-3.55
SBSdk	2.41	2.28	2.27	2.43	2.34

Note: “-” = habitats and seasons that did not have collar locations.

Shading indicates selection of the BGC subzone

Habitat Selection Summary

Although the habitat selection analysis was completed at the BGC subzone level, the results correspond generally to the findings of the more detailed analysis completed by MacLean et al. (2008). The collared moose data and the moose locations obtained during winter population surveys all show that habitats within the SBSdk are selected more frequently than their availability. The SBSdk subzone has lower snow levels than the SBSmc2, as well as having more deciduous, riparian and floodplain habitats that provide important forage species for moose. Overall, the SBSdk was selected during the winter within the WRW-RSA and the W-LSA. When the collared data is divided by year, there was more use of SBSmc2 habitats during the winters. In the growing season, the moose are able to move around the landscape and take advantage of feeding and security/thermal habitats in the SBSmc2 as well as the subalpine ESSF forests and parklands. The moose collared in 1998 and some of the moose collared in 2003 appeared to spend much of their time in SBSmc2 during the growing season, as well some were selecting subalpine habitats during the growing season. Although the habitat selection data was only based on 12 moose, it is likely representative of moose habitat use within the WRW-RSA and W-LSA based on the literature and on other baseline information obtained about moose habitat use.

Distribution

The collared moose data shows distinct areas of use within the WRW-RSA landscape, with some animals using lower elevation SBSmc2 and SBSdk areas near the Telkwa, Bulkley and Morice rivers during the growing season, while two of the moose used areas further to the west in sub-alpine ESSFmc and ESSmk subzones (Figure 3.8-6). Due to the short period that the collars were on and small number of animals collared, these patterns only provide a limited look at how moose are using the WRW-RSA and it is very likely that many other patterns of use would show up using more collared animals that were followed longer.

During the winter season, the moose were all gathered within SBSdk subzone habitats, with some use of lower elevation SBSmc2 areas along the Telkwa, Bulkley and Morice rivers. The moose appeared to use overlapping areas during the winter as they concentrated along the Bulkley River (Figure 3.8-7).

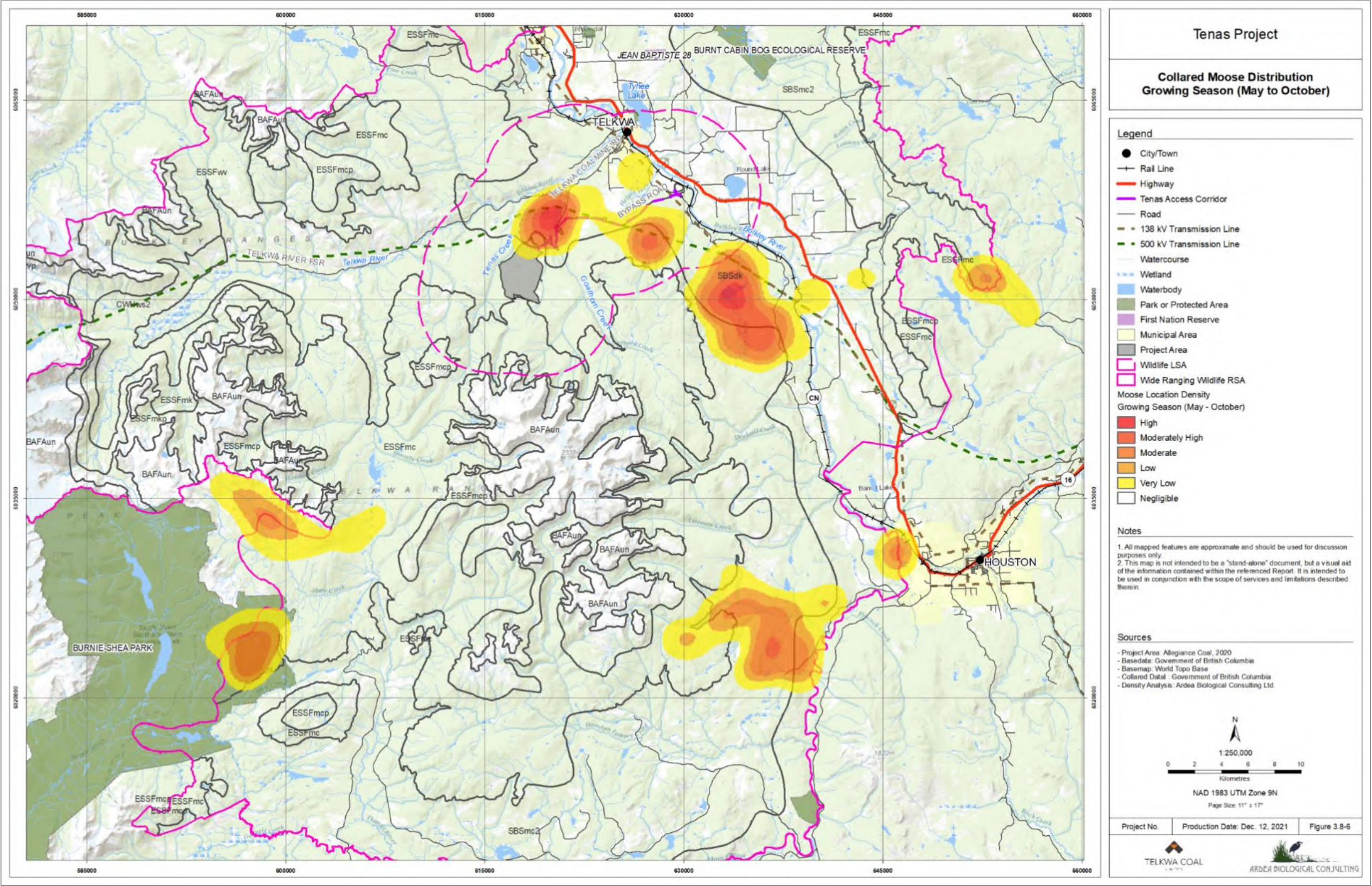


Figure 3.8-6: Distribution of moose GPS collar locations in the growing season (May to October) from 1998 to 2000 and 2003 to 2004.

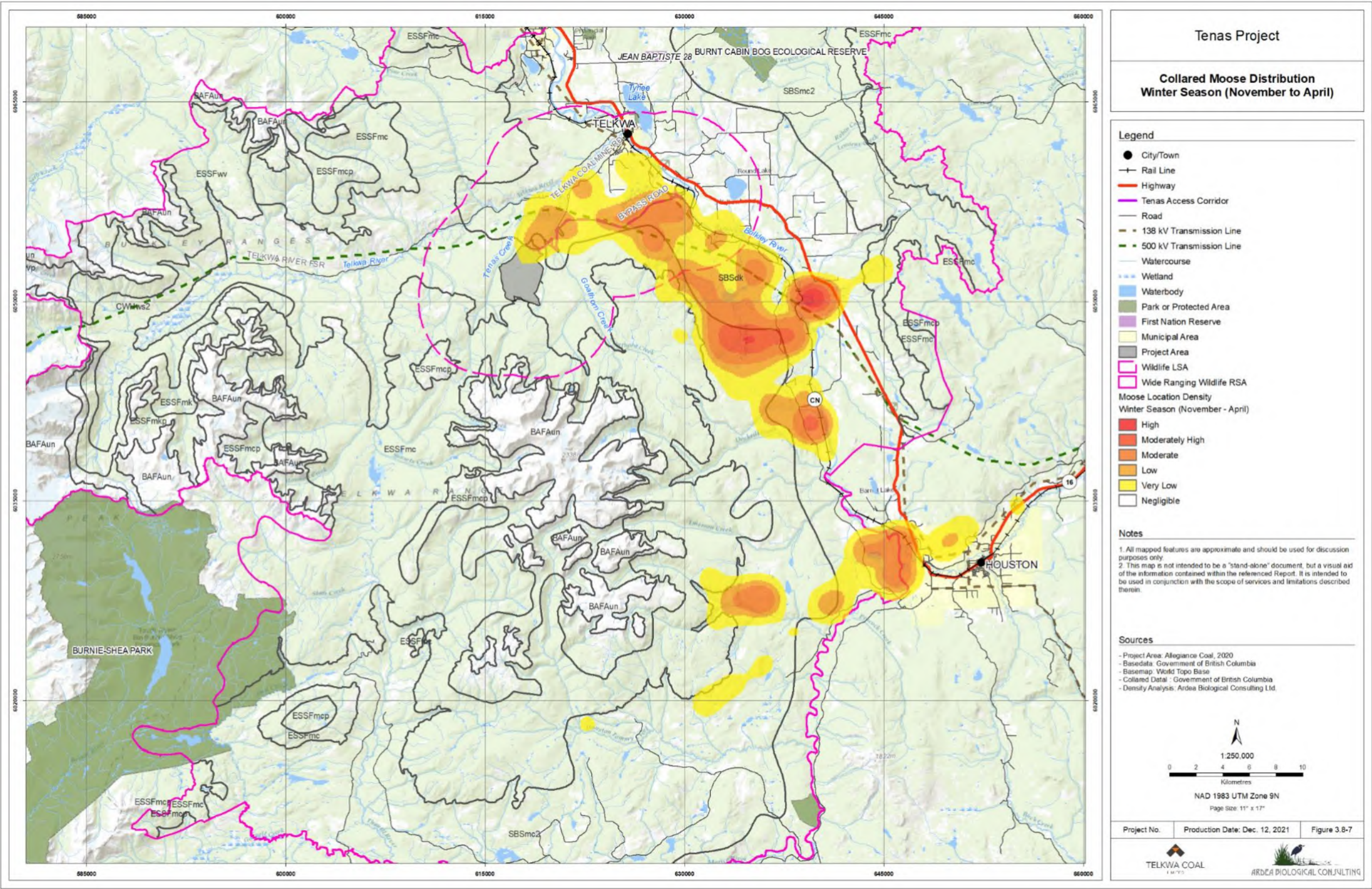


Figure 3.8-7: Distribution of moose GPS collar locations in the winter season (November to April) from 1998 to 2000 and 2003 to 2004.

Movements

Although the number of animals collared and time they were collared was limited, some general movement patterns were observed which may provide an insight into how moose may be using the landscape within the WRW-RSA. In general, the collared moose showed lower daily movement rates from January to March during the winter, when deeper snow conditions would limit extended movements (Figure 3.8-8). As snow melted in April, movements became longer through May and June, with more variability in the length of the movements. July showed the largest range of daily movements, while during the remaining portion of the year from August to December, daily movements were relatively consistent, with an increase in variability in December. Overall, the median daily movements were quite consistent at 0.5 km/day, rising slightly in July to 0.7 km/day, and lowering slightly in November to 0.4 km/day.

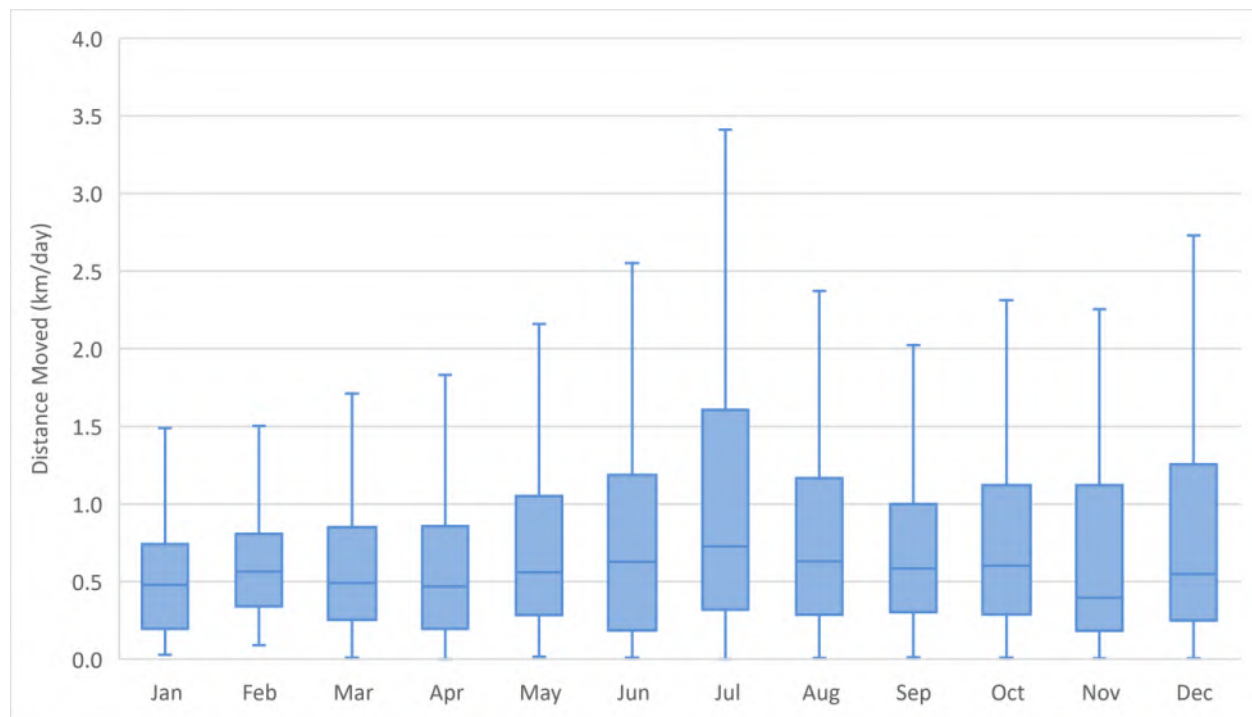


Figure 3.8-8: Boxplot of daily distance travelled by GPS collared moose by month from 1998 to 2000 and 2003 to 2004. The horizontal line inside the box indicates the median, boxes show the middle 50% of the data, and vertical lines indicate the upper and lower 25% of the daily distance travelled by the collared moose.

Figure 3.8-9 and Figure 3.8-10 outline the movements by the collared moose during the growing season and winter seasons. Longer movements (greater than 3 km/day) related to moving to seasonal use areas are outlined in brown with an arrow denoting the direction of movement, while shorter, more local movements (less than 3 km/day) are outlined in orange. During the growing season, a mixture of long and short movements were observed for all moose, with several moose undertaking long, seasonal migrations from low elevation areas near the Telkwa and Morice rivers to sub-alpine forested and parkland habitats to the west. These animals were ones collared in 2003 and each did seasonal trips to the west in 2003 and 2004. In the early part of the winter season, these animals made their way back to the lower elevation areas near the Telkwa and Morice rivers, to overwinter in the lower elevation SBS subzones. Both of these moose initiated their long-distance movements within the first few days of November in both 2003 and 2004, although the northern moose returned back to the sub-alpine area in late November and then returned to the Telkwa River area in early December.

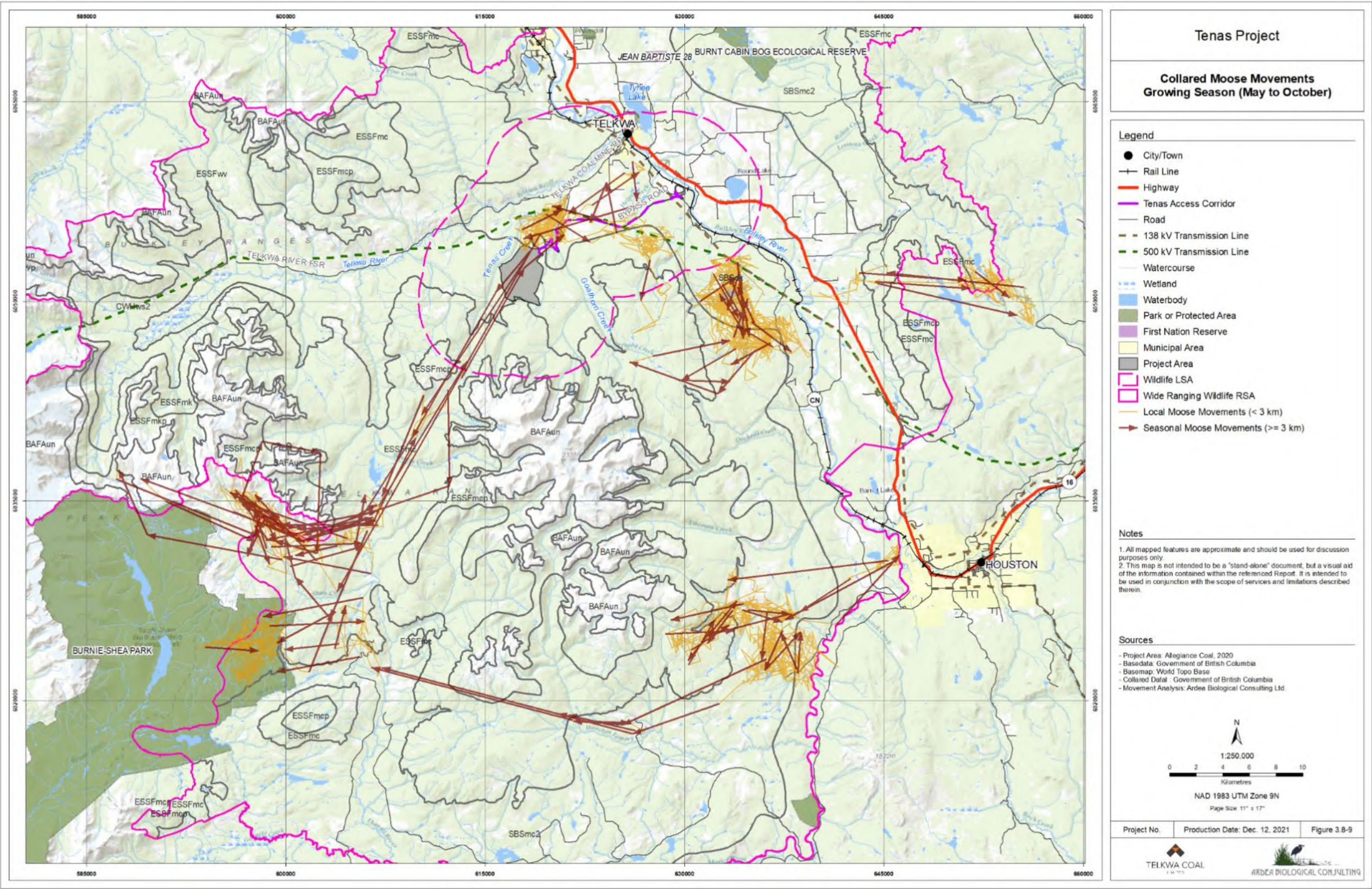


Figure 3.8-9: Collared moose movement paths in the growing season (May to October) from 1998 to 2000 and 2003 to 2004.

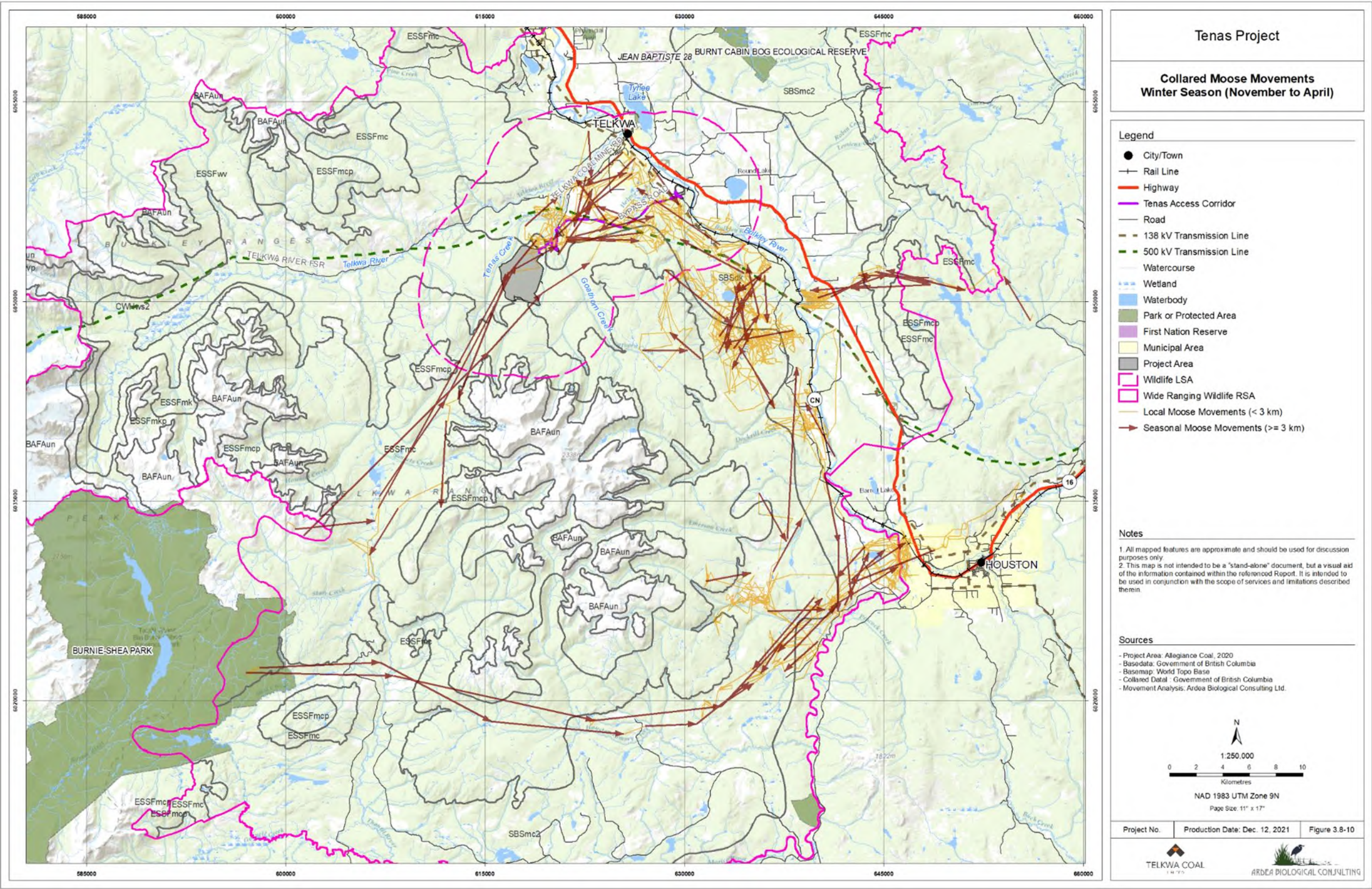


Figure 3.8-10: Collared moose movement paths in the winter season (November to April) from 1998 to 2000 and 2003 to 2004.

3.8.3 Assessment and Survey Results

Snow Tracking Surveys

In 2018, a total of 31,548 m of snow track surveys were conducted within three general areas; the minesite, the Goathorn Creek area and the rail infrastructure area. A low track density for moose (0.3 TKDSS) were observed in the minesite area in January, while the rail infrastructure area showed a moderate track density of 2.2 TKDSS (Figure 3.8-11). Much higher track densities were observed in February, with 5.5 TKDSS found in the Goathorn Creek area and 4.4 TKDSS in the rail infrastructure area, while track densities in March were similar to January, with 0.2 TKDSS in the minesite and 2.5 TKDSS in the Goathorn Creek area.

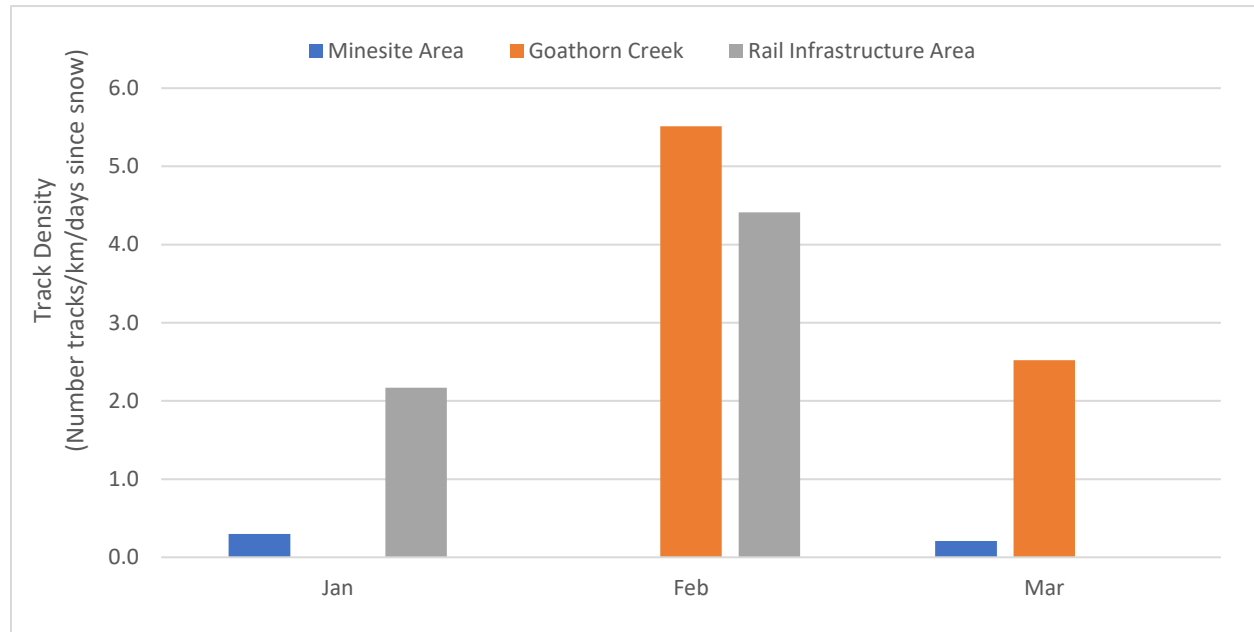


Figure 3.8-11: Number of moose track densities observed within the general areas of the W-LSA January to March 2018.

Track densities were much lower overall in the SBSmc2 subzone, with mature forest and open areas showing slightly higher track densities (0.8 TKDSS and 0.6 TKDSS respectively) than young and edge habitats (0.3 TKDSS for both) (Figure 3.8-12). In the SBSdk subzone, edge habitats were found to have the highest track densities (5.5 TKDSS), followed by young habitats at 3.2 TKDSS and mature habitats at 1.5 TKDSS. These findings correlate with other observations and analysis of moose use of the BGC subzones, and confirm the results of the analysis of collared moose habitat selection and distributions outlined in Section 3.8.2.

Figure 3.8-13 outlines the track densities observed from January to March in relation to general forest types, with January track densities relatively low (0.3 TKDSS) in conifer forest and slightly higher in mixed forests (1.0 TKDSS). February moose track densities were the highest during the snow tracking period, with conifer forests having a density of 6.9 TKDSS, mixed were 4.0 TKDSS and riparian forest at 5.3 TKDSS. In March tracks were only observed in mixed and riparian forests with track densities of 1.2 TKDSS and 2.1 TKDSS respectively.

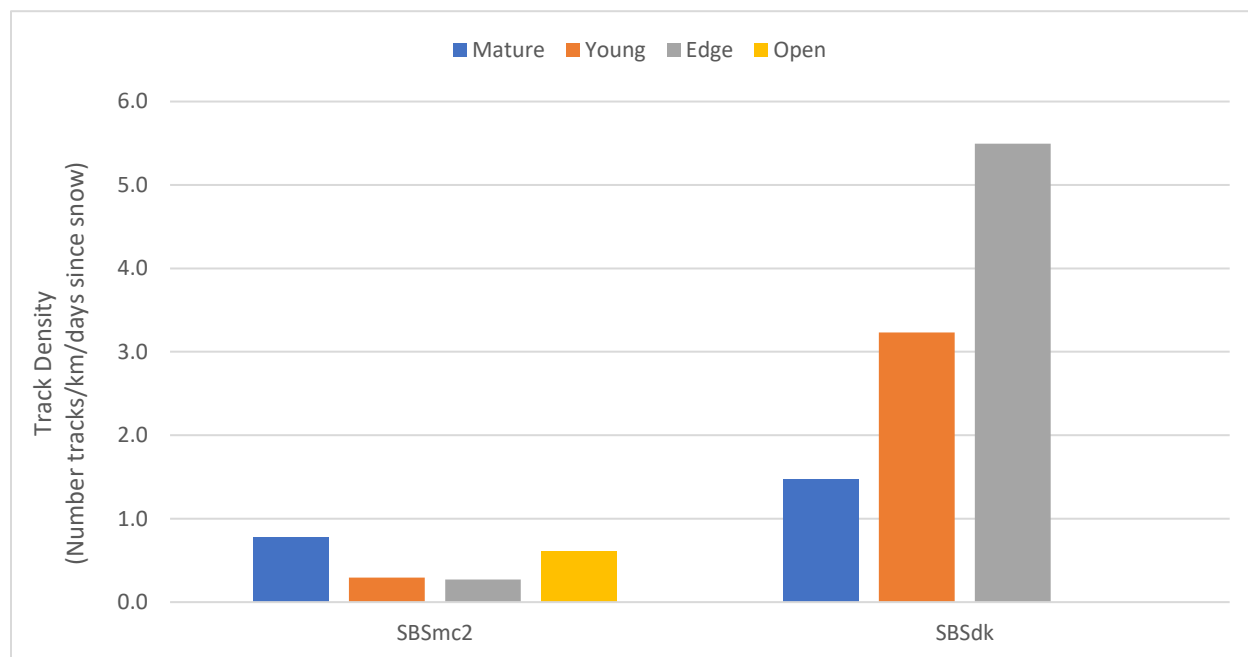


Figure 3.8-12: Number of moose track densities observed within the SBSmc2 and SBSdk subzones of the W-LSA January to March 2018.

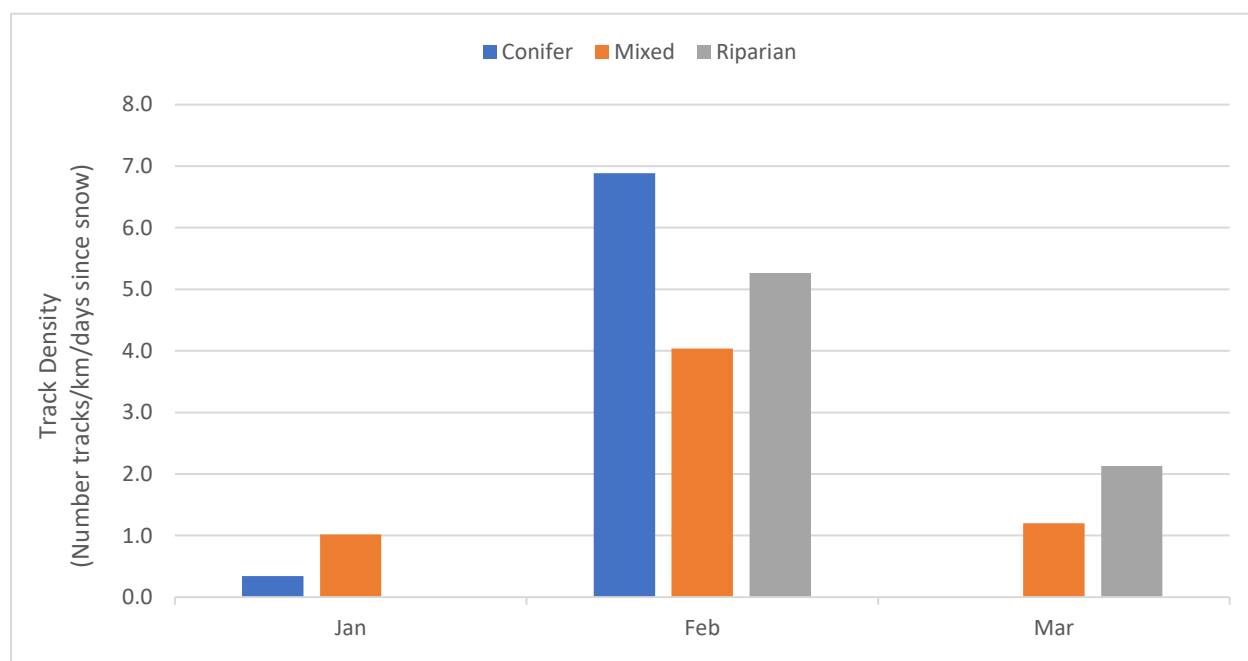


Figure 3.8-13: Number of moose track densities observed within conifer, mixed and riparian habitats of the W-LSA January to March 2018.

Wildlife Trail Cameras

As mentioned in previous sections, wildlife trail cameras were deployed in six locations for total of 294 days over 2017 and 2018. Of the 1,929 photo images of wildlife collected, a total of 946 were of moose, with 114 identified as unique observations of moose. Moose were the most photographed animal during remote

surveys, being observed in over six months of year and active at all hours of the day. Photos of moose were collected on 34 days in 2017 and 36 days in 2018.

During 2017, Site 4 and Site 7 (see Figure 2.11-1 for camera locations) obtained the highest number of photos of moose per 100 camera days, with 23.5 and 27.0 photos/100 camera days respectively (Figure 3.8-14). In 2018, Site 7 again captured the most photos, with 25.4 photos/100 camera days. Site 7 is along a road within a 15-year-old cutblock with extensive shrub cover and often moose would forage nearby and in some cases bed down in front of the camera, which caused there to be hundreds of photos of moose at this site.

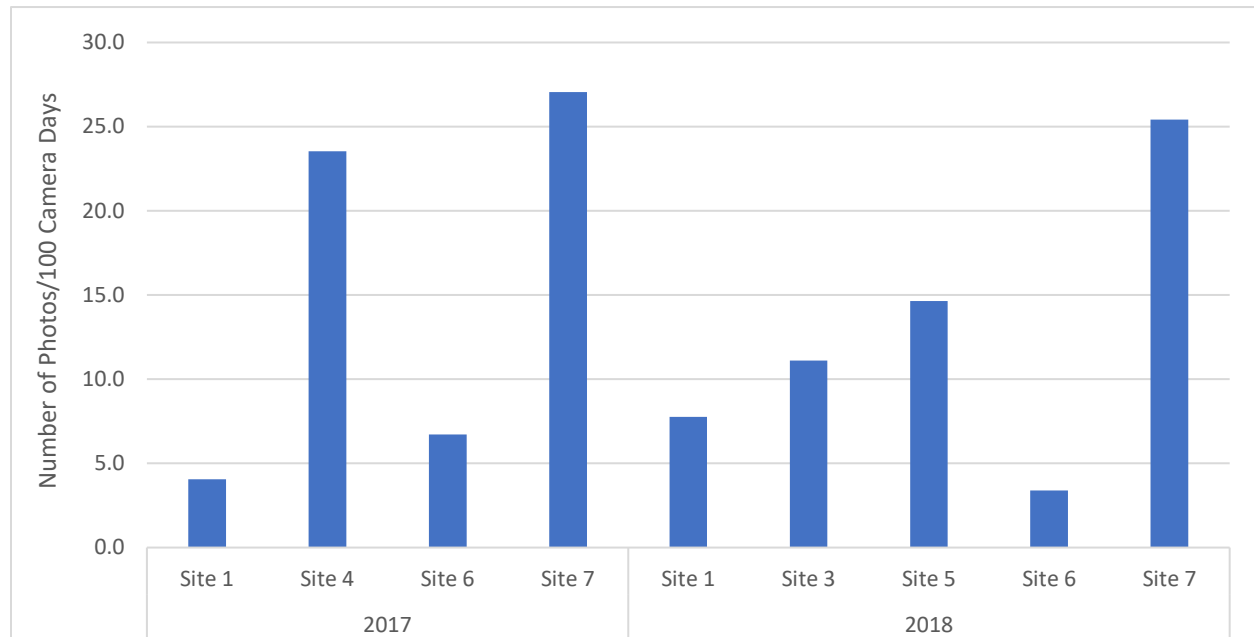


Figure 3.8-14: Photos of moose recorded at each camera site per 100 camera days during 2017 and 2018 within the W-LSA.

Assuming that photos obtained from the camera sites are a reflection of moose activity levels within the W-LSA; relatively high activity levels were recorded during June 2017 and May 2018, with the highest activity occurring during the month of August in 2018 (Figure 3.8-15). It is unclear why there are fewer photos/100 camera day during July and September in both years, but it could be related to movements of moose into different areas for feeding or perhaps increased activities by predators or humans during that time.

Activity levels based on the camera photos was also observed through the time of day that the photos were obtained (Figure 3.8-16). Moose activity was observed to be highest during the late evening and early morning (2100 to 0000 hrs and 0500 to 0900 hrs), with limited photos obtained during the mid-part of the day and early evening (1000 to 2000 hrs). It should be noted that although not quantified, some of the photos obtained during the night were of moose bedded down in front of cameras and moving slightly, causing a photo to be taken, rather than an actual movement or feeding activity occurring. It is likely however that the lack of photos and activity from 1100 to 2100 hours is to avoid activity during the heat of the day as moose are known to be susceptible to overheating (McCann et al. 2014, Ditmer et al. 2018, Borowik et al. 2020). This is also shown in Plate 3.8-1, which shows photos of moose taken in mornings when temperatures were quite low (4 to 5 °C).

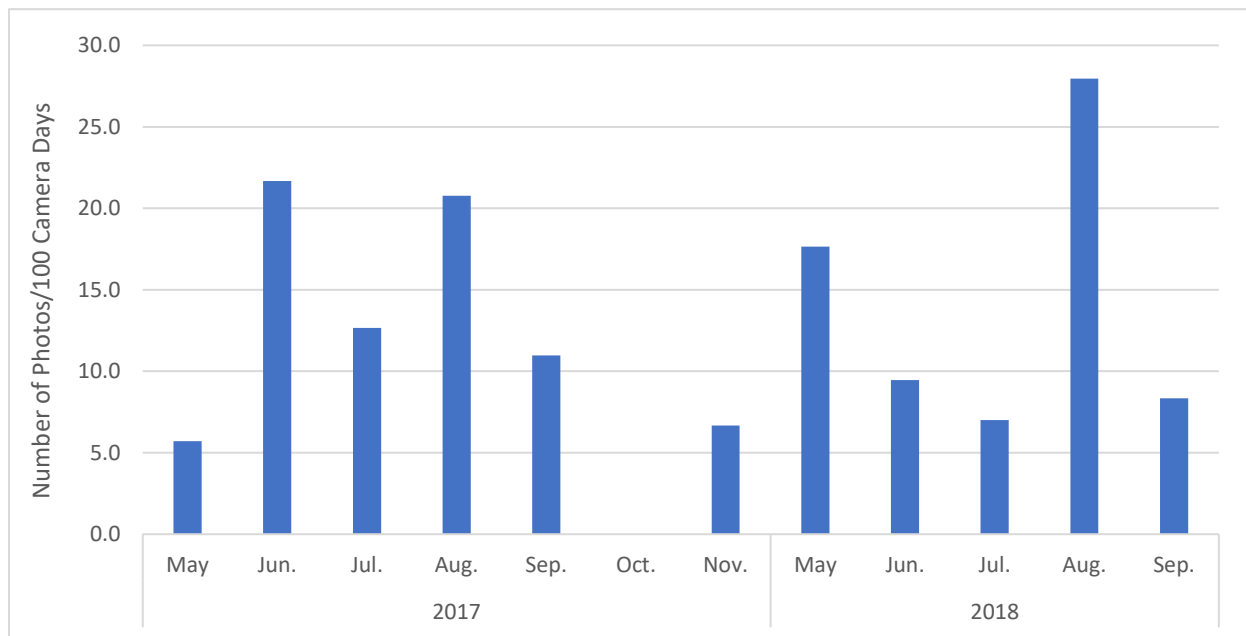


Figure 3.8-15: Photos of moose recorded at all camera sites per 100 camera days for each month and year during 2017 and 2018 within the W-LSA.

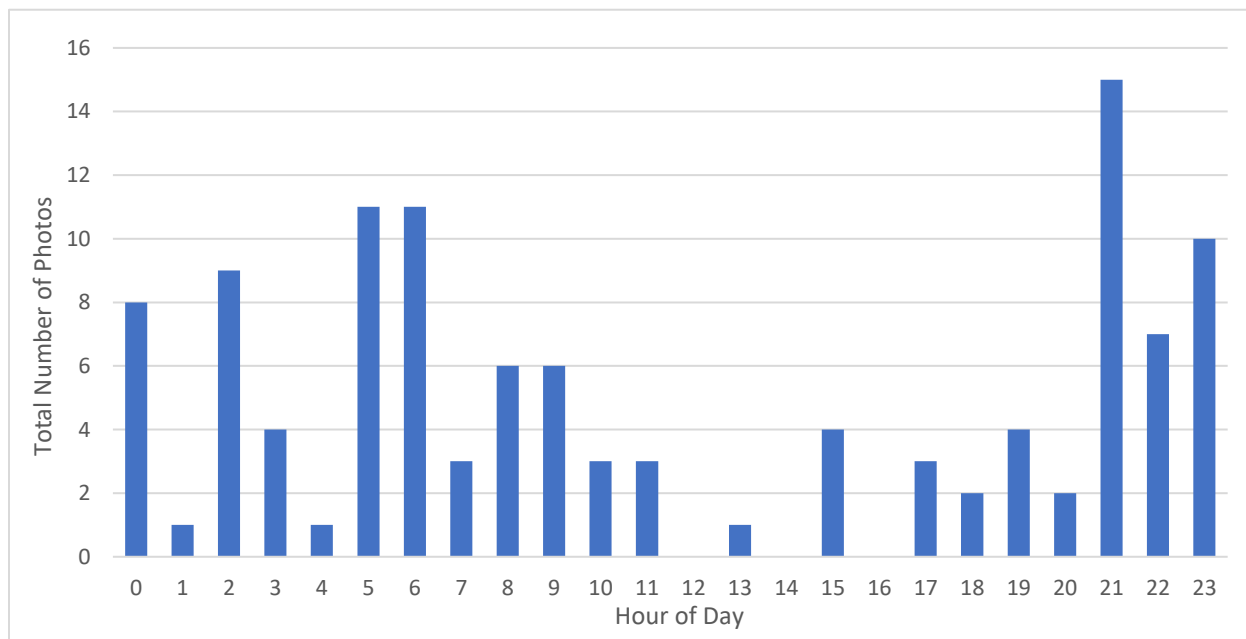


Figure 3.8-16: Total number of photos of moose recorded at all camera sites by time of day during 2017 and 2018 within the W-LSA.



Plate 3.8-1: Two adult female moose in August 2017 and May 2018 at Camera Site 7.

Wildlife Trail Assessments and Incidental Observations

During the wildlife trail assessments, moose sign (tracks, browse evidence and scat) was recorded on 66% of the wildlife trails ($n = 45$) that bisected the access corridor and moose were the most observed species sign found during the wildlife trail assessments. The locations and intensity of use of wildlife trails along the access corridor are outlined in Figure 3.8-17 and were rated from low to high based on the amount of use

of the trail by animals. In many cases more than one species was identified using the trails, including mule deer, elk, black bear, as well as domestic cows in many cases.

Observations of moose sign were recorded during WHA plots as well as during other wildlife baseline studies in 2017 to 2019, and are provided in Table 3.8-7. A total 779 observations of moose evidence of use were recorded for a variety of activities, with feeding (n = 252), excrement (n = 238) and tracks (n = 129) accounting for 79% of all observations. Wildlife trails where moose sign was observed (n = 52), as well as wildlife trails (n = 31), where there was no clear evidence of moose use but it is likely they could be, were identified and rated using the same criteria as was used in the wildlife trail assessments. A total of seven mineral licks were also observed, two that had clear evidence of use by moose and five where it was unclear if moose were using them. All wildlife trails and mineral licks observed within the W-LSA are outlined in Figure 3.8-17, along with the distribution of all other moose sign observations.

Table 3.8-7: Summary of observations of moose sign and activity from WHA plots, wildlife trail assessments and incidental observations within the W-LSA from 2017 to 2019.

Sign Age/Type	Type of Sign / Activity / Use											
	Bedding	Body Part ¹	Carcass	Disturbed ²	Excrement	Feeding	Grooming	Living ³	Mineral Lick	Territoriality	Tracks	Wildlife Trail
Moose	30	13	5	2	238	252	2	49	2	5	129	52
Ungulates									5			31
Visual				2		1		1			1	
Fresh	20	2			14	11		2	2	1	47	31
Young	10	4	3		134	150	1	25	5	1	78	52
Old		7	2		63	41		6		3	4	31
Winter					40	36	1	9			2	
Growing					7	23		6				
Unknown					16	11	1	2			2	

Notes: 1) Body Part: portions of an animal's body which are left behind but do not indicate the animal is dead eg; antler sheds, hair.

2) Disturbed: Behaviour for the purpose of avoiding the observer, activity before disturbance unknown.

3) Living: Activity ambiguous or could not be specified.

Along with a general summary of activities and use, Table 3.8-7 also summarizes seasons of use or age of the sign observed. As some observations of sign could include various ages or seasons that could be attributed to the sign or activities, the numbers for these can be greater than the totals provide in the top rows for moose or general ungulates.

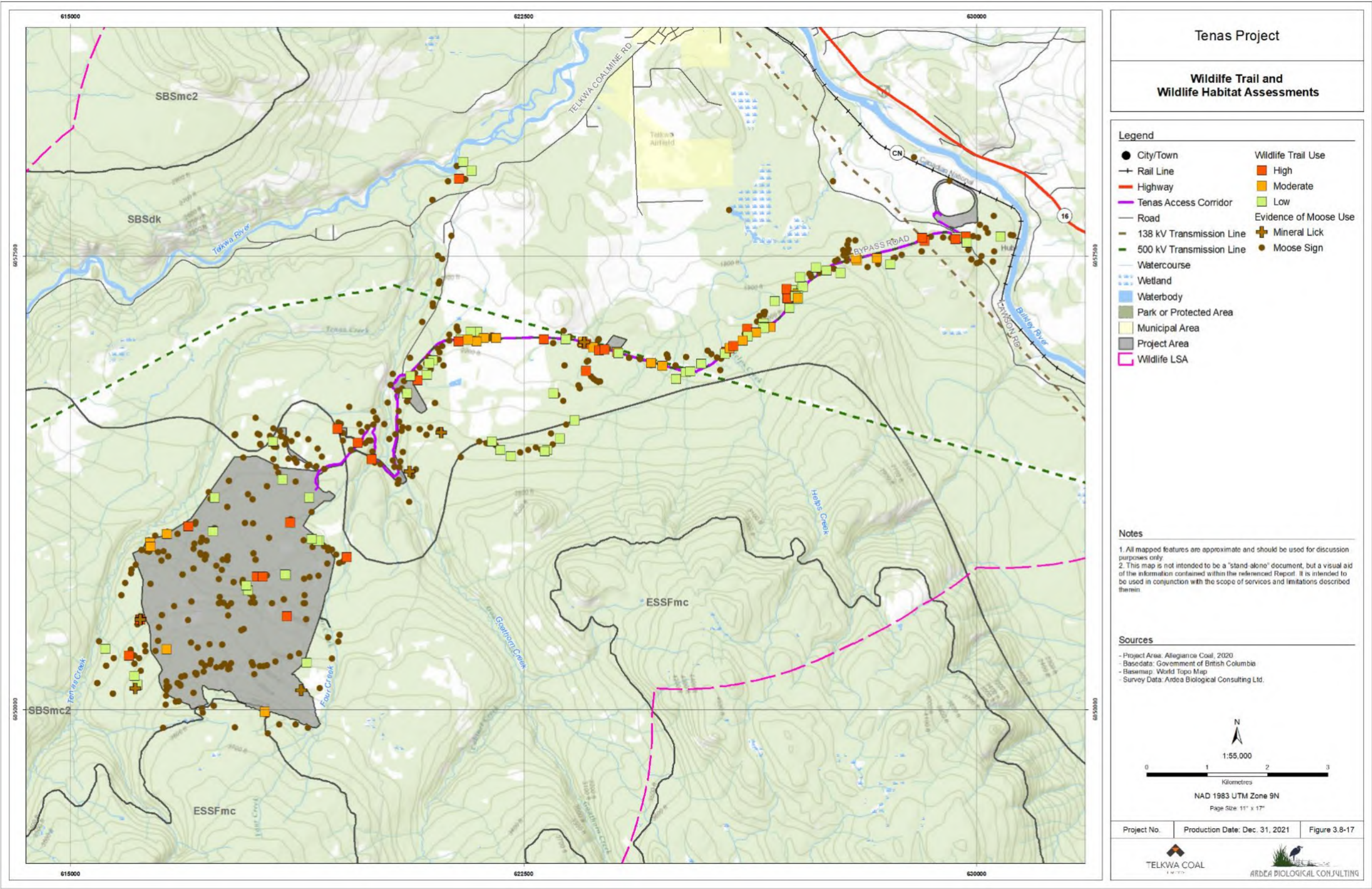


Figure 3.8-17: Distribution of wildlife trails, mineral licks and moose sign observed within the W-LSA from 2017 to 2019.

Wildlife Habitat Assessments

At total of 448 WHA assessments were conducted that assessed moose foraging habitat, 339 assessments for security habitat and 435 assessments for thermal habitat. Assessments were generally evenly divided between the SBSmc2 and SBSdk subzones, with the proportions also even when assessing foraging and thermal habitats between the growing season and winter seasons. For assessing security habitats, 63% of the assessments were completed for the growing season and 37% for the winter season.

Foraging habitat was rated moderate to high most often within the SBSdk, with over 47% of plots being rated moderate or higher (Figure 3.8-18); while more sites were rated low or very low as thermal habitats in the SBSmc2 than the SBSdk, likely due to the amount of forest harvesting in the SBSmc2 (Figure 3.8-19).

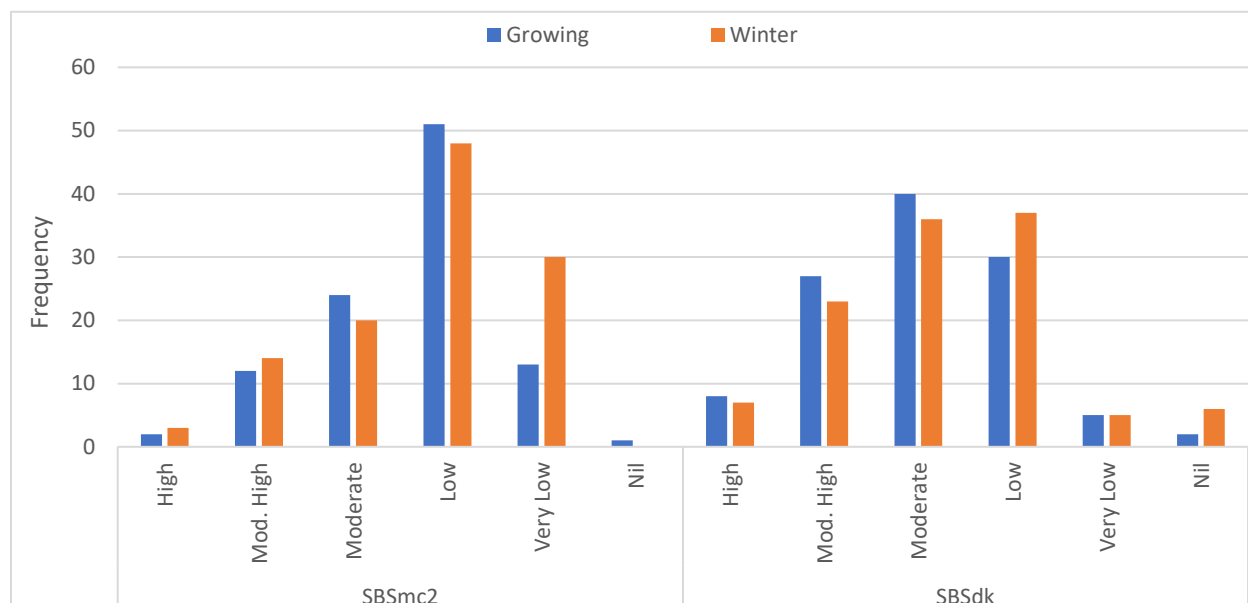


Figure 3.8-18: Forage suitability ratings within the W-LSA for moose.

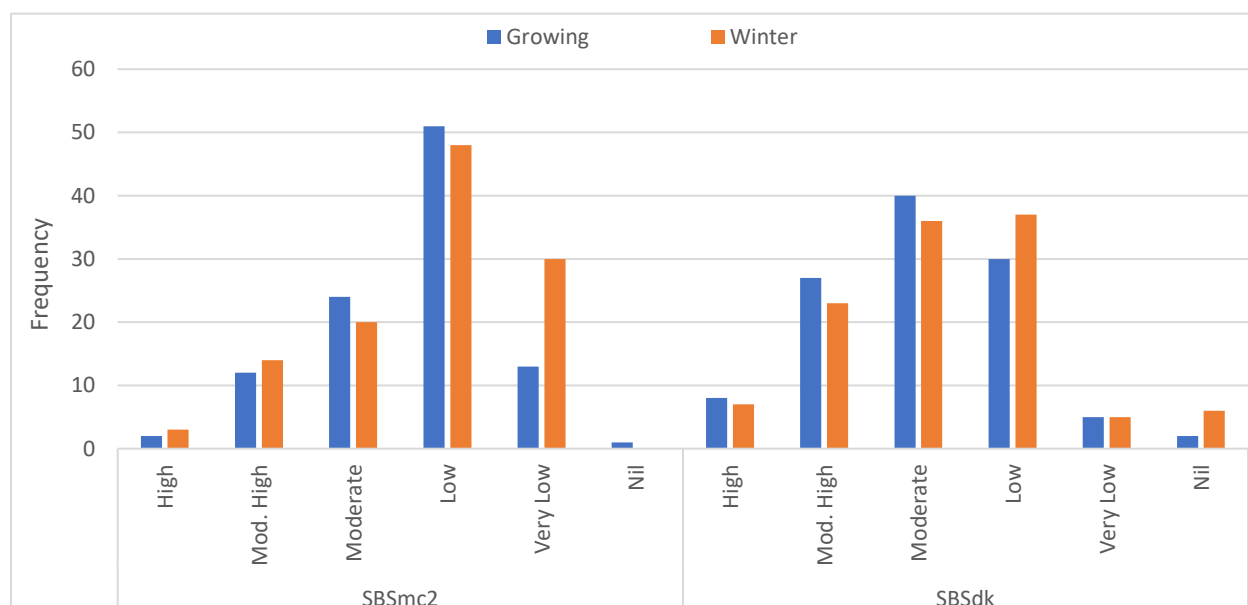


Figure 3.8-19: Thermal cover suitability ratings within the W-LSA for moose.

3.8.4 Habitat Suitability Model Summary

Edie (1998a) completed moose habitat suitability and capability models using the Oikos TEM (Oikos 1999) information for Manalta Telkwa Coal project application in 1997. An updated habitat suitability model for moose living in the winter was developed using the TEM completed for the current baseline program for the WRW-LSA using a new TEM from Ardea (2021a), the Oikos TEM updated for new harvesting, as well as Predictive Ecosystem Mapping (PEM) completed by the province updated by new fires and harvesting information. The species account, along with details on the development and implementation of the habitat suitability model is outlined in Appendix G.

The results of the moose winter habitat suitability model are provided in Table 3.8-8, and mapped in Figure 3.8-20 and Figure 3.8-21. Approximately 5% of the W-LSA was rated as high, located in riparian and deciduous forests within low elevation areas near the Telkwa and Bulkley rivers. Within the WRW-RSA 2.4% (8,495 ha) was identified as high by the suitability model, distributed within the low elevations of the WRW-RSA. Moderate and moderately high rated habitats within the W-LSA made up 22.4% and 12.5% respectively, while these same ratings made up 7.6% and 13.4% of the WRW-RSA. These were located at low to mid slope positions within the Telkwa, Bulkley, and Morice river corridors. Nil to low rated habitats were generally found at higher elevations, with all alpine habitats rated nil.

Table 3.8-8: Summary of the results of the baseline moose habitat suitability model within the W-LSA and the WRW-RSA.

Season	Habitat Suitability Rating	Wildlife LSA (ha)	Wildlife LSA (%)	Wide-Ranging Wildlife RSA (ha)	Wide-Ranging Wildlife RSA (%)
Winter	High	1,759.7	4.9	8,495.0	2.4
	Moderately High	4,483.0	12.5	27,123.1	7.6
	Moderate	8,041.7	22.4	47,764.8	13.4
	Low	8,964.5	25.1	102,104.0	28.6
	Very Low	7,882.5	22.1	110,965.6	31.0
	Nil	4,621.6	12.9	61,134.5	17.1
Total		35,725.9	100.0	357,587.0	100.0

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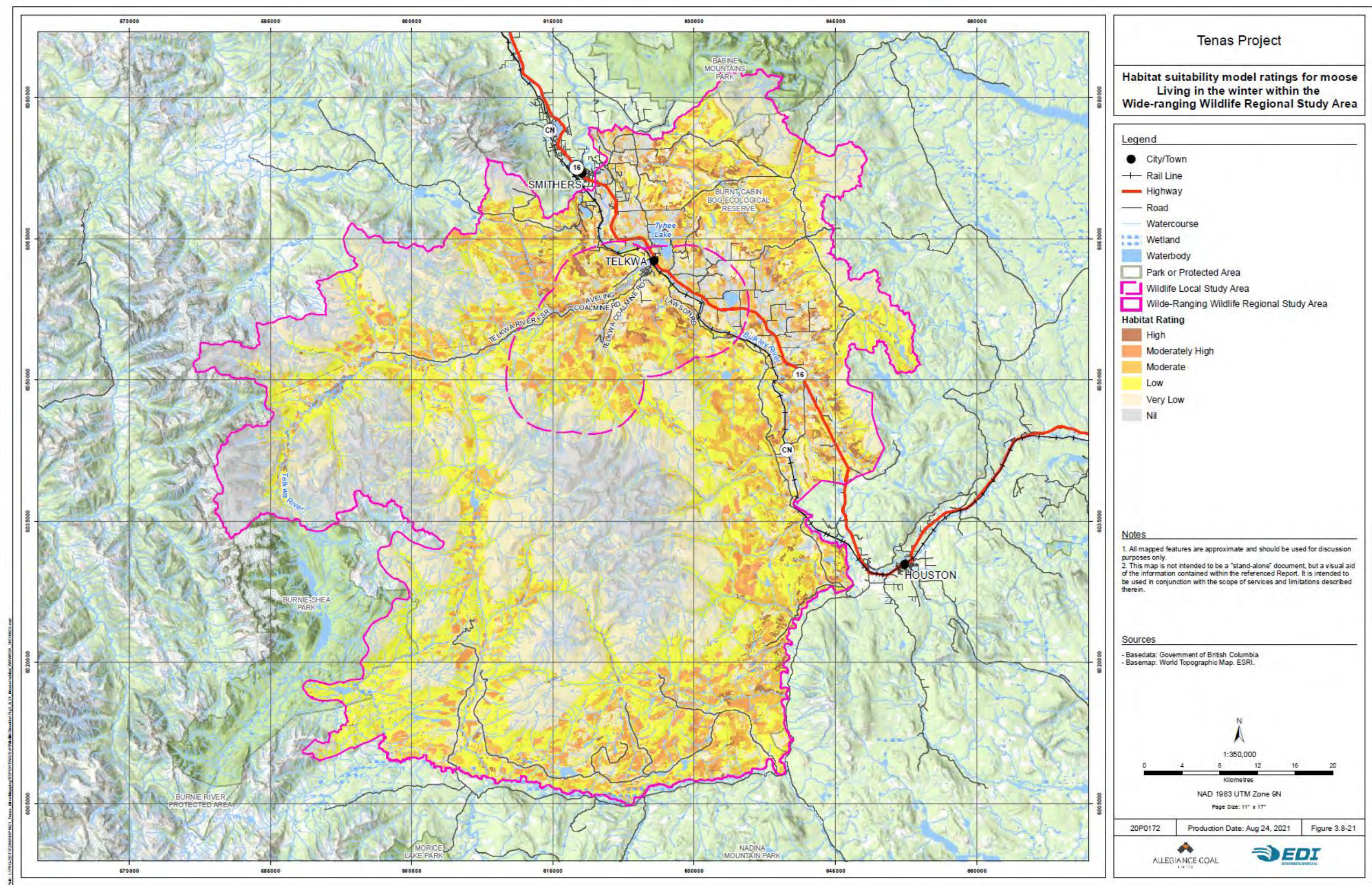


Figure 3.8-21: Habitat suitability model ratings for moose Living in the winter within the WRW-RSA.

3.9 Rocky Mountain Elk

3.9.1 Existing Information on Rocky Mountain Elk

Elk (*Cervus elaphus*) are the second largest member of the Cervidae (deer) family next to moose (*Alces americanus*) and have been historically established in BC for the past 10,000 to 15,000 years. There are two subspecies of elk in BC, Roosevelt elk (*Cervus elaphus roosevelti*) and Rocky Mountain elk (*Cervus elaphus nelsoni*). Roosevelt elk are found only in the Lower Mainland, Vancouver Island and the Gulf Islands of BC, while rocky mountain elk are found in the remainder of the mainland of the province and were introduced on Haida Gwaii.

Conservation Context and Management Initiatives

Rocky mountain elk are a Yellow listed species (BC CDC 2019), and are managed for hunting purposes in BC. They are considered to be stable throughout the province with their numbers increasing since the late 1970s (Blood 2002).

Distribution and Habitat Use

Elk are found in a variety of habitats from coastal old-growth rainforests to grassy valleys of the interior, being tolerant of dry interiors and wet coastal climates but generally keep to areas where snow remains shallow throughout their winter range (Blood 2002). Elk are not as adapted to deep snow as moose are, and depend heavily on low-growing forage which would disappear under deep snow. Snow depth has been suggested as the most important variable in winter habitat selection (Poole and Mowat 2005) and wintering habitat is typically at the lowest elevation of an elk's seasonal home range to avoid deep snow.

All elk are social animals and congregate in groups with up to 20 or more of cows, calves and yearlings, that live apart from smaller groups of bulls except during the fall rut (Blood 2002). Elk have a tendency to be migratory, with herds move varying distances between summer and winter ranges. Across their range in mountainous regions, elk summer in alpine meadows and winter in valleys, and on more level terrain, seeking wooded hillsides in summer and open grasslands in winter (Blood 2002).

Elk are primarily a grazer, but they also consume forbs, and may browse on willow, aspen, oak, etc. Active at night, but most active at dusk and dawn. Feeding periods are more prolonged in winter, concentrated in morning and evening. During the winter, elk also require forest cover for thermal protection, and good elk winter ranges typically have an interspersed of food and cover components. Most elk foraging occurs within 200 m of forest cover (Cairns and Telfer 1980, Lyon 1980).

Within the Bulkley Valley area, elk have been common since the early 1980's (Shultz 2011) and likely migrated from more eastern populations following forest harvesting and agricultural clearing along the Bulkley River. Previous baseline studies within the W-LSA (TAESCO 1985, Edie 1998b), however did not report on elk sightings or sign within the project area. In 2004, three female elk were collared by the Ministry of Environment with GPS collars and monitored from March 2004 to April 2005. Seasonal utilization distributions for the three elk are provided in Figure 3.9-1 and Figure 3.9-2 and are considered to be representative of several members of the population due to their tendency for mixed gender and age groups into herds (Blood 2002).

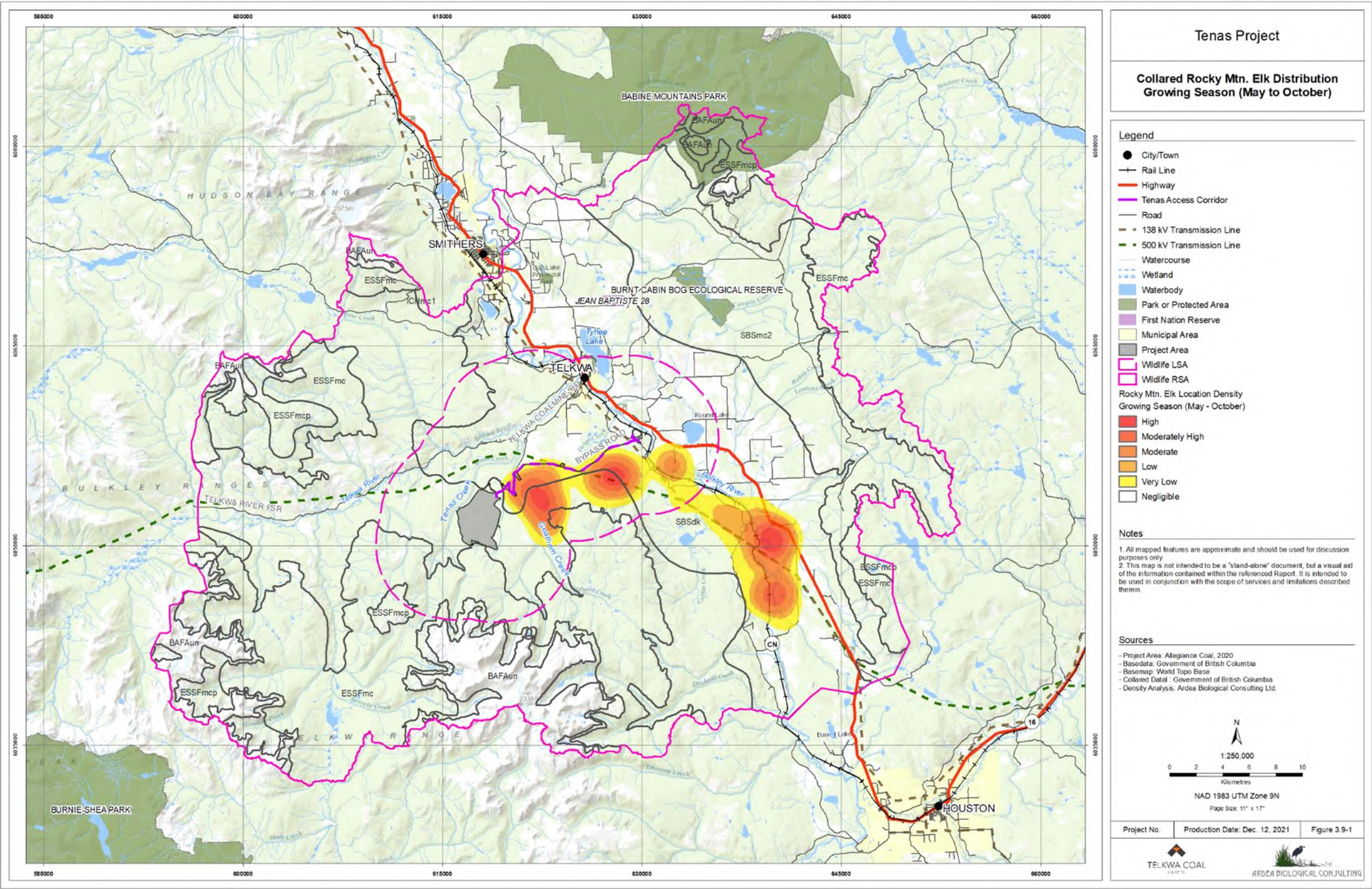


Figure 3.9-1: Distribution of collared Rocky Mountain elk GPS collar locations in the summer (May to October) from 2004 to 2005.

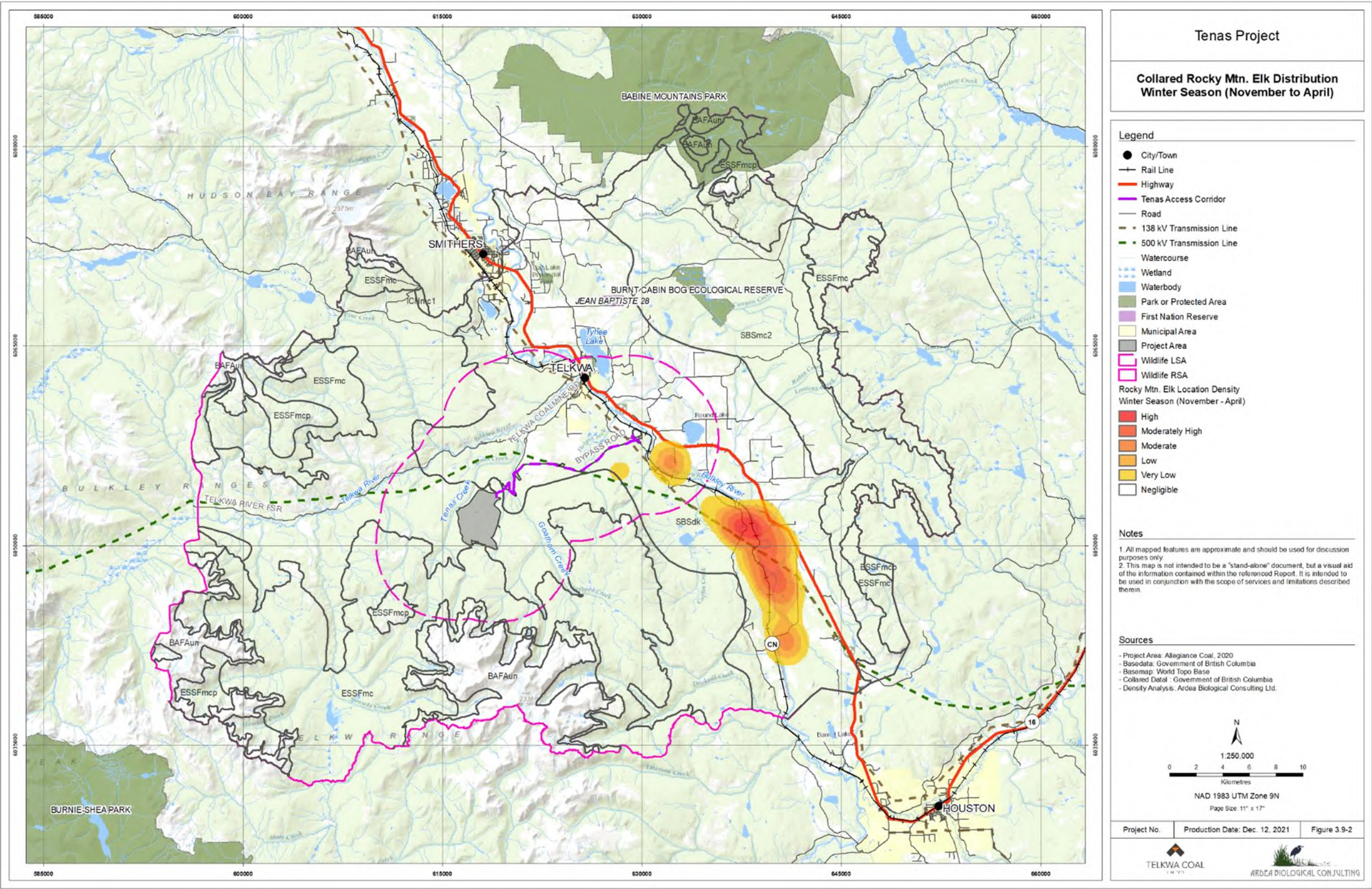


Figure 3.9-2: Seasonal distributions of Rocky Mountain elk GPS collar locations in the winter (November to April) from 2004 to 2005.

During the growing season, from May to October (2005), elk were more mobile, moving longer distances and foraging over a wider range of habitats (Figure 3.9-1). Hatler (1990) reported sightings of a few individuals 10 km to the northwest of Dennis and Aldrich Lakes, approximately 15 km outside of the W-RSA. This pattern of occasional sightings of animals, as well as observations from trail cameras over the past 10 years suggest that wandering animals (primarily bulls) are likely to be found from valley floor to mountain top within the central portion of the W-RSA (Turney 2014).

In the winter season, the telemetry data (Figure 3.9-2), sightings from local landowners provided during open house presentations in 2018, and historic observations during winter ungulate surveys (Schultz 2011) indicate that elk are primarily located in the pasture farmland and adjacent forest on either side of the Bulkley River from just south of Telkwa to Walcott.

Abundance

In 2000, the northern BC population of Rocky Mountain elk was estimated at 18,000 animals (Blood 2000) and in 2018 the population was estimated at 15,700 to 37,500 animals (BC MOE 2018)

In a 2011 winter survey, Schultz (2011) observed 24 animals within a smaller survey area from Round lake to Walcott, and after applying a visibility correction factor estimated that a population of 50-70 animals in the Bulkley Valley area. In 2016 and 2018 population counts were performed primarily by landowners in the region, which indicated that a population of approximately 200 elk were within the Bulkley Valley (Mark Wong pers. comm. 2020). An aerial survey performed from Witset to Francois lake in 2020 in the Bulkley Valley and Lakes District counted 59 animals in the portion from Witset to Houston (Mark Wong pers. comm. 2020). No data regarding sex and life stage is available at this time, and no correction for missed animals has been applied.

Harvesting and Mortality

No harvesting of rocky mountain elk was permitted within MU 6-08 or MU 6-09 from 1998 to 2017, with a limited entry harvest initiated in 2018. That year, resident hunters harvested two elk in MU 6-08 and four in MU 6-09 (BC MFLNRORD 2021).

Human caused mortality, other than hunting includes; poaching, vehicle collisions and railway accidents. A study in southeastern BC found that human-caused mortality (including hunting) accounted for 73% of elk mortalities (Gibson and Sheets 1997). Gibson and Sheets (1997) also found that cows made up 100% of the elk related vehicle collision mortalities.

Besides moose, elk are a common prey for wolves and grizzly bears in northern coniferous forests (Gillingham and Parker 2008). Predation mainly occurs on sick individuals (often in winter when individuals are struggling) and calves. Winter is the season that stresses elk far more than any other (Nyberg and Janz 1990). Temperatures are low, precipitation is high and furthermore, most females are growing fetuses, males are suffering aftereffects of the frenetic activity of the rut, and predation, disease, and accidents remain ever present risks (Nyberg and Janz 1990).

3.9.2 Survey Results and Analyses

Wildlife Trail Cameras

Elk were observed twice during remote camera surveys. An adult male elk was observed on August 7th 2017 within the minesite area (Plate 3.9-1), while another adult male was observed southeast of the minesite area on June 22nd 2018 (Plate 3.9-2).



Plate 3.9-1: Adult male elk observed on August 7, 2017 at Camera Site 7 in the southwest portion of the minesite area.



Plate 3.9-2: Adult male elk observed on June 22, 2018 at Camera Site 1 southwest of the minesite area.

Wildlife Trail Assessments and Incidental Observations

A total of 29 observations of elk sign were collected from 2017 to 2019 within the WHA program and incidentally during other field work. One visual observation of an elk was made in July of 2018. The majority of the elk sign were pellets (22 observations), with 7 observations of elk tracks. Elk sign was found fairly uniformly throughout all parts of the LSA and consistently within the SBSdk and SBSmc2 BGC zones (Figure 3.9-4).

Wildlife Habitat Assessments

Habitat suitability ratings were collected for elk as part of the WHA baseline program in the event that an elk habitat suitability model was developed. As outlined in Figure 3.9-3, habitat ratings for ecosystems during the growing and winter seasons were collected. Very few sites were assessed to be high or moderately high value, with the majority of the sites assessed identified as having very low to moderate ratings.

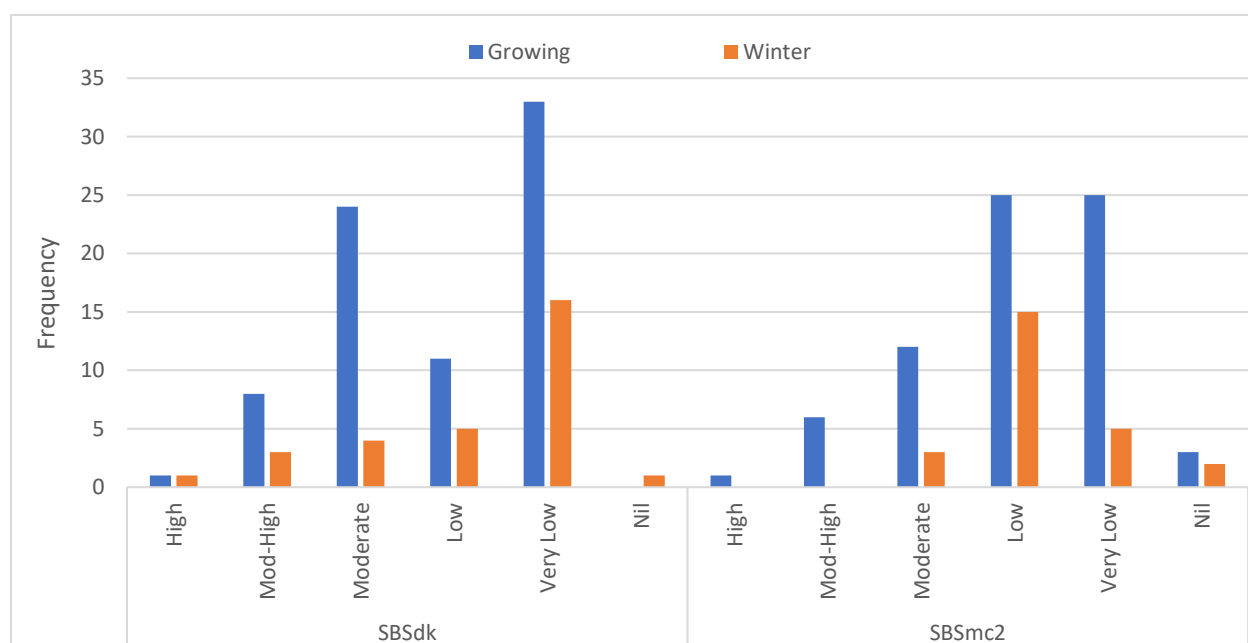


Figure 3.9-3: Summary of Rocky Mountain elk WHA ratings for feeding habitat during the growing and winter seasons.



Figure 3.9-4: Distribution of wildlife trails and Rocky Mtn. elk sign observed within the W-LSA from 2017 to 2019.

3.10 Mule and White-tailed Deer

3.10.1 Existing Information on Mule and White-tailed Deer

Mule deer are a medium sized member of the family Cervidae (deer) and are a widespread and adaptable species found throughout a broad range of habitats in BC. There are three sub-species of mule deer (*Odocoileus hemionus*) in BC. Columbian black-tailed deer (*Odocoileus hemionus columbianus*) are found on the southern coast and Vancouver Island; Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) occur in the Haida Gwaii and the northern mainland coast; and mule deer (*Odocoileus hemionus hemionus*) are found in the interior portions of the province (Bunnell 1990). Mule deer (*O. h. hemionus*) are found throughout the non-coastal mainland portion of the province in most temperate and mountain biogeoclimatic zones (Stevens 1995).

White-tailed deer are distributed in two disjunct regions of BC. The first area white-tailed deer are known to occupy is in the northeastern part of the province, where they are situated predominantly in the Rocky Mountain east slopes. Populations in this area are situated in the Boreal Plain Ecoprovince, with small remnant groups dispersed throughout the Sub-Boreal Interior, Taiga Plains, and Northern Boreal Mountains Ecoprovinces. This area represents the northern most extent of white-tailed deer. The second population is distributed amongst the southeastern portions of the province and includes; the Kootenay, Columbia, Kettle and Okanagan lower valley areas. These white-tailed deer populations are found exclusively within the Southern Interior Mountains and the Southern Interior Ecoprovinces (Saxena 1996). Climate change has been studied as a vector for range expansion for white tail deer. Dawe and Boutin (2016) studied the driver behind white-tailed deer range expansion at the norther extent of its range and suggest that climate change, represented by decreasing severity of winter conditions and increasing length of the growing season, increases the probability of presence across substantially more of the landscape than did land use change in all decades and further changes in white-tailed deer distribution are expected across the northern (Alberta) boreal forests as climate continues to change (Dawe and Boutin 2016).

Conservation Context and Management Initiatives

Both mule deer and white-tailed deer are Yellow listed species (BC CDC 2020) and are managed for hunting purposes in the province of BC.

The Bulkley LRMP (BVCRB IRT 1998) is mainly concerned with the loss of mature forest for winter range for both deer species. As much of mule deer winter range is located on private land, there is little that can be directly affected by the LRMP (BVCRB IRT 1998).

The Bulkley Valley SRMP (BC MAL 2005) applies to an area within the 1998 Bulkley LRMP planning region and provides strategies focussed on the forest management practices to ensure adequate security areas, winter forage, and large areas with little human activity. Recommendations include seasonal restrictions to forest harvesting activities and access management by BGC zone.

The Morice LRMP (BC MAL 2007) outlines the important of winter range for both species of deer with emphasis on the crown land areas for the welfare of deer populations, noting that times of atypically deep snow are especially perilous to winter movement and habitat. The plan calls to maintain and enhance deer winter range and retain closed canopy forest in low elevation habitats.

Distribution and Habitat Use

In general, mule deer prefer open forested areas or parklands with adjacent grasslands, but also inhabit timbered river breaks, foothills and mountain slopes. In the central interior of BC, mule deer show preference for old forest stands in winter, especially during periods with moderate (250 to 400 mm) and deep (more than 400 mm) snow. A moderate to dense forest canopy is characteristic of deer winter range during periods with deep snow. Mule deer are primarily a browsing herbivore feeding on a wide range of

shrub and tree species throughout the year, however in summer they will also eat a wide variety of forbs (Armleder *et al.* 1994).

Habitats used by white-tailed deer encompass coniferous forests, mixed wood forests, grasslands, as well as flood plains and riparian areas. The broad diversity of habitat types used by white-tailed deer is due to the extensive use of edge habitats which provide a wide range of forage, cover and security requirements needed to sustain the species. White-tailed deer have been designated 'ecotonal' because of the transitional uses of various habitat types (Saxena 1996). Seasonal variation in weather dictates the foraging, security and thermal requirements sought out by white-tailed deer (Allen 1968; Forsyth 1985). White-tailed deer are adapted to selectively forage on plant materials that are low in cellulose and high in cell soluble proteins, carbohydrates and fats which is particularly evident in the species' close association with agriculture (Mackie *et al.* 1998).

The winter season provides the most restrictions for both mule and white-tailed deer as forage becomes limited. Preferred winter forage is woody browse and arboreal lichen and occurs typically in mature conifer or mixed forests (Willms *et al.* 1976, Potvin *et al.* 1983, Armleder *et al.* 1986, Jenkins *et al.* 1987). Suitable winter habitat with shallow snow, adequate food, security cover and thermal conditions can reduce the rate of energy loss and support survival for both species (Armleder and Waterhouse 1994).

According to the Bulkley Valley LRMP (BVCRB IRT 1998) winter range in the Bulkley Valley for both white-tail and mule deer is comprised of bottom-land aspen-mixed wood stands and dry pines stands. Preferred winter forage is woody browse typically found in and around mature conifer or mixed forests but they will also browse on arboreal lichen throughout the winter. Conifer stands also serves as thermal habitat, protecting from wind and snow during the winter season. Early spring green-up is particularly imperative for pregnant does. Deer are known to capitalize on south-facing slopes where snow cover sheds first in early spring. Mature forest cover is especially important for the species in the Bulkley Valley.

Abundance

Population estimates for mule deer in the Skeena region are 2,000 to 3,000 animals while white-tailed estimates have been reported at 500 to 1,500 animals (BC MFLNRO 2018). The most recent estimates were provided in the 2017 preharvest season. Both species were estimated to have stable populations in the Skeena region (BC MFLNRO 2018)

In previous surveys and habitat assessments at the Tenas site the TAESCO (1984) report documented the presence of deer using 790 ungulate pellet plots and 764 browse plots stratified by habitat types along 64 transects. They recorded only a low density of deer with pellets encountered on 19 plots, which represented 6 of 20 macrohabitats. The highest density of pellets was seen in logged early successional mixed stands and in deciduous stands. Seasonally in summer pellets were found throughout the study area, but in winter they were confined south-facing slopes of the Telkwa River and old growth forests in the lower Telkwa River floodplain.

Within the larger W-RSA, aerial ungulate counts and ground-based sign surveys were conducted in 1990, as part of Telkwa Coal wildlife assessments north of the Telkwa River (Hatler 1990). This survey documented low densities of deer with highest densities observed in the dry flat pine sites, with a few additional observations on steep aspen dominated south facing slopes, and recently harvested areas.

Harvesting and Mortality

Mule deer and white-tailed deer are both vulnerable to legal hunting and vehicle collisions. In the most recent report from WARS (2012), 187 deer were involved in highway collisions along highway 16 in Northern BC.

Mule deer have been consistently harvested in both MU 6-08 (W-LSA) and MU 6-09 (W-RSA and W-LSA). In the last 20 years a total of 2,593 mule deer, and a total of 255 white-tailed deer have been harvested

from the MUs which overlap with the W-RSA and W-LSA. A peak in mule deer harvesting numbers was observed in 2003 with 164 reported harvested mule deer. In 2016 white-tailed deer harvest observed a peak with 40 harvested individuals.

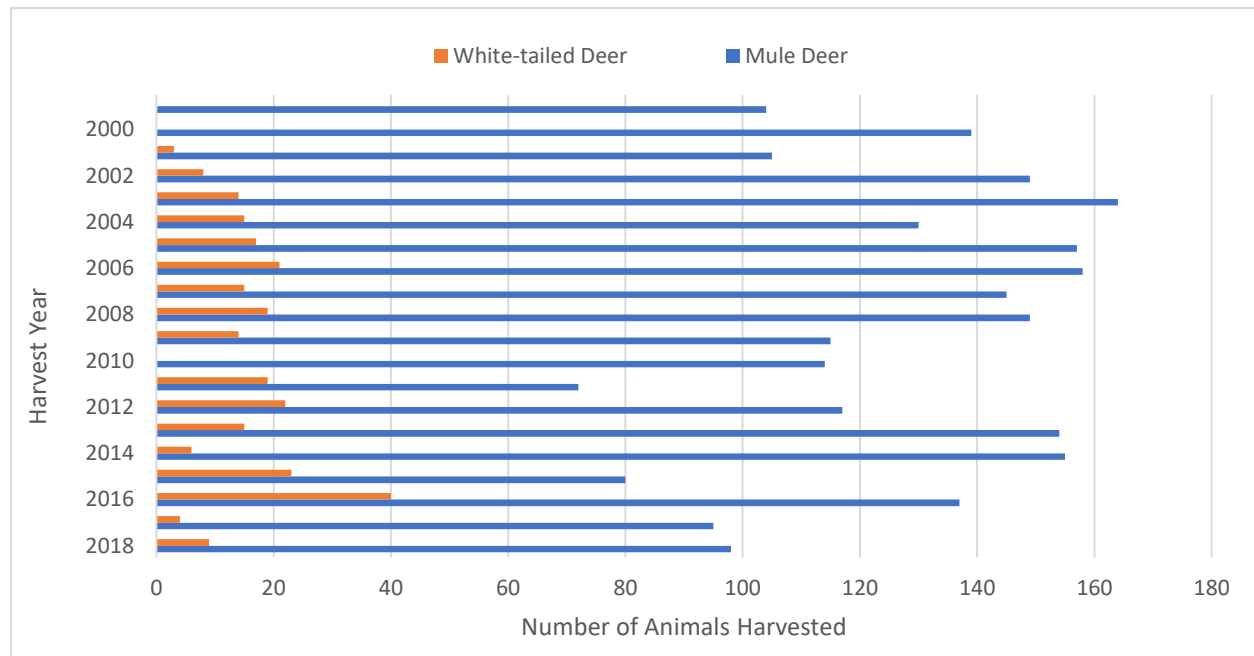


Figure 3.10-1: Total harvest (both resident and non-resident) of mule deer and white-tailed deer per year in MU 6-08 and MU 6-09.

Very little regional data is available which describes natural mortality trends in deer populations. Predation and winter starvation are the main causes of natural mortality for both species and as with other ungulates, fawns and sick individuals are most susceptible (Blood 2000). In their southern counterparts white-tailed deer are largely predated on by cougar (Robinson *et al.* 2002), while the Southern Interior Mule Deer Project reported predation on mule deer primarily from cougar, but also from black bear, wolf, coyote, and possibly grizzly bear (BCWF 2021).

3.10.2 Assessment and Survey Results

Snow Tracking Surveys

Mule deer tracks were observed on two of the snow tracking survey days (Jan. 15 and Feb. 1 in 2018) with an estimated track density of 0.22 TKDSS based on observations of tracks within two transects over three habitat types. Mule deer tracks accounted for less than two percent of the total observed tracks and were only observed in the rail infrastructure area and Goathorn Creek area. No mule deer tracks were recorded in the minesite area during snow track surveys.

Deer snow tracks were mainly observed in mature forest types followed by edge habitats as outlined in Figure 3.10-2, with a much higher track density found within the rail infrastructure than in the lower Goathorn Creek area.

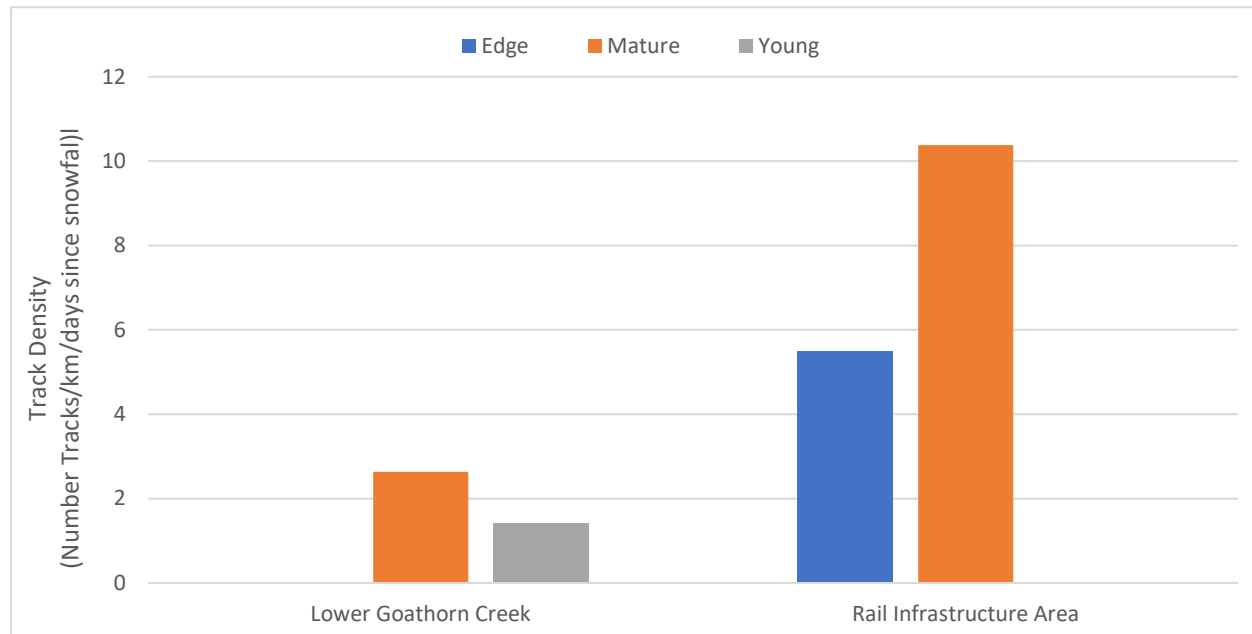


Figure 3.10-2: Deer snow tracks observed during the 2018 snow tracking surveys within the SBSdk subzone of the W-LSA.

Wildlife Cameras

The remote wildlife camera monitoring within the W-LSA identified mule deer as the most common photographed deer species with a total of 64 trigger events. A total of 167 images of mule deer were captured during the 2017 and 2018 remote wildlife camera surveys. Figure 3.10-3 outlines the distribution of photographs obtained at the camera sites during 2017 and 2018, with Camera site 6 capturing 22.1 mule deer photos/100 camera days and the other sites only capturing approximately 5 photos of mule deer / 100 camera days.

There were seven trigger events that resulted in 19 images of white-tailed deer. White-tailed deer were captured on three occasions in June of 2017 at Camera Site 5 (Figure 3.10-4). It was not possible to determine if the images were of different individual animals or not and it is likely that the same animal visited the camera site over those three days. Mule deer images were most frequently captured in June of 2017 (25.0 images/100 days of camera operation) followed by August of 2017 (19.5 images/100 days of camera operation). September captured the most images of mule deer for 2018 with 8.3 images/100 days of camera operation. July for both years was notably less active for mule deer than the other summer months (Figure 3.10-4).

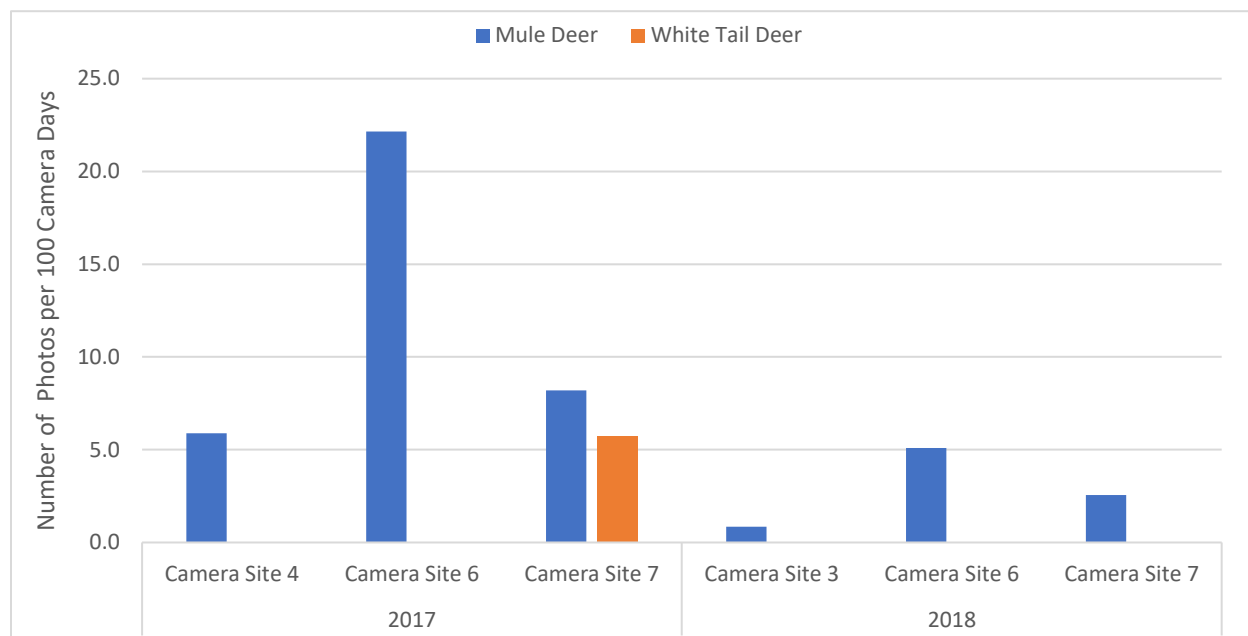


Figure 3.10-3: Photos of deer recorded at each camera site per 100 camera days during 2017 and 2018 within the W-LSA.

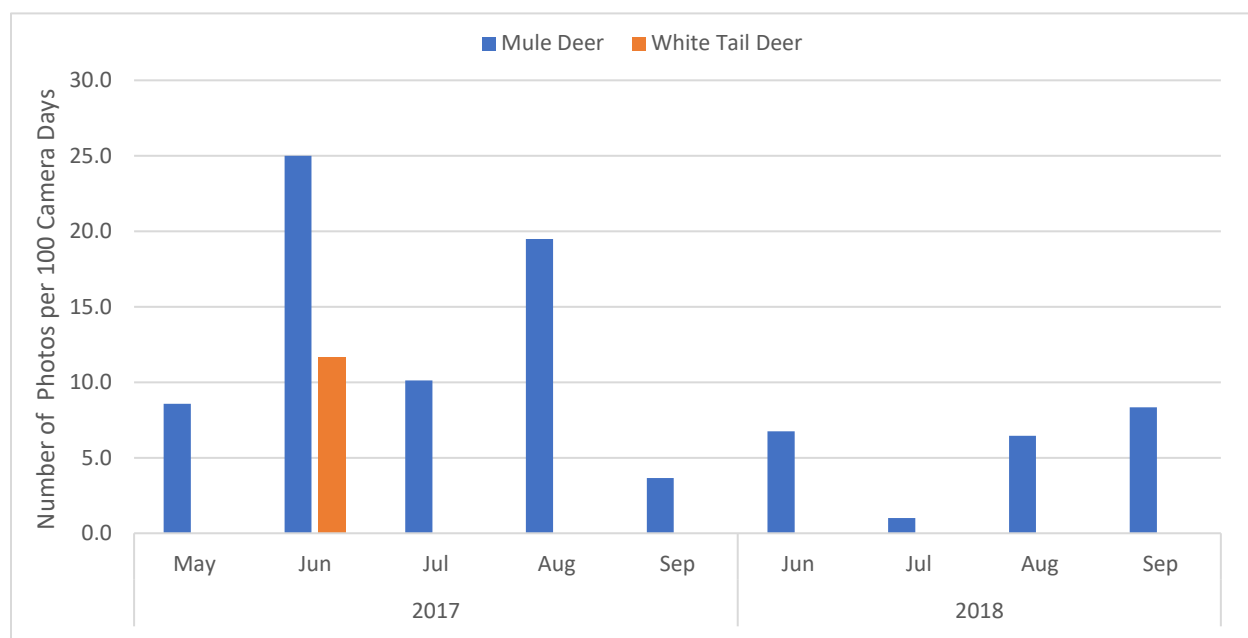


Figure 3.10-4: Photos of deer recorded at all camera sites per 100 camera days for each month and year during 2017 and 2018 within the W-LSA.

On June 3rd 2017 at Camera Site 7, a white-tailed doe was observed fleeing a hunting grey wolf (Plate 3.10-1). In the images, the doe can be seen headed west along the trail at 6:27AM while a wolf can be seen tracking at 11:01AM. At 11:03AM the doe can be seen in midair leap and in the following image, three seconds later, the wolf can be seen pursuing the doe.



Plate 3.10-1: Sequence of photos showing stalking and chasing of white-tailed deer by wolf June 3, 2017 at Camera Site 7.

Wildlife Trail and Incidental Observations

All evidence of use which was designated as generalized deer sign was presumed to be mule deer evidence as mule deer, and mule deer habitats are thought to be much more common in the W-LSA. During the wildlife trail assessments, 8 of 45 plots were found to contain deer sign (tracks, excrement), with 3 trails rated as high use and 3 rated as moderately used. Deer sign observed during the WHA surveys and as incidental sightings are outlined in Table 3.10-1 and were primarily tracks (n = 51), followed by evidence of feeding (n = 28). Almost all of the sign was relatively new (n = 90) as it was either young or fresh, with six observations of deer during the surveys.

Figure 3.10-5 outlines the distribution of the wildlife trails and sign observed within the W-LSA from 2017 to 2019 and shows several trails along the access corridor as well as in minesite areas, with the majority of deer sign found within the minesite area.

Table 3.10-1: Summary of observations of deer sign and activity from WHA plots and incidental observations within the W-LSA from 2017 to 2019.

Sign Age/Type	Type of Sign / Activity / Use							Total
	Bedding	Living ¹	Excrement	Feeding	Grooming	Tracks	Trails	
Visual		3		1		2		6
Fresh	2		3			26	12	43
Young	1		16	2	1	23	4	47
Old		1	2	1				4
Winter			2	1				3
Growing			2					2
Unknown			3	1				4
Total	3	4	28	6	1	51	16	109

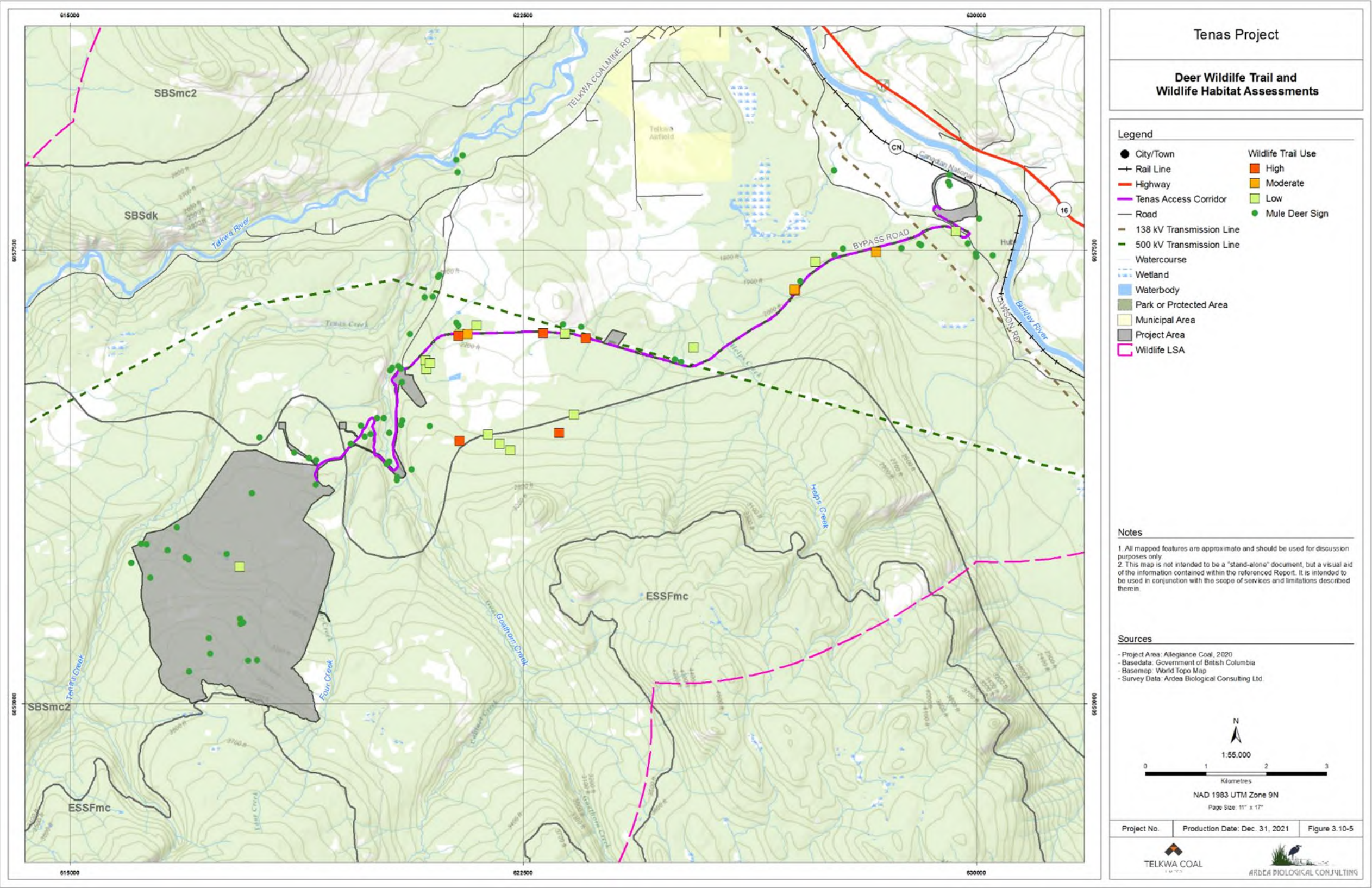
Notes: 1) Living: Activity ambiguous or could not be specified.

Wildlife Habitat Assessments

Habitat suitability ratings were collected for mule deer as part of the Wildlife Habitat Assessment baseline program in case a mule deer habitat suitability model was developed. The results of the WHA ratings are provided in Figure 3.10-6 for growing and winter seasons for the SBSmc2 and SBSdk subzones in the W-LSA. White-tailed WHA data was not collected as a part of this baseline due to the limited extent of the species in the area.

Of the 186 WHA plots performed for mule deer, the majority of deer high value foraging habitat is located in the SBSdk while there is a nearly normal distribution of forage habitat in the SBSmc2 with majority of plots (n=39) having moderate rating. Winter forage is more prevalent in the SBSdk at lower elevations but only nine plots of 186 we rated moderately high or better. For winter forage 41 of 50 winter forage rated plots were rated moderate or low with only nine plots rated as moderately high or higher. No plots were rated as a nil for deer forage habitat suggesting most sites within the W-LSA offer at least very low foraging opportunities.

Mule deer winter forage habitat within the W-LSA were rated primarily moderate to low while growing season forage habitat was moderate to high.



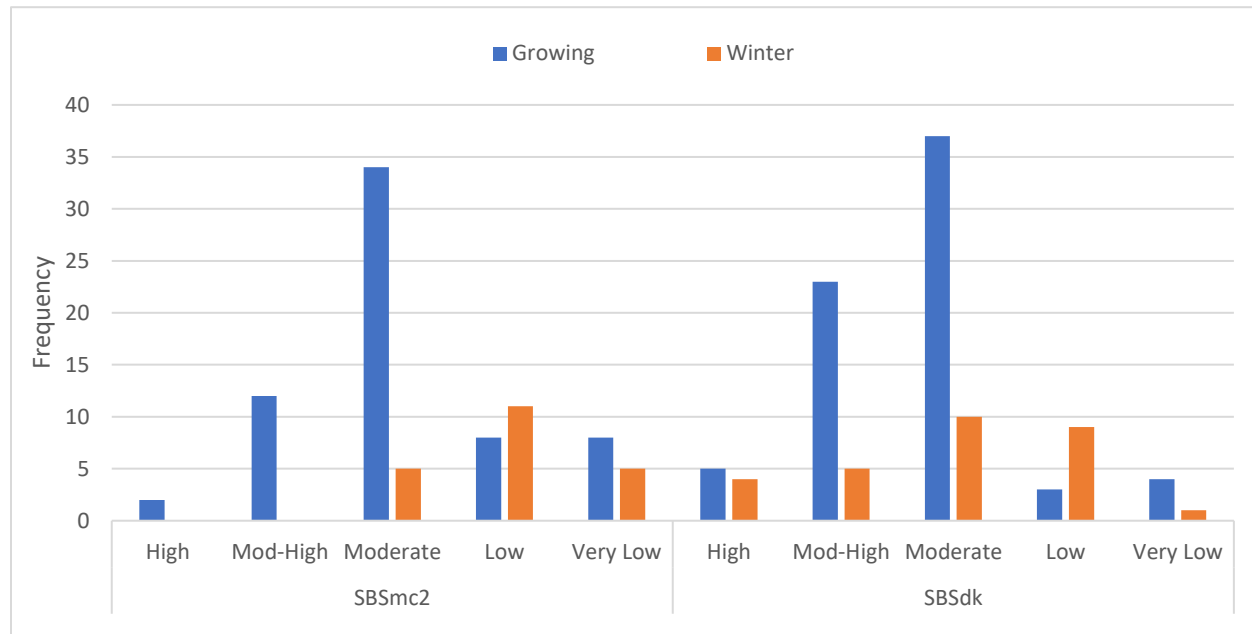


Figure 3.10-6: Summary of mule deer WHA ratings for feeding habitat.

3.11 Mountain Goat

3.11.1 Existing Information on Mountain Goat

Mountain goats (*Oreamnos americanus*) are not true goats, but members of the Family Bovidae, whose closest relatives are in Europe and Asia (Côté and Festa-Bianchet 2003). They are a mountain-dwelling ungulate characterized by extraordinary climbing skills and use of steep terrain to escape predators (MGMT 2010). British Columbia is home to over half of the world's population of mountain goats. While there are currently no recognized subspecies of mountain goats, differences in seasonal habitat use and movement patterns between populations from coastal and interior regions of BC has led to the recognition of "coastal" and "interior" ecotypes (Hebert and Turnbull 1977), with the coastal ecotype found in the W-RSA.

Conservation Context and Management Initiatives

Mountain goats are a Blue listed species (BC CDC 2019) due to an accumulation of low to medium level threats, such as human intrusion and disturbance, mining, renewable energy development, harvesting of timber in winter range, and increased access for predators and hunters along roads and linear corridors (MGMT 2010). The species has not been assessed federally and was considered secure globally when last reviewed in 2016 (NatureServe 2021). The primary management tools for the conservation of the species in BC are a regulated limited entry hunt and the legal designation of UWR within which specified Wildlife Measures must be applied (MGMT 2010).

Distribution and Habitat Use

Mountain goats are found throughout alpine and subalpine areas of BC, covering approximately 40% of the province (MGMT 2010). They occupy a wide variety of mountainous habitat, from rainforests near sea level in coastal areas, to dry interior peaks >3000 m in elevation. Escape terrain is critical for predator avoidance and is characterized by steep slopes generally $\geq 40\%$ of shear or broken cliffs (MGMT 2010). Mountain goats are reluctant to move more than 400 to 500 m from escape terrain, so it is the proximity of forage and escape terrain that defines quality habitat (MGMT 2010). Mountain goats tend to summer in upper elevation

alpine and subalpine ecosystems (Boyd et al. 1986), above an elevation of 1400 to 1500 m. Winter is a critical season for mountain goats and movement is restricted, likely because of the energetic cost of moving through deep snow (Dailey and Hobbs 1989). Coastal ecotype mountain goats typically winter at moderate to lower elevations in forested habitats (MGMT 2010).

Abundance

The estimated population size of mountain goat in BC was estimated in 2012 as 41,000 to 66,000 animals (Shackleton 2013) while the 2017 pre-harvest season estimate was 43,000 to 71,000 animals (BC MFLNRO 2018). The Skeena Region, in which the Tenas Project is located, contains nearly half of BC's population of goats (MGMT 2010). In 2008 it was estimated that goat populations in the Region were stable at 16,000 to 35,000 (MGMT 2010) while the 2017 pre-season estimate was stable at 20,000 to 40,000 animals (BC MFLNRO 2018). A recent review of the current state of knowledge of mountain goat populations in the Skeena Region indicated, however that insufficient inventory studies had been conducted in the Region to estimate current population levels or determine population growth trends (Blythe and Kriss 2018). This review identified seven population units that should be prioritized for inventory based on higher levels of reported hunting, none of which occur in the W-RSA.

3.11.2 Assessment and Survey Results

There is a relatively minor overlap between UWR 6-007 that was established for mountain goat in 2019 and the south-eastern portion of the W-LSA (Figure 3.11-1). Specifically, the overlap includes a section of canyon habitat in the headwaters of Goathorn Creek, and a small section of subalpine/alpine habitat in the Telkwa Mountain Range. A portion of UWR 6-007 along Goathorn Creek was surveyed by helicopter on April 24, 2019, with no mountain goats observed during the flight.

The total area of the overlap between the UWR and the W-LSA is 81.6 ha, amounting to 0.09% of the UWR. The shortest edge-to-edge distance between the UWR and the Project Area is 4.87 km. Given that the maximum distance from the UWR over which the Wildlife Measures extends is 2 km (i.e., no blasting within 2 km during winter and no aircraft activity within 2 km of observed goats), no interactions between the Project and mountain goats were anticipated. As such, no further consideration was given to mountain goats in the assessment of existing conditions in the W-RSA.

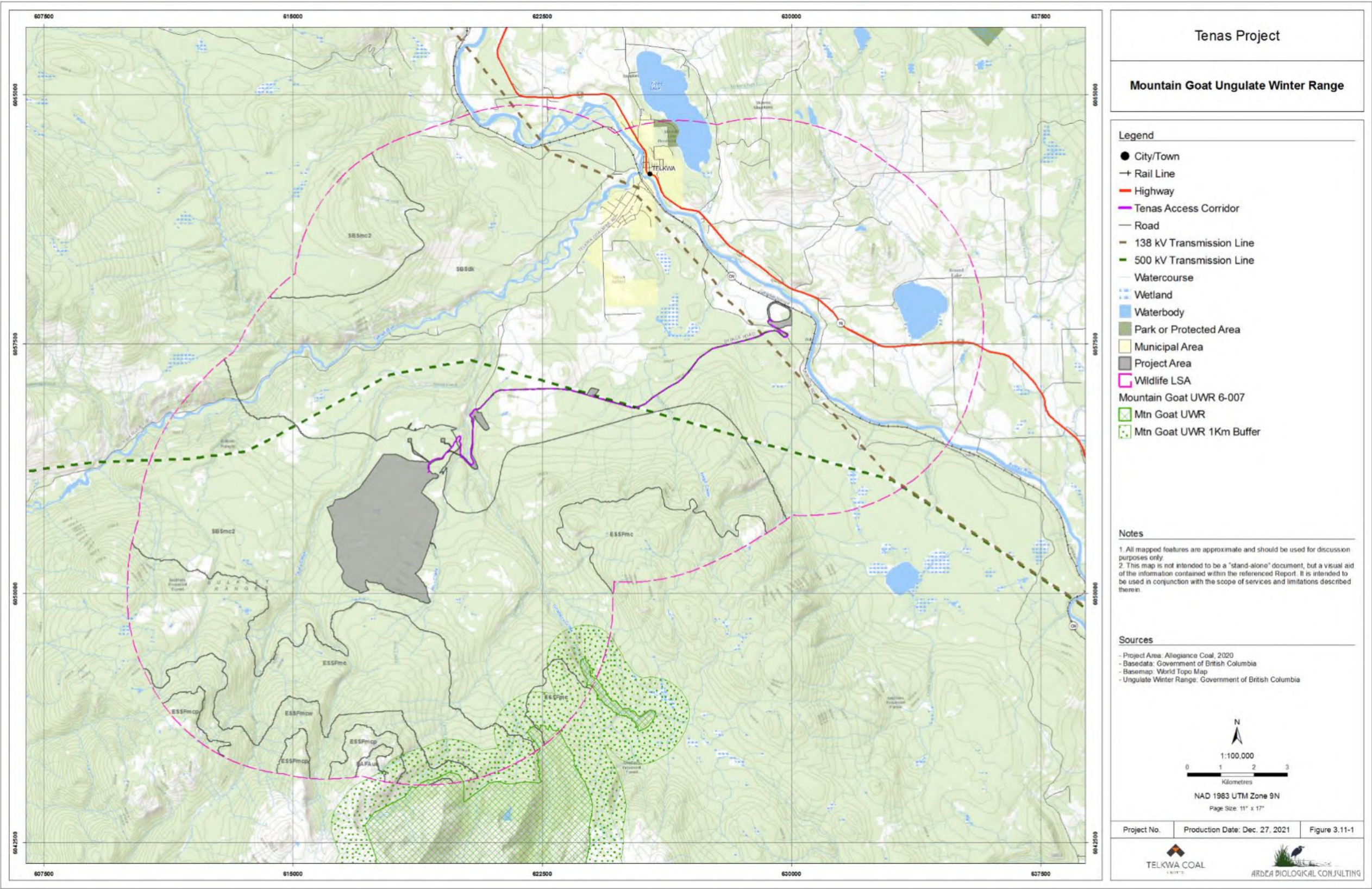


Figure 3.11-1: Location of mountain goat UWR 6-007 within the W-RSA.

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