

RANGE ASSESSMENT AS A CUMULATIVE EFFECTS MANAGEMENT TOOL:

ASSESSMENT OF THE CARCROSS CARIBOU HERD RANGE IN YUKON

Prepared for:
Environment Yukon
Fish and Wildlife Branch
Regional Programs

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Assessment of the Carcross Caribou Herd Range in Yukon

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Prepared for:

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Fish and Wildlife Branch

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SUMMARY

1. Background

The Carcross caribou herd (hereafter the Carcross herd) is a population of northern mountain ecotype woodland caribou (*Rangifer tarandus caribou*) (COSEWIC 2011) that resides in the Southern Lakes region of south-central Yukon and northern British Columbia (**Figure S1**). It is one of 26 northern mountain woodland herds recognized in Yukon (Hegel and Russell 2013). Northern mountain woodland caribou range through parts of northern British Columbia, Northwest Territories, Alaska and Yukon. Northern mountain caribou were listed as a species of Special Concern under the federal *Species at Risk Act* in 2005, and its Special Concern status was reconfirmed in a recent assessment (COSEWIC 2014).

The Carcross herd, together with the Atlin and Ibex herds, are three distinct and relatively independent woodland caribou herds that collectively comprise the Southern Lakes caribou herds. These three herds are considered to be the small and fragmented remains of a population that was once large and healthy. Oral history indicates that prior to the Klondike Gold Rush there were thousands of caribou inhabiting the Southern Lakes region. Their distribution extended west of Kusawa Lake, and caribou crossed the narrows near the community of Carcross in large numbers.

During the Gold Rush, many Southern Lakes caribou were commercially harvested to feed the burgeoning human population, and in Yukon, low levels of harvesting continued until the 1980s (a small harvest still occurs in British Columbia). By the early 1990s, the Carcross herd had been reduced to approximately 400 animals. In 1992, concern over declining caribou numbers in the Southern Lakes area led to the formation of the Southern Lakes Caribou Steering Committee (originally called the Carcross Caribou Recovery Team). The community-based Southern Lakes Caribou Recovery Program (originally called the Carcross Caribou Recovery Program) stopped most hunting through a seasonal closure for licensed Yukon hunters, and First Nations implemented a voluntary harvest closure. Since 1997, the population size of the Carcross herd has roughly doubled to 775 (Hegel and Russell 2013).

It is unlikely that the caribou population will ever recover close to historic levels, as over the past decades parts of the Southern Lakes region have been transformed through human settlement and land use. The Carcross herd shares a landscape with the City of Whitehorse, several smaller communities, and many nodes of dispersed country residential properties—approximately 80% (29,000) of the Yukon's total population lives within the Carcross herd range. These areas, in combination with agriculture, transportation, industrial, tourism and recreational land uses, have removed or affected large portions of the winter range, and many once remote areas have become accessible to people.

While harvest limitations to most user groups have been successful from a population recovery perspective, the herd remains vulnerable to the human-caused cumulative effects of habitat loss, conversion and fragmentation, and caribou-vehicle collisions and sensory disturbance.

2. Purpose

This range assessment identifies key risk factors and provides recommendations for maintaining the integrity of the Carcross herd's seasonal habitats and known migration routes, and reducing population-level impacts. This assessment and its recommendations apply to the Yukon portion of the Carcross herd annual range. It contributes to fulfilling recommendation 2.18 of the Southern Lakes Wildlife Coordinating Committee Southern Lakes Regional Wildlife Assessment (SLWCC 2012a) regarding Southern Lakes caribou herds.

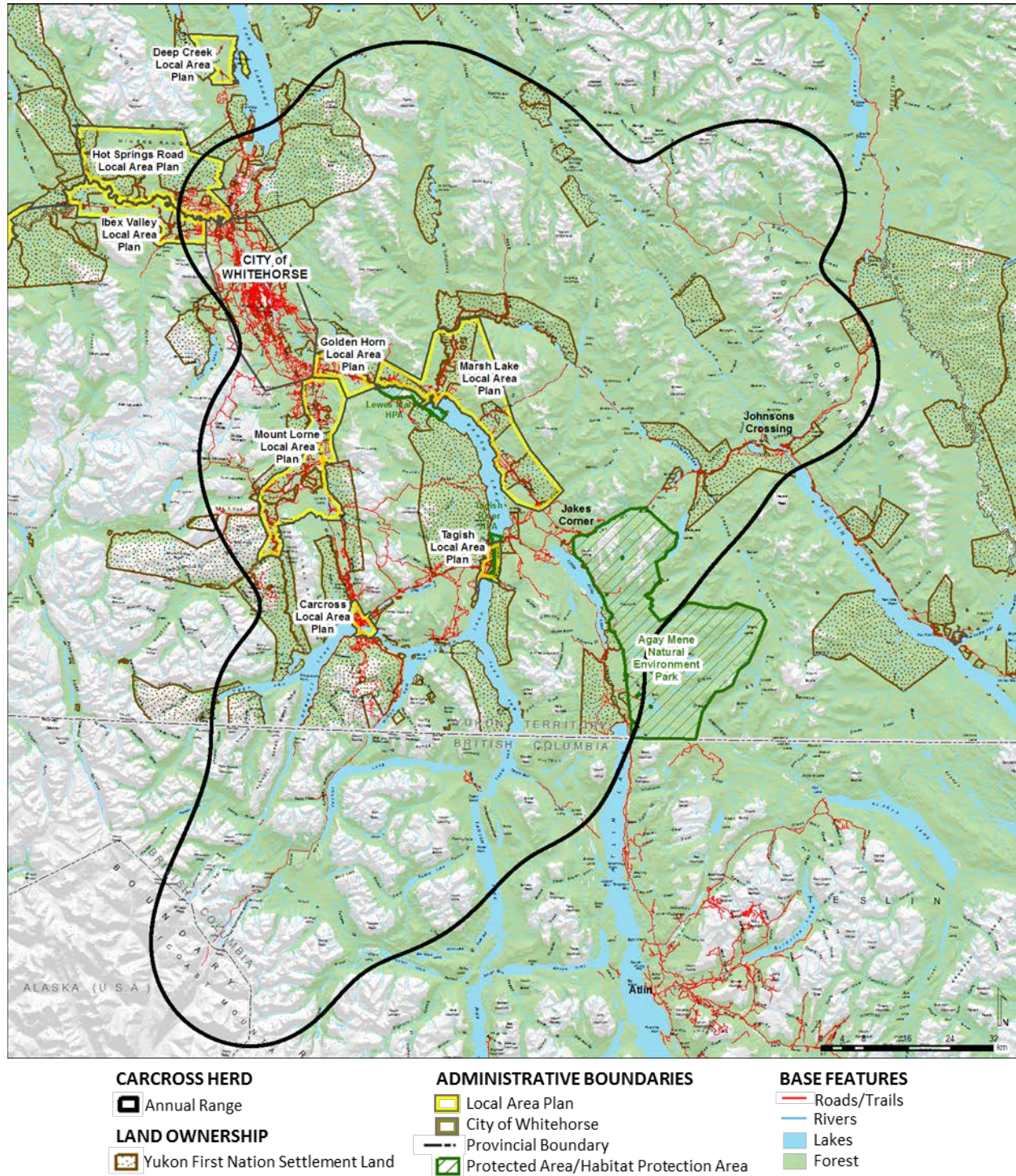


Figure S1. Annual range of the Carcross caribou herd in Yukon and British Columbia.

3. Risk Assessment Summary

Despite the recent recovery to a population size of 775 animals with a stable trend (Hegel and Russell 2013), the Carcross herd is still vulnerable as the habitat and the caribou themselves will likely be subject to continued and increasing stressors. Current risk factors on habitat are related to an expanding human footprint (largely from incremental residential, agricultural and industrial land parcels), resulting in permanent loss of winter range habitat, and high levels of human access (and potential sensory disturbance). Currently:

- 15% (2,602 km²) of the annual range has been directly or indirectly affected by human activities. However, 97% (196 km²) of the total direct human development footprint and 87% (1,593 km²) of the total human zone of influence affects the low elevation, forested winter range.
- 58% (474 km²) and 41% (295 km²) of the Whitehorse and Golden Horn-Mount Lorne areas, respectively, have been directly or indirectly affected by human activities. Given the extent and nature of development, many of these areas have been permanently lost from the winter range.
- Recent wildfires are an additional source of habitat disturbance. Ten percent (822 km²) of the winter range has been affected by fire since 1946. Some of the burned areas have been very slow to regenerate. The Southern Lakes region receives active wildfire control and given the length of time some areas have escaped burning, there is now the potential for a large, catastrophic fire event.
- 21% (2,602 km²) of the annual range and 29% (2,302 km²) of the winter range have been affected by the combined effects of human and wildfire disturbance.

Given the current situation, it is likely that the Yukon portion of the Carcross herd range contains the highest level of direct and indirect human-caused habitat impacts of any woodland caribou herd range in Yukon. Our assessment suggests that when combined with the potential for increased wildfire (Weber and Flannigan 1997; Farnell 2009), total disturbance within the caribou range will likely increase resulting in a reduction in functional habitat with negative implications to population potential.

This risk assessment suggests that the Carcross herd has relatively low ecological resilience, which is a state that the herd will likely continue into the future. Low resilience means that the caribou herd and the range have limited capacity to absorb additional stressors that reduce habitat conditions (i.e., amount, effectiveness and availability, and/or connectivity) or risk factors that directly affect the population itself through increased rates of mortality and/or decreased productivity. This vulnerability and reduced resilience is largely due to the cumulative and interacting effects of:

- Incremental and permanent habitat loss due to rural residential, agricultural and industrial development, and associated transportation features, primarily within the low elevation forested winter range (Florkiewicz et al. 2007);
- Increased disturbance and loss of habitat effectiveness resulting from:
 - timber and fuelwood harvesting;
 - an expanding road and trail network;
 - high levels of motorized and non-motorized recreational trail use; and
 - increasing demand for backcountry recreation opportunities from a large and growing human population in Whitehorse, the surrounding Southern Lakes communities, and tourism (Florkiewicz 2008);

- Ongoing and potentially increasing sources of mortality from vehicle collisions (Florkiewicz 2008; Hegel and Russell 2013); and
- A changing climate, and its effect on the frequency and magnitude of:
 - anomalous winter or spring weather events and snow conditions; and
 - severe wildfire events (and potentially insect outbreaks affecting forest ecosystems). Combined with the legacy of fire suppression, this contributes to an increased risk of large scale wildfire that would not only be damaging to human infrastructure, but could potentially eliminate a large area of caribou winter range in a single event (Farnell 2009).

Of these factors, human-caused habitat loss and disturbance within the winter range is likely the primary factor that can be managed through current and future land use planning, disposition, and assessment processes.

4. Key Recommendations

Appendix A contains a series of large scale maps and tables summarizing levels of disturbance, habitat effectiveness, land ownership and area-specific recommendations within each of eight caribou assessment areas.

4.1. Habitat-related Recommendations

Given the high level of existing habitat impacts in the southern portion of the Carcross herd winter range, the long-term integrity of these areas will depend on achieving the following:

HABITAT GOAL: Maintain the Yukon portion of the Carcross herd annual range in a condition that will support the current or an increasing caribou population size.	
Habitat Objective 1	Maintain the amount of remaining large, intact patches of high value winter habitat in the Yukon portion of the Carcross herd range.
Habitat Objective 2	Maintain or increase the amount and effectiveness of remaining habitat in the Yukon portion of the Carcross herd winter range.
Habitat Objective 3	Maintain functional migration routes between priority core winter habitat areas, and between the summer and winter ranges.

To achieve Habitat Objectives 1 and 3, **Priority Core Winter Habitat Areas** (represented by 14% of the Yukon portion of the annual range) and **Priority Migration Areas** have been identified. These areas provide specific, place-based recommendations to achieve landscape-scale habitat objectives. Managing new land dispositions (i.e., private land parcels) and permanent human development are the key strategies required to maintain the priority areas in a condition that will support ongoing caribou use.

Habitat Objective 2 focuses on maintaining or improving the effectiveness of remaining winter range habitats, particularly within and around areas already impacted by human development. To minimize

the spatial extent of human-caused habitat impacts, new private land parcels and residences should be located adjacent to existing parcels (i.e., within the existing human zone of influence), and to the extent possible, they should be located in areas of lower quality winter habitat. Temporary land use activities (e.g., fuel wood harvesting) should not be conducted during the late winter period (January 1 – April 15). Habitat reclamation and enhancement may also contribute to maintaining or increasing the amount and quality of winter habitat.

4.2. Population-related Recommendations

Caribou mortality resulting from vehicle collisions is currently the largest source of direct human-caused mortality in the Yukon portion of the Carcross herd range. Three areas are of particular concern: 1) Judas Creek-Jakes Corner, 2) Golden Horn-Mount Lorne-Lewes Marsh, and 3) Tagish-Crag Lake. These areas are also intersected by **Priority Migration Areas**. Achieving the following objective will assist in reducing direct human-caused population impacts:

POPULATION GOAL: Avoid a decline in the Carcross herd population.	
Population Objective 1	Decrease the number of vehicle-caused caribou mortalities in the Carcross herd winter range.

Existing efforts focusing on education and driver awareness, improved signage and the development of other caribou-road safety techniques should be continued. However, it should be recognized that collisions with vehicles will continue to be a source of mortality to Carcross herd caribou, and may increase with increasing traffic levels, despite attempts for additional mitigation.

5. Implementation and Monitoring

Other plans (e.g., local area planning, forest management planning, regional land use planning, etc.), specific project reviews during YESAA and non-YESAA processes, and other initiatives (e.g., land use policy development and implementation) are intended to be the main implementation mechanism for recommendations contained in this range assessment. This assessment is intended to complement and support these exercises by identifying management concerns in specific areas, and to provide recommendations that can then be considered during those other processes. Recommendations for ongoing or periodic monitoring of important caribou habitat and population, and land use-related indicators, are provided.

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Glossary

Annual Range: The total area used or occupied by a woodland caribou herd. The Carcross herd annual range boundary was defined by the extent of all radio and GPS-collar locations for the period 1996-2013. The Carcross herd annual range is 15,494 km² and includes areas in Yukon and British Columbia. The Yukon portion of the annual range is 12,237 km² (79% of the annual range), and includes most of the herd's winter range.

Caribou Assessment Area: A part of the annual range used for more detailed assessment of disturbance, habitat, land use, land ownership or other factors affecting caribou. Eight assessment areas within the Yukon portion of the Carcross herd annual range have been identified.

Core Winter Range: The most intensively used part of a winter range by woodland caribou. The Carcross herd core winter range boundary was defined by the extent of all radio and GPS-collar locations for the period 1996-2013, for the period December 1 – April 15. The Carcross herd core winter range represents 34% (4,104 km²) of the Yukon portion of the annual range.

Fragmentation (habitat): The process by which habitats are increasingly divided into smaller units. Habitat fragmentation results in increased isolation of habitat patches, reduced habitat areas, and smaller habitat patches with reduced interior area.

Habitat Effectiveness: The degree to which a patch of habitat is able to support an animal or group of animals (i.e., the value of a habitat). Habitat effectiveness incorporates the concepts of habitat quality (the physical or vegetation characteristics of the habitat), accessibility (the ability of an animal to gain access to and utilize the habitat), and disturbance (the amount of human-caused sensory or other disturbance affecting the habitat). A habitat with high effectiveness is of good quality, is accessible, and is not influenced by human or other disturbance.

Habitat Quality: The ability of the habitat type to provide necessary life functions to a wildlife species, based on its physical or vegetation characteristics. For the Carcross herd, high quality winter range habitats have a high abundance of ground lichens and occur in areas with relatively low snow depths. In the low elevation, forested winter range of the Southern Lakes region, mature pine-lichen or mixed pine/spruce-lichen forest types occurring on coarse-textured soils or landforms of glacio-fluvial origin generally provide the highest quality winter habitats.

Human Development Footprint: The area directly disturbed by human development and land use activities (e.g., roads, gravel pits, residential lots, agricultural fields, etc.). The human development footprint results in the physical loss or alteration of wildlife habitat.

Human Zone of Influence (ZOI): The area around a human development footprint that is indirectly influenced by the human activities. Sensory disturbance, increased mortality risk or similar factors may influence the use of areas by wildlife adjacent to human developments. Wildlife may avoid or use areas less intensively within the ZOI, resulting in indirect habitat loss and reduced habitat effectiveness.

Linear Density: the total length of all human-created linear features, such as roads, trails, survey lines, utility corridors, and similar (measured in km), within a defined area. Linear density is expressed as km of features per unit of area (km/km²). It provides a measure of landscape fragmentation and the potential level of human access within an area.

Potential Winter Range: the area of winter range that was potentially available to caribou historically, prior to European settlement. In the Carcross herd range, this would have included all of the currently developed areas in the low elevation valleys of the Southern Lakes region. Large lakes (Marsh, Tagish, Bennett, Little Atlin, and Laberge) are not considered part of the potential winter range.

Priority Core Winter Habitat Areas: Remaining patches of large, relatively intact, high value winter habitat that provides secure areas for continued caribou use within the Carcross herd winter range.

Priority Migration Areas: Areas with a high level of documented fall and spring use for caribou migration, typically when caribou are moving between their summer and winter ranges. In the Carcross herd winter range priority migration areas are where caribou cross major roads, and are therefore locations with the highest recorded number of vehicle-caused caribou mortalities.

Resilience (ecological): The capacity of an ecosystem or species to absorb disturbance and still retain essentially the same function and structure. For woodland caribou, a resilient population is able to recover from natural and human-caused disturbances, and be self-sustaining within a range of natural variation.

Summer Range: The areas used most intensively by woodland caribou during the calving, post-calving and fall rut period. For Carcross caribou this represents the period late-May to early-October. In the Carcross herd annual range, subalpine and alpine plateaus greater than 1,200m in elevation (above treeline) forms the summer range. The summer range covers 32% (3,885 km²) of the Yukon portion of the annual range.

Special Management Area: an area identified and established within a Yukon First Nation traditional territory pursuant to Chapter 10 of the Umbrella Final Agreement and may include:

- a) national wildlife areas;
- b) National Parks, territorial parks, or national park reserves, and extensions thereof, and national historic sites;
- c) special wildlife or fish management areas;
- d) migratory bird sanctuaries or a wildlife sanctuary;
- e) Designated Heritage Sites;
- f) watershed protection areas; and
- g) such other areas as a Yukon First Nation and Yukon Government agree from time to time.

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1 INTRODUCTION

1.1 Background

The Carcross caribou herd (hereafter the Carcross herd) is a population of northern mountain ecotype woodland caribou (*Rangifer tarandus caribou*) that resides in the Southern Lakes region of south-central Yukon and northern British Columbia (**Figure 1**). Northern mountain woodland caribou range through parts of northern British Columbia, Northwest Territories, Alaska, and the Yukon; they were assessed in 2002 by the Committee on Status of Endangered Wildlife in Canada (COSEWIC), and subsequently listed as a species of Special Concern under the federal *Species at Risk Act* in 2005. In response, the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada (Environment Canada 2012) has been developed¹. A recent assessment reconfirmed their *Special Concern* status (COSEWIC 2014).

1.1.1 A Recovering Caribou Population

The Carcross herd, together with the Atlin and Ibex herds, are three distinct and relatively independent woodland caribou herds that collectively comprise the Southern Lakes caribou herds. These three herds are considered to be the small and fragmented remains of a population that was once large and healthy. Oral history indicates that prior to the Klondike Gold Rush there were thousands of caribou inhabiting the Southern Lakes region. Their distribution extended west of Kusawa Lake, and caribou crossed the narrows near the community of Carcross in large numbers.

During the Gold Rush, many Southern Lakes caribou were commercially harvested to feed the burgeoning human population, and in Yukon low levels of harvesting continued until the 1980s (a small harvest still occurs in British Columbia). By the early 1990s, the Carcross herd had been reduced to approximately 400 animals. In 1992, concern over declining caribou numbers in the Southern Lakes area led to the formation of the Southern Lakes Caribou Steering Committee. The community-based Southern Lakes Caribou Recovery Program stopped most hunting through a seasonal closure for licensed Yukon hunters, and First Nations implemented a voluntary harvest closure². Since 1997, the population size of the Carcross herd has roughly doubled³.

¹ While the Management Plan for the Northern Mountain Population of Woodland Caribou in Canada (Environment Canada 2012) provides a general assessment and management strategies for all identified northern mountain herds in Canada, the development of range-specific goals and management recommendations is required, particularly for at risk herds.

² A licensed harvest of 5-10 animals (bull only)/year continues in the British Columbia portion of the range.

³ In 2008, the year of the most recent population survey, the herd was estimated at 775 animals.

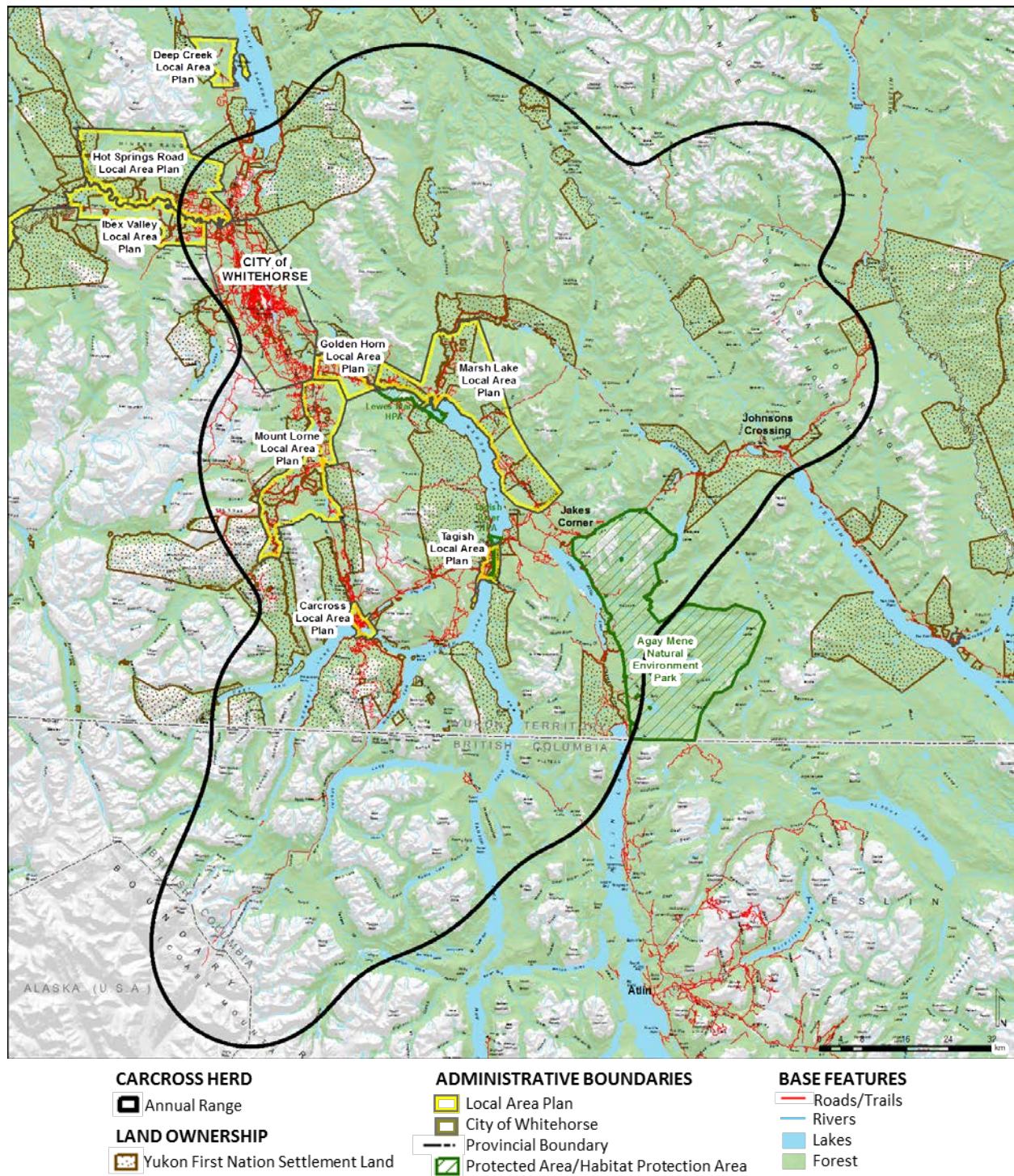


Figure 1. Annual range of the Carcross caribou herd in Yukon and British Columbia.

However, it is unlikely that the caribou population will ever recover close to historic levels, as over the past decades the Southern Lakes region has been transformed through human settlement and land use. Since the 1950s, the human population and development footprint in the herd's range has grown substantially. In 1960, 8,000 people lived in the Whitehorse area (Lotz 1965). In 2012, the regional population was approximately 29,000 (Yukon Bureau of Statistics 2013), representing 80% of the Yukon's total resident population. The Carcross herd shares a landscape with the City of Whitehorse, several smaller communities, and many nodes of dispersed country residential properties. These areas, in combination with transportation, agriculture, industrial, tourism, and recreational land uses, have removed or affected large portions of the range, and many once remote areas have become accessible to people.

While harvest limitations to most user groups have been successful from a population perspective, the herd remains vulnerable to the human-caused cumulative effects of habitat loss, conversion and fragmentation, caribou-vehicle collisions, and sensory disturbance. The potential influence of a warming climate, particularly for natural disturbances such as wildfire and forest insects, may also be an important consideration for future management of the herd.

1.1.2 Need for a Long-term Habitat Management Strategy

Intact functional habitat at a landscape scale is a fundamental requirement for self-sustaining caribou herds to persist in future decades, and to be healthy and resilient to human and natural disturbance factors. In the past 100 years woodland caribou across Canada have declined significantly and some populations have been extirpated. Despite the general understanding that habitat conservation is critical to woodland caribou, the key issue affecting herds across the boreal forest continues to be the incremental loss of functional habitat due to human land use (see Thomas and Grey 2002, Schaefer 2003, Vors et al. 2007).

For the Carcross herd, a long-term habitat management strategy is therefore required to maintain and restore: a) adequate and accessible amounts of functional habitat in large, intact patches, and b) connectivity between habitat patches and seasonal ranges (Florkeiwicz et al. 2007, SLWCC 2012a). In the Carcross herd range, the need for a landscape-level habitat management strategy is required for the following reasons:

1. Habitat Loss, Avoidance and Fragmentation

- Northern mountain woodland caribou require intact winter ranges with adequate ground lichen resources to sustain them during the critical late winter period. In the Southern Lakes region, almost all human development has occurred in the winter range of the Carcross herd. Additionally, much of this development is located in mature pine and spruce stands with the most abundant lichen resources (Florkeiwicz et al. 2007). Therefore, the direct incremental impact of human development on habitat loss and function has been disproportionately high.
- The high level of human activity within the range, particularly along the main road corridors, settlements, and high use recreational trails/locations, results in indirect habitat loss or a decline in habitat effectiveness. Human land use activities create sensory disturbances (i.e., noise) that result in avoidance or reduced use of habitats by caribou in proximity to these features. This human 'zone of influence' expands the effects of human land use well beyond the physical footprint of human developments.

- The southern portion of the Carcross herd winter range is bisected by two primary road corridors, the Alaska Highway and South Klondike Highway. A number of secondary and rough roads further criss-cross the area, and most human development and residential areas are clustered along these roads. Over time, the habitat fragmentation caused by roads and other developments may result in several smaller groups of caribou using discrete portions of the annual range, with reduced migration between them.

2. Vehicle Collisions

- The main roads also create a high risk of mortality from vehicle collisions during the spring and fall migration periods, and when the caribou are on their winter range. Approximately 65% of the caribou killed by vehicle collisions are pregnant females, resulting in heightened impacts to calf recruitment and population growth. While the number of recorded caribou-vehicle collisions has declined, this remains the highest source of human-caused mortality in the Yukon portion of the range.

3. A Complex Land Management and Administration Regime

- The Carcross herd resides in an area with a complex land management regime—there is a mosaic of Government of Yukon public lands, Yukon First Nation Settlement Lands, the City of Whitehorse municipal boundary, and hundreds of other private and titled land parcels. Public lands managed primarily by Government of Yukon comprise 77% of the Carcross herd range. First Nation Settlement Land represents 21% of the area, with private or titled lands accounting for the remaining 2%. Most private lands are within or around the City of Whitehorse. Local Area Plans are in place for some communities and a variety of Development Area Regulations apply to other locations.
- Outside of the City of Whitehorse municipal boundary and in areas with approved Local Area Plans, the current land disposition process is generally based on a system of spot land applications where access to land parcels is requested, assessed and granted or denied individually. This creates challenges for caribou habitat conservation as each land parcel has the potential to be located in important habitats or migration routes. In this situation, each parcel becomes a potential point of contention between wildlife managers, land managers, First Nations, and the public.

4. Competing Conservation and Land Development Goals

- The Southern Lakes Caribou Steering Committee, along with the Carcross/Tagish, Kwanlin Dün and Ta'an Kwäch'än First Nations, have established a goal of increasing the Southern Lakes caribou herd population to a level where they can once again support low levels of sustainable harvest. Since 1992, First Nations have voluntarily stopped harvesting to assist in achieving this goal of increasing the herd's population.
- Yet the level of habitat disturbance in the winter range resulting from human land uses—urban and rural residential, forest harvesting, mineral exploration, transportation and recreation—continues to increase. Without changes to current land use practices and land disposition approaches, it is unlikely that the range will be able to support an increasing caribou population to allow a return to a limited harvest in the future.

1.2 Purpose

This range assessment summarizes existing information for the Yukon portion of the Carcross herd range. It identifies key risk factors and provides management objectives, recommendations and strategies for maintaining the integrity of the herd's seasonal habitats, maintaining known migration routes, and reducing population-level impacts. In **Section 5**, two types of management recommendations are provided:

- General strategies that apply to the entire range; and
- Recommendations that apply to specific parts of the range.

The intended audience for this assessment is project-level assessors and other land and resource managers and decision-makers. Its purpose is to assist with evaluating and managing the effects of ongoing and proposed human land use activities within the Carcross herd range, with a focus on habitat management. This document also provides guidance for future data collection and monitoring programs.

The Carcross herd range assessment also contributes to fulfilling recommendation 2.18 of the Southern Lakes Regional Wildlife Assessment, which was completed by the Southern Lakes Wildlife Coordinating Committee (SLWCC 2012a): *“Carefully manage human use of caribou habitats, with a particular focus on limiting access, development and human disturbance in important caribou habitat.”*

1.3 Scope of the Range Assessment

This range assessment was prepared by Environment Yukon in response to an immediate need to provide habitat management guidance for the Carcross herd range to Yukon land managers in land use planning and land use decision-making processes. The assessment is based on prior Environment Yukon technical studies and publications. The range assessment recommendations and management strategies only apply to the Yukon portion of the Carcross herd range. However, the British Columbia portion of the range is considered while discussing risk factors that affect the herd, particularly harvest.

This range assessment is not intended to replace regional land use planning or other future planning exercises (e.g., forest management or Local Area Planning) within the Yukon portion of the Carcross herd range. Rather, it is intended to complement and support these exercises by identifying management concerns in specific areas and providing recommendations that can then be considered during those other planning exercises. Other plans, specific project reviews, and other initiatives are intended to be the main implementation mechanism for the recommendations.

1.4 Report Organization

The Carcross herd range assessment has six major parts:

1. Section 1 provides context and purpose for the range assessment;
2. Section 2 outlines the project methods;
3. Section 3 describes the setting and seasonal habitats of the range, and the population and habitat status of the Carcross herd;
4. Section 4 is an assessment of the major habitat and population factors affecting the herd, and the potential risks they pose to the herd's long-term viability;
5. Section 5 provides management recommendations to address the major factors and risks affecting the Carcross herd; and
6. Section 6 outlines considerations for implementation and monitoring.

The concept of **Caribou Assessment Areas** has been introduced to provide a better understanding of disturbance and habitat conditions in different parts of the range, and to provide area-specific recommendations. **Appendix A** contains information for each of the eight caribou assessment areas. Disturbance, habitat and land ownership summary tables, and larger scale maps for the annual and seasonal ranges for the Yukon portion of the Carcross herd range, are shown.

Different readers may find different parts of the report of interest. **Sections 4 and 5, and Appendix A,** are intended for project assessors and land managers.

2 METHODS

This assessment draws heavily from a large body of prior studies and Environment Yukon technical work including: O'Donoghue (1996), Farnell et al. (1998), Florkiewicz et al. (2007), Florkiewicz (2008), Farnell (2009), the Southern Lakes Wildlife Coordinating Committee (SLWCC 2012a and 2012b), and Hegel and Russell (2013). It also considers and reflects the broad management goals, objectives and recovery measures that have been recommended in the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada (Environment Canada 2012).

Range assessment methodology generally follows Francis et al. (2013) and is consistent with the Canadian Boreal Forest Agreement Methodological Framework (Antoniuk et al. 2012), and the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada (Environment Canada 2012). Disturbance-based risk assessment methodology generally follows Environment Canada (2011) but has been adapted to consider northern mountain caribou ecology.

2.1 Spatial Information

The disturbance-based risk assessment methodology of Environment Canada (2011) relies on spatial information. The following sources were utilized:

2.1.1 Carcross Herd Range Boundaries

The Carcross herd annual range is represented by a smoothed home range polygon containing 99% of GPS radio-collar locations collected from 28 adult female caribou for the period 1999 – 2011. The core winter range polygon was developed from the same caribou location information but only for the winter period (December 1 – April 15). The summer range boundary was developed by using a 90m digital elevation model and selecting areas greater than 1,200 m elevation, which generally represent areas above treeline with subalpine or alpine habitat conditions. Potential winter range is defined as all areas less than 1,200 m elevation, excluding the large lakes of the Yukon portion of the Southern Lakes region (Marsh, Tagish, Bennett, Little Atlin, and Laberge).

2.1.2 Caribou Assessment Areas

Eight caribou assessment areas were created to better understand levels of disturbance and potential management issues in different parts of the Yukon portion of the Carcross herd annual range. The eight assessment areas are:

1. City of Whitehorse and Surrounding Area;
2. Golden Horn - Hamlet of Mount Lorne;
3. Carcross - South Klondike Highway - Bennett Lake;
4. Marsh Lake - Lewes Marsh;
5. Tagish - Taku Arm;
6. Atlin Road - Jakes Corner - Johnsons Crossing ;
7. Squanga Lake - Michie Creek - M'Clintock Lakes; and
8. Teslin River - South Canol Road.

The caribou assessment areas were digitized manually by considering human land use patterns and administrative boundaries (i.e., communities, existing land ownership, land management and land use), and caribou habitat conditions. **Appendix A** contains an overview map of the assessment areas, as well as larger scale maps and tables summarizing levels of disturbance, habitat effectiveness, land ownership, and area-specific recommendations for each caribou assessment area.

2.1.3 Human Development Footprint and Zone of Influence Mapping

Human footprint mapping used in this assessment incorporates the human development mapping products of AEM (2004) and Wildlife Conservation Society (2012). Areas with missing human footprint mapping in the City of Whitehorse-Hot Springs Road-Lake Laberge areas were mapped as part of this range assessment. From these three products, a consistent human development footprint map for the Carcross herd annual range within Yukon was produced, current to approximately 2013. Human zone of influence buffers were identified around human development features following Florkiewicz et al. (2007), based on prior studies completed by AEM (2004).

2.1.4 Land Ownership, Land Use and Administration

First Nation Settlement Lands, private or titled land parcels, municipal and local area plans, parks and protected areas, mineral claims and permits (quartz and placer), and Timber Harvest Plan boundaries were obtained from the Geomatics Yukon geospatial data warehouse or were provided by Government of Yukon departments. All land ownership, land use, and administrative boundaries used in the analysis were current as of February 2014.

3 THE CARCROSS HERD RANGE

3.1 Setting

The Carcross herd annual range is within the Southern Lakes region of south-central Yukon and northern British Columbia (**Figure 1**). The annual range is 15,494 km², with the Yukon portion accounting for 79% (12,237 km²) of the total area.

3.1.1 Biophysical Setting

The Carcross herd range is a transitional mountain landscape between the Coast Mountains and Interior Yukon Plateau⁴. There are a number of mountain peaks over 2,000 m elevation dissected by broad forested valleys with large lakes, extensive alpine and subalpine plateaus, and a diversity of glacial and fluvial landforms, including eskers, moraines, kettle lakes, glacial lake beds, and terraces. The Yukon portion of the annual range is primarily within the Yukon Southern Lakes ecoregion, while the British Columbia portion of the annual range is in the Yukon-Stikine Highlands ecoregion (Yukon Ecoregions Working Group 2004; Demarchi 2011).

The Yukon Southern Lakes ecoregion is characterized by subdued mountains with broad valleys covered in extensive boreal forests. Mean annual temperatures in valley floors vary from -1 °C to -3 °C, and snow typically covers the ground at lower elevations from October through April. In valley bottoms the diversity of soils and landforms create a mosaic of forest, shrub, grassland and wetland habitats. Treeline generally occurs around 1,200 m.

The Yukon-Stikine Highlands is part of the Coast Mountains and receives high amounts of precipitation (300-500 mm annually) with very deep winter snow conditions. The Coast Mountains are rugged and have large areas of alpine and subalpine conditions.

Approximately 60% of the annual range is forested, with the Yukon portion of the annual range containing the majority. In the Yukon Southern Lakes, lower elevations are dominated by extensive forests of boreal white spruce (*Picea glauca*), lodgepole pine (*Pinus contorta*), and trembling aspen (*Populus tremuloides*). Trembling aspen is most frequently associated with disturbed sites and dry, south-facing slopes and grasslands. At higher elevations, in the upper boreal and subalpine areas, subalpine fir (*Abies balsamea*) becomes important. Permanent shrublands of willow (*Salix* spp.) and shrub birch (*Betula* spp.) are extensive both in the subalpine and in many valley floors of the Yukon Stikine Highlands, associated with cold air drainage (Pojar and Stewart 1991). Alpine areas are characterized by low stature shrubs and tundra, with grasses and forbs dominating wetter sites and dwarf shrubs and lichens occurring in drier areas. In steep topography, large areas of bare rock and rubble are also present.

Based on fire records for the period 1950 – 2000, a fire cycle⁵ of 217 years has been calculated for the Yukon Southern Lakes ecoregion, with the Yukon-Stikine Highlands ecoregion at 1,081 years (Yukon Wildfire Management Branch, unpublished data). The large difference in fire activity between the Yukon and British Columbia portions of the range reflects the differences in precipitation, amount of forested area, and summer fire weather conditions. For comparison, the Yukon Plateau-Central

⁴ Description of the biophysical setting is adapted from Reid et al. (2013) and Florkiewicz et al. (2007).

⁵ Fire cycle refers to the length of time required to burn an area equal to the total forested area.

ecoregion, around the communities of Carmacks and Pelly Crossing—an area with a vigorous fire regime—has a calculated fire cycle of 104 years. Effective fire suppression since the 1980s may also be playing a role in the extended fire cycle of Yukon Southern Lakes ecoregion.

3.1.2 Human Land Use, Ownership and Administration

Figure 2 shows the location of Yukon communities, human land use features, First Nation and private or titled land parcels, mineral and forestry interests, and important land management boundaries. Along with the City of Whitehorse, a number of smaller communities, country residential properties, and agricultural nodes, including Carcross, Marsh Lake, Mount Lorne, Tagish, Hot Springs Road, North Klondike Highway and Ibex Valley, are situated within the Yukon portion of the range. Approximately 29,000 people reside in the Southern Lakes region, representing 80% of Yukon's total population (Yukon Bureau of Statistics 2013). Most (28,000) live within the City of Whitehorse municipal boundary. Between 1960 and 2012, the human population growth of the Southern Lakes region rate has averaged 2.2%. In the British Columbia portion of the range, there are no permanent settlements and very limited land development.

Two main transportation corridors bisect the range—the Alaska Highway and South Klondike Highway—and most human residential and agricultural developments are located along these corridors. A large number of people commute by vehicle daily from country residential areas to the City of Whitehorse for work, school and services. An extensive network of secondary and rough roads and trails is located throughout the southern portion of the Yukon range, both in the valley bottoms and leading up to high elevation alpine areas. These provide motorized and non-motorized access to most parts of the southern herd range.

As of February 2014, there are approximately 2,600 active quartz mineral claims and 5 active quartz mineral permits, covering 4.2% (510 km²) and 2.3% (277 km²) of the Yukon portion of the range, respectively. There are also a limited number of placer claims and permits. In the recent past commercial forestry has been limited in extent. Two Timber Harvest Plans—Marsh Lake and Lubbock Valley—are active, and there are also a number of informal areas used for fuel wood harvesting. Historically, mining and transportation were the primary land uses in the Southern Lakes region. However, this may be transitioning to a more residential pattern of development (both urban and country residential) with an increasing focus on government and professional services, and outdoor recreation opportunities. There is ongoing demand for urban and country residential areas, and lake-front recreational properties. A variety of year-round tourism markets and opportunities are being promoted in the region, facilitated by increased air access to the Erik Neilson International Airport from other jurisdictions. The Southern Lakes region contains most of Yukon's active agricultural land. In the Yukon portion of the Carcross herd annual range, cleared agricultural parcels account for 28% (56.6 km²) of the total human development footprint.

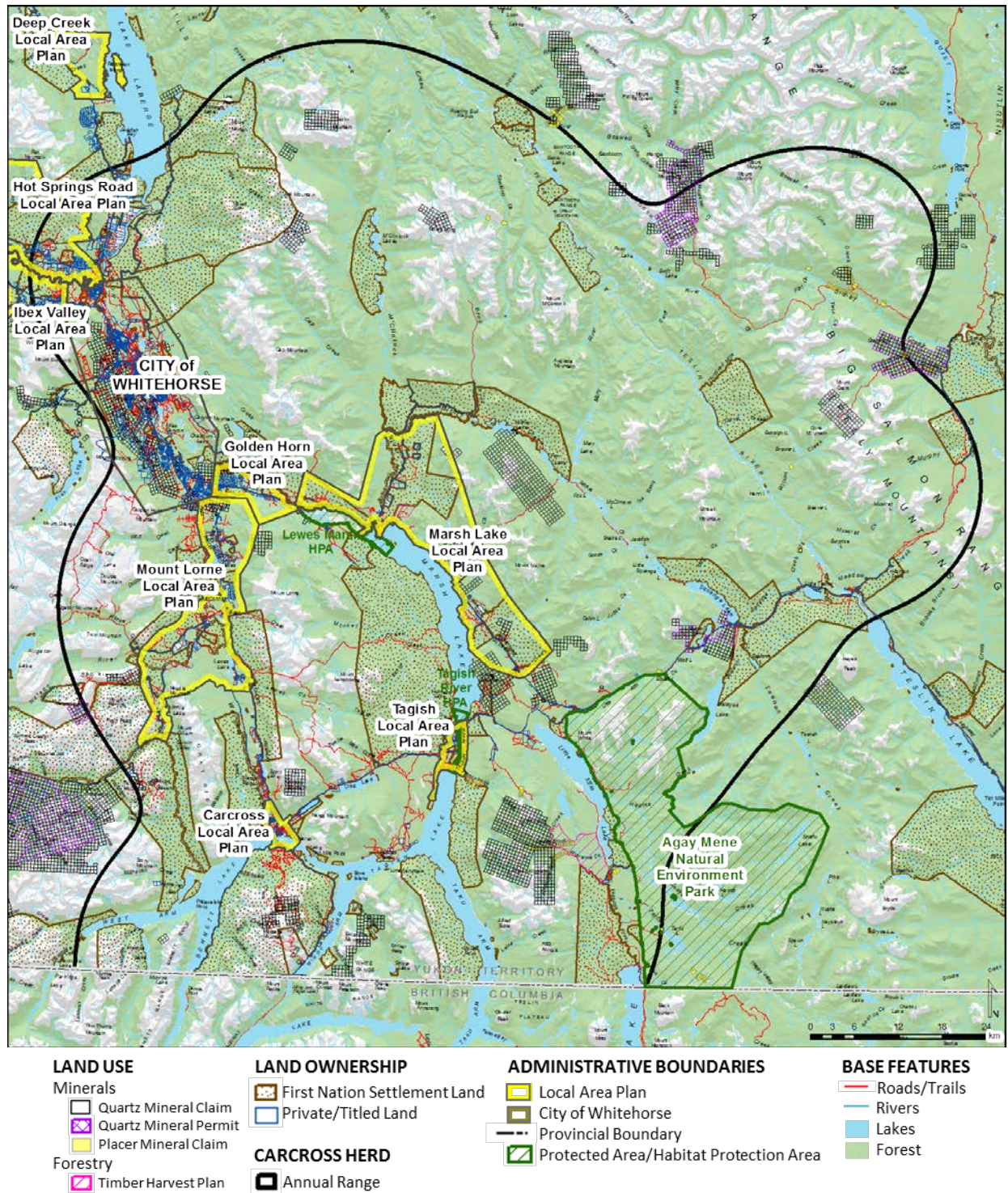


Figure 2. Land use, ownership and administration areas within the Yukon portion of the Carcross herd range.

The Yukon portion of the range is within the traditional territories of three Yukon First Nations: Carcross/Tagish, Kwanlin Dün and Ta'an Kwäch'än. Yukon public lands comprise 77% (9,462 km²) of the Yukon portion of the range, with these areas being managed primarily by Government of Yukon. First Nation Settlement Land represents 21% (2,568 km²) of the area, and private or titled lands account for the remaining 2% (207 km²). Most private and titled land parcels are within or adjacent to the City of Whitehorse.

The City of Whitehorse municipal boundary covers approximately 400 km² of the Yukon portion of the range. Local Area Plans have been approved for the communities of Mount Lorne, Golden Horn, Hotsprings Road, Ibex Valley and Carcross. As of July 2014, the Marsh Lake Local Area Plan is nearing completion, and a Local Area Planning exercise for the Community of Tagish has been initiated. Various Development Area Regulations apply in other locations.

The Yukon portion of the Carcross herd range contains three territorial Special Management Areas (SMAs). Two of these include the Lewes Marsh and Tagish River Habitat Protection Areas. They are relatively small areas (20.5 km² and 5 km², respectively) focused on the conservation of aquatic and waterbird values. Combined, these two HPAs represent less than 0.2% of the Yukon portion of the Carcross herd range. The third SMA, Agay Mene Natural Environment Park, is located between the Atlin Road and the Alaska Highway. Approximately half (333 km²) of the 725 km² park is within the Yukon portion of the Carcross herd range. Agay Mene covers 2.7% of the Yukon portion of the range and includes areas with high winter habitat potential. However, much of the park was affected by a large 1958 wildfire, and is recovering slowly. As of July 2014, management plans for these three SMAs are either not completed or have not been approved.

3.2 Seasonal Ranges, Important Habitats and Migration Routes

The general ecology of northern mountain ecotype woodland caribou is described in Environment Canada (2012). Florkiewicz et al. (2007) and Florkiewicz (2008) provide a detailed description of the Carcross herd seasonal ranges and important habitats⁶. Typical of most northern mountain herds, the Carcross herd exists as a number of sub-groups that utilize discrete seasonal ranges during the summer and winter periods and move between them in the spring and late-fall. **Table 1** provides an overview of the herd's seasonal cycle. **Figure 3** shows the location of the summer and winter ranges, and generalized migration routes.

3.2.1 Summer

The summer range includes the high elevation (greater than 1,200 m) subalpine and alpine plateaus of the major mountain blocks of the Southern Lakes region (**Figure 3**). Areas with late lying snow patches are particularly important for summer insect relief. There are large areas of potential summer range in both Yukon and British Columbia (potential summer range in Yukon is 32% (3,885 km²) of the total annual range). While on the summer range, cow caribou give birth to their calves and feed on grasses, sedges and dwarf shrubs during the post-calving period. The fall rut also occurs in these same high elevation areas.

⁶ Note: The annual and winter range boundaries used in this assessment are different than those shown in Florkiewicz et al. (2007), Florkiewicz (2008) and Reid et al. (2013). Additional animal location information collected since these studies has resulted in an expanded annual range and more refined core winter range.

At this time, a detailed map of summer habitat effectiveness has not been developed as there are currently few immediate management concerns in the summer range. With the exception of some mountain plateaus in the Whitehorse and Carcross areas, the summer range has relatively low levels of human development footprint and activity.

Table 1. Overview of Carcross herd seasonal ranges and habitats.

Seasonal Range	Seasonal Activity	Period	Description
	Migration to Summer Range	Late April – mid-May	
Summer Range (high elevation mountain plateaus) 3,885 km ² (32%) of Yukon annual range	Calving	Late May – early June	• Generally areas >1,200m elevation (above treeline) • Broad subalpine and alpine plateaus with late-lying snow patches are particularly important • In Yukon, major mountain blocks with known summer ranges include Montana Mountain, Caribou Mountain-Mount Lorne, Joe-Cap-Teslin Mountains, Mount Byng-M'Clintock, Mount Michie-White, Jubilee Mountain, and the Pelly Mountains (Sawtooth Range-Mount Grant) • Grasses, lichen, moist sedge, and low shrubs provide high quality forage • The summer range may provide security from predators during the calving and post-calving period
	Post-calving	Mid-June – mid-September	
	Fall Rut	Late September – early October	
	Migration to Winter Range	Mid-October – late-November	
Winter Range (low elevation forested valleys) <u>Potential Winter Range</u> 7,998 km ² (65% annual range) <u>Core Winter Range:</u> 4,104 km ² (34% of annual range)	Winter	December 1 – mid-April	• Generally forested valleys at low elevation (<1,200m) • The forested valleys of the Yukon portion of the range are in the precipitation shadow of the Coast Mountains, resulting in lower snow depths • The most intensively used winter habitats (i.e., most important) are mature coniferous forest (lodgepole pine and mixed pine/spruce) habitats with open tree canopies supporting a high abundance of ground lichens. • The mature pine and mixed pine/spruce forests with the highest lichen abundance are often associated with coarse-textured soil conditions of glacial-fluvial origin. • The winter strategy for predator avoidance is for small groups of caribou to disperse across the landscape.

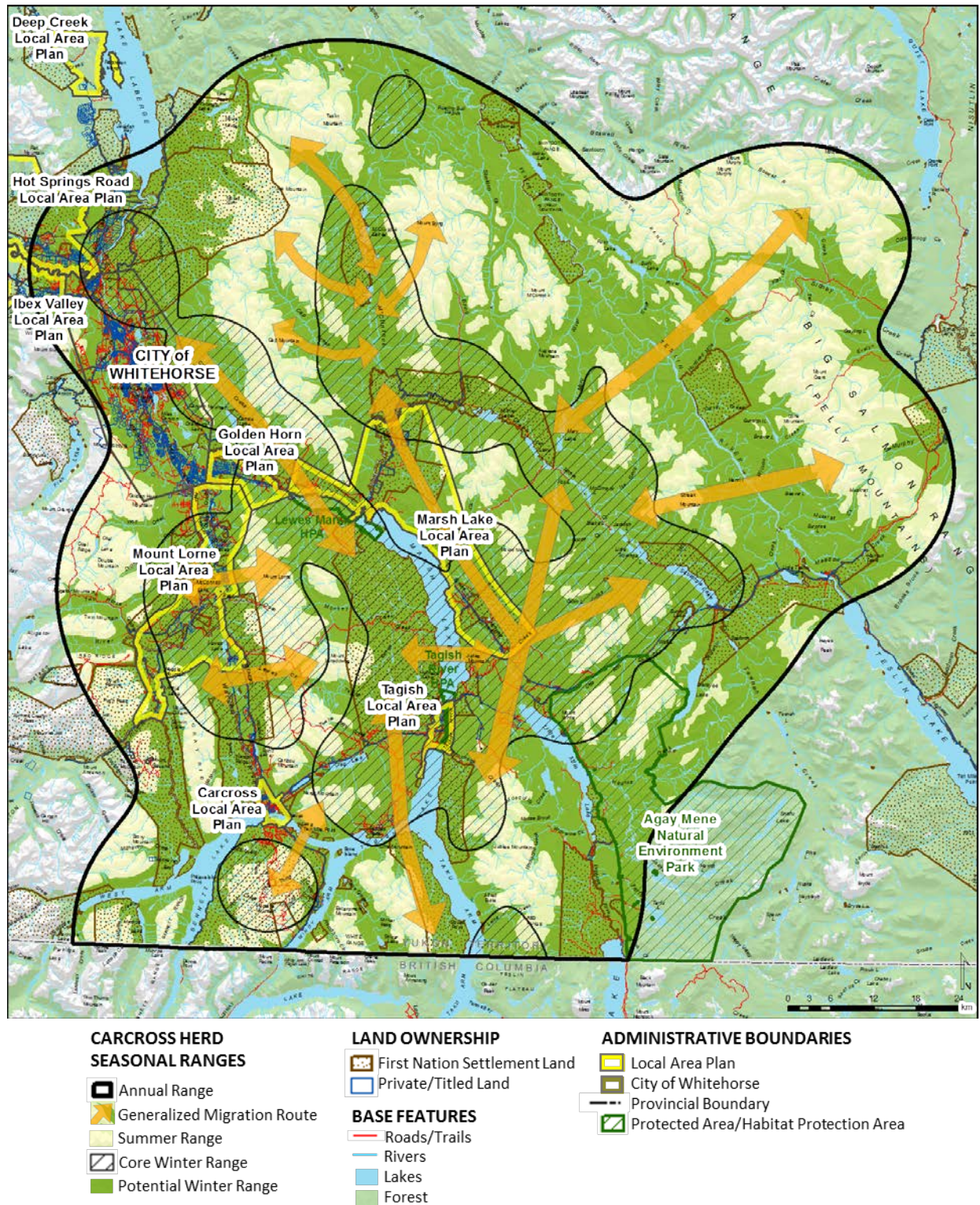


Figure 3. Carcross herd seasonal ranges and generalized migration routes in the Yukon portion of the annual range.

3.2.2 Winter

The winter range is generally comprised of the low elevation (less than 1,200 m) forested valleys of the Southern Lakes region⁷. Almost all of the Carcross herd winter range is within the Yukon. In this assessment, two types of winter range are recognized:

Potential Winter Range

The potential winter range is defined as all areas in the Yukon portion of the winter range below treeline (less than 1,200 m in elevation) that could be used as winter range in the absence of human and wildfire disturbance, excluding the large lakes of the area (i.e., Marsh, Tagish, Bennett, Little Atlin, and Laberge). The purpose of introducing the potential winter range concept into the assessment is to provide a means to evaluate what amount of winter range habitat has been lost or affected by human development and indirect effects. The core winter range is part of the potential winter range. As defined, the potential winter range is 65% (7,998 km²) of the Yukon portion of the annual range (**Figure 3**).

Core Winter Range

The core winter range is the most intensively used part of the winter range by caribou (**Figure 3**). The boundary of the core winter range was defined by GPS radio-collar caribou locations of 28 adult female caribou for the period 1999 – 2011. In the core winter range, the most strongly selected winter habitat types—mature pine and mixed pine/spruce-lichen forest communities (Florkiewicz et al. 2007)—are located in the valley bottoms at less than 800 m elevation. These are the same areas where most human development and transportation corridors are located. The core winter range is 34% (4,104 km²) of the Yukon portion of the annual range.

3.2.2.1 Late Winter Habitat Effectiveness

A late winter period (January – April) habitat effectiveness map, which identifies the best quality caribou habitats not influenced by human activities, is shown in **Figure 4**. **Table 2** summarizes the amount of high effectiveness late winter habitat in the Yukon portion of the Carcross herd range. At this time, late winter habitat mapping is available for 77% (9,374 km²) of the Yukon portion of the annual range, 78% of the potential winter range, and 95% of the core winter range. Managing the effects of ongoing and proposed human land use activities within the Carcross herd range is most important in the core winter range.

Northern mountain woodland caribou typically select forest stands with the most abundant lichen resources. These tend to be associated with coarse-textured soils of glacio-fluvial (flowing water from melting ice) or eolian (windblown) origin that occur along glacial meltwater channels, old river terraces, or in sand dune areas (Florkiewicz et al. 2007). Such conditions are limited in extent and represent a relatively small proportion of the overall winter range; only 20% of the core winter range is comprised of these high value habitats. Some of the best examples of these conditions occur in the Squanga Lake-Michie Creek, Mount Lorne-Golden Horn, and Livingstone Trail areas. Approximately 60% of the total mapped high value winter habitat in the Yukon portion of the annual range is encompassed within the core winter range polygon, which is centered on these glacio-fluvial or eolian landforms.

⁷ Some northern mountain woodland caribou remain at high elevations all year, including those in the adjacent Ibex herd range. Montana Mountain and Mount Lorne are high elevation areas utilized by Carcross caribou during the winter period, likely due to shallow snow conditions. These mountains are in the precipitation shadow of the Coast Mountains and have wind-swept conditions.

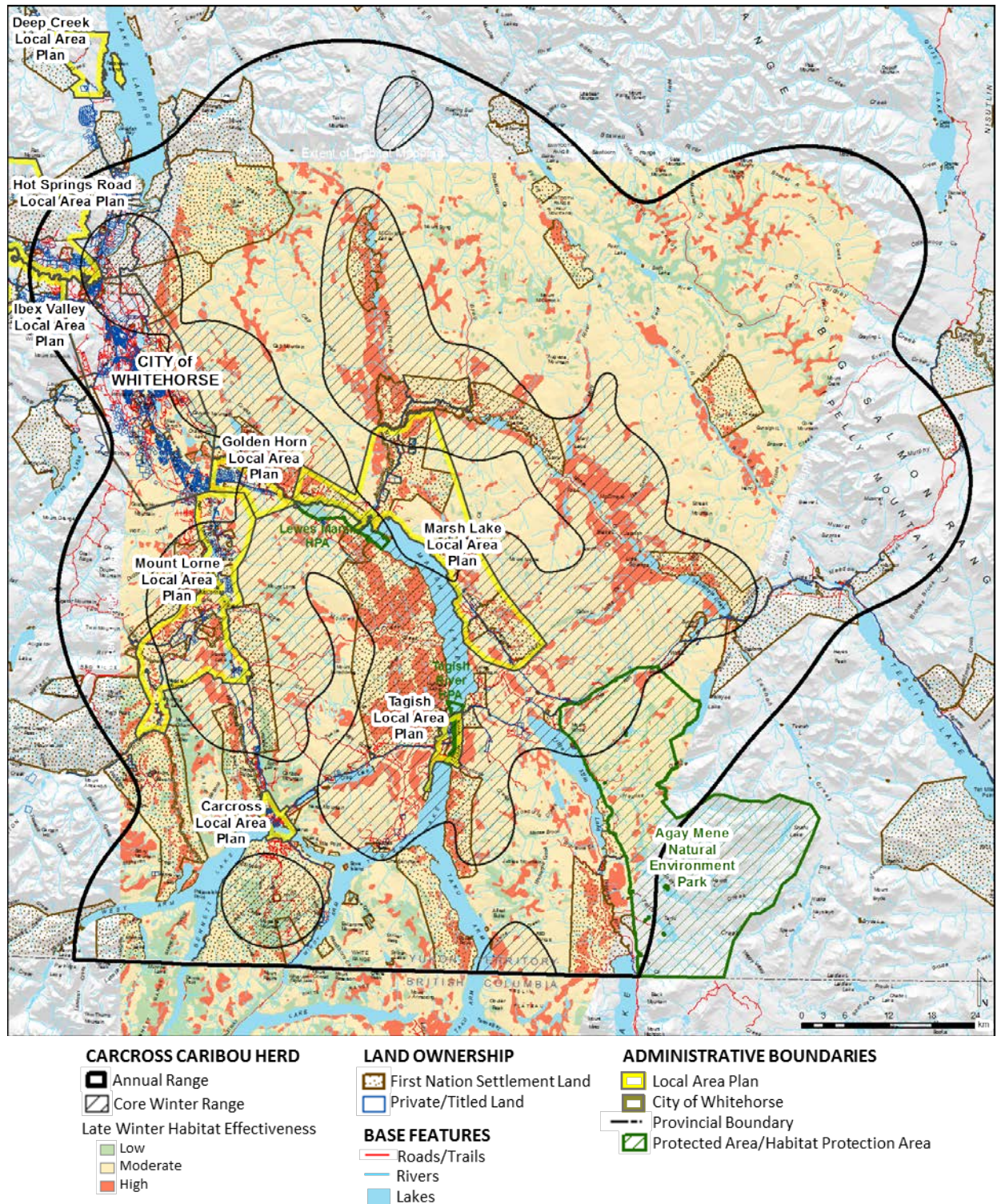


Figure 4. Carcross herd range late winter habitat effectiveness map, showing low, moderate and high value habitat classes. The late winter habitat mapping provides coverage for almost all (95%) of the core winter range and most (75%) of the Yukon portion of the annual range.

Table 2. Amount of mapped high value (i.e., high habitat effectiveness) late winter habitat in Yukon portion of the Carcross herd annual, potential winter, and core winter ranges. In this table, high value habitats are those most heavily selected by caribou that occur outside of the human zone of influence. In Figure 4, high value habitats are shown in red.

Seasonal Range	Area (km ²)	Area (% annual range)	Extent of Habitat Mapping* (km ²)	Extent of Habitat Mapping* (% of annual range)	Area of High Value Winter Habitat (km ²)	Area of High Value Winter Habitat (% of habitat mapping)
Annual Range	12,237.06	100.00	9,374.15	76.60	1,325.83	14.14
Potential Winter Range [†]	8,353.10	68.26	6,476.46	77.53	1,049.42	16.20
Core Winter Range	4,103.72	33.54	3,889.19	94.77	771.81	19.85

***Note:** The habitat classification imagery used to create the late winter habitat effectiveness map was not available for the entire annual range.

†Note: To make potential winter range habitat results comparable with annual and core winter range, large lakes have been included in the area calculation of Potential Winter Range (i.e., large lakes comprise 354.76 km² of the 8,353.10 km² potential winter range).

3.2.3 Migration

The ability for all populations of northern mountain ecotype woodland caribou to move between seasonal ranges is vitally important (Environment Canada 2012). Seasonal movements provide increased forage availability and quality, as well as enhanced security through reduced predation risk. Generalized migration routes used by the Carcross herd are shown in **Figure 3**. These migration routes were identified using a combination of GPS radio-collar data, localized concentrations of highway mortalities, and expert opinion. Given the configuration of the major mountain blocks, large lakes, and major roads in the Southern Lakes region some key migration routes cross the Alaska Highway and other heavily travelled roads. In these locations where vehicles travel at high speeds, caribou mortalities occur due to vehicle collisions. In other areas, human residential or agricultural development may create barriers or deterrents to caribou movement between the summer and winter ranges.

4 ASSESSMENT OF RISK FACTORS

The purpose of this range assessment is to summarize the current habitat and population status of the Carcross herd, describe the key risk factors⁸ affecting the herd, and identify which factors represent the greatest threat to the herd's long term viability. The assessment considers both human-caused (anthropogenic) and natural factors that affect current condition and longer-term sustainability of habitat and the population. Assessing risks to long-term woodland caribou population persistence and viability requires the consideration of the potential cumulative effect of all relevant human and natural factors that may affect the habitat and population. For the Carcross herd these factors have been described extensively by Florkiewicz et al. (2007), Florkiewicz (2008) and the Southern Lakes Wildlife Coordinating Committee (SLWCC 2012a and 2012b).

Although the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada (Environment Canada 2012) provides general guidance, at this time there is no single accepted method to assess the overall or cumulative level of risk for northern mountain woodland caribou populations. An approach to assessing risk to long-term population viability for boreal woodland caribou⁹ has been developed by Environment Canada (2011), as part of the national boreal woodland caribou recovery strategy. This approach calculated the total extent of all human (i.e., direct footprint and a potential zone of influence of 500 m around those features) and natural disturbances (i.e., recent fires less than 40 years old that are more than 200 ha in size) in a boreal caribou range. The total level of disturbance within the range, expressed as percent, was then related to the probability of a herd remaining stable or increasing over a 20 year period. The correlation between level of disturbance within a range and risk of population decline was determined empirically from 57 boreal caribou herds across Canada.

Reid et al. 2013 examined the potential application of the boreal caribou population viability equation (Environment Canada 2011) to the Carcross herd range. They suggested that at this time, it should not be used directly to assess northern mountain ecotype woodland caribou herd population viability, as some of the assumptions behind the use of the boreal caribou equation may not be met. Most important among these is the migratory nature of the northern mountain herds and the spatial separation between high elevation, alpine summer ranges and low elevation, forested winter ranges. Further, given the mountainous nature of northern mountain herd ranges, most of the human development footprint is concentrated in the low elevation winter range, which is generally recognized as the most critical period for woodland caribou (Florkiewicz 2008; Farnell 2009).

While the Environment Canada (2011) population viability equation may not be directly applicable to an assessment of the Carcross herd, the examination of important human and natural disturbance factors remains a useful approach, particularly understanding the differences in levels of habitat disturbance and human activity between the summer and winter ranges, versus a single, range-wide disturbance assessment. Therefore, the Environment Canada (2011) 'total zone of influence approach' has generally

⁸ In the context of a caribou range assessment, 'risk' is considered the degree to which one or more factors threatens the long-term viability and persistence of a caribou population and/or its habitats.

⁹ Boreal woodland caribou in Canada inhabit the boreal forests east of the Rocky Mountains. These caribou generally do not exhibit a migrational pattern like northern mountain woodland caribou, so there is limited separation between summer and winter ranges. Consideration of the seasonal ranges of northern mountain caribou as part of the range assessment methodology is an important addition to the Environment Canada (2011) approach.

been adopted for this Carcross herd range assessment, but has been modified to consider both habitat and population-related risk factors relevant to the ecology of northern mountain woodland caribou, particularly the importance of winter range conditions. However, given the findings of Reid et al. (2013), direct relationships between levels of habitat disturbance and caribou population viability have not been suggested at this time.

The habitat and population-related risk factors are discussed in the following sections, and then are summarized in **Table 4**. Areas of major management concern are identified. Human and wildfire disturbance summaries for the annual and seasonal ranges are provided in **Table 3**. **Appendix A** provides the same disturbance summaries reported by Caribou Assessment Area, including larger scale maps of each area. Maps showing the seasonal ranges and important winter habitats of the Carcross herd are provided in **Section 3.2**, above.

4.1 Level of Habitat Impacts (Human and Wildfire Disturbance)

Figure 5 shows the location of human development and recent wildfires (1946 – 2013) within the Yukon portion of the Carcross herd range. For human-caused disturbance, both the direct footprint and estimated zone of influence (ZOI) of the features is shown.

4.1.1 Human Development

There is approximately 202 km² (1.65%) of direct human development footprint within the Yukon portion of the Carcross herd annual range. Almost all (97%, or 196 km²) of this footprint occurs within the potential winter range, and 46% (94 km²) within the core winter range. There is large spatial variation in the location of the development footprint, with 50% occurring in the City of Whitehorse and its periphery. This concentration of footprint is created by the cumulative area of residential (urban and country residential) and agricultural developments. When the indirect effects of human development are considered (i.e., zone of influence), the amount of area affected by human activities expands to almost 20% of both the potential and core winter range areas. While direct comparison studies are not currently available, the Yukon portion of the Carcross herd range likely contains the highest level of direct and indirect human-caused habitat impacts of any woodland caribou herd range in Yukon.

The amount of potential winter range removed or affected by the City of Whitehorse and its periphery is reflected by the difference between the amount of area disturbed by human development in potential winter range vs. core winter range (103 km² of direct footprint, and 787 km² of zone of influence, approximately 10% of the total potential winter range). The core winter range no longer includes this area due to the high amount of human footprint and activity.

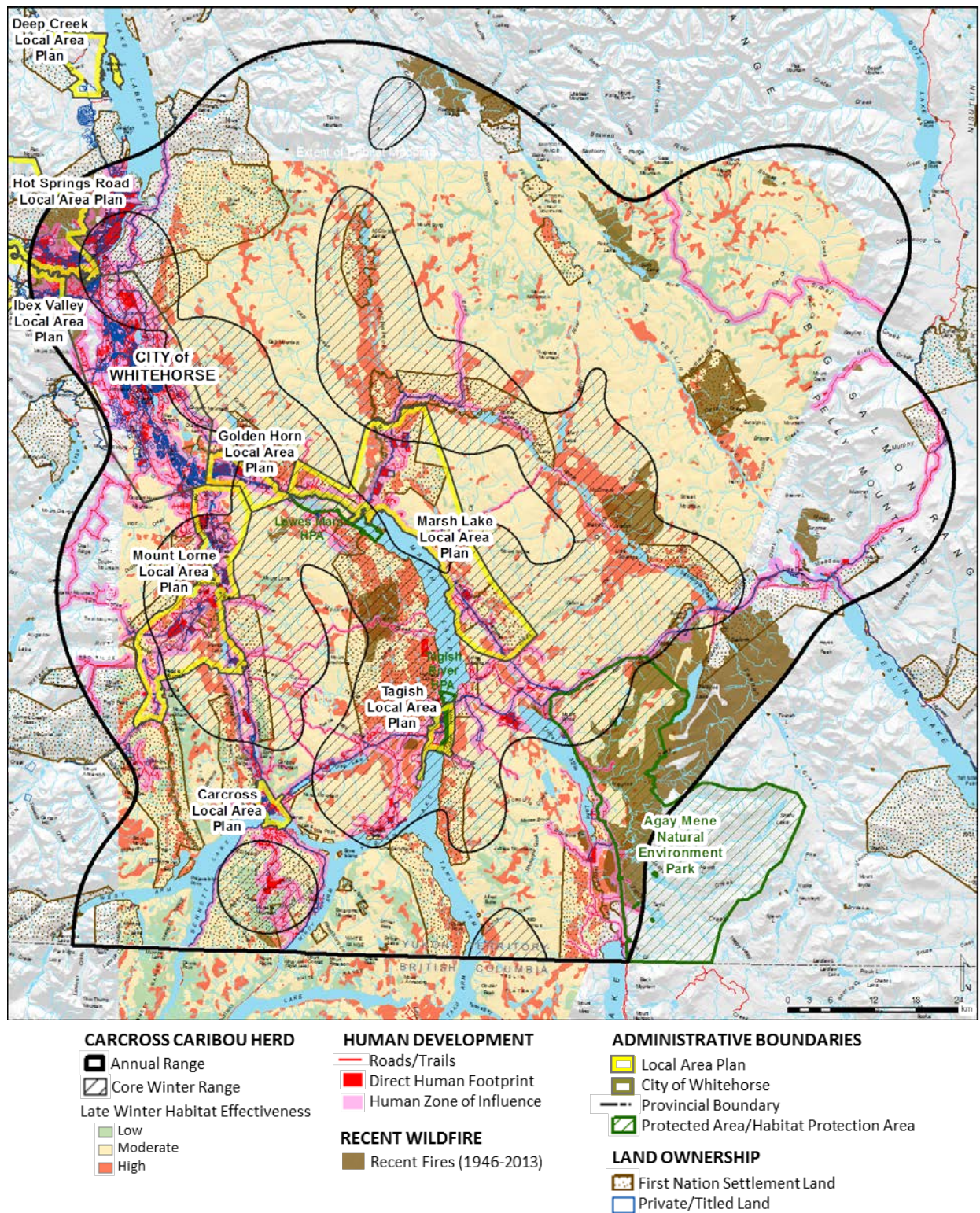


Figure 5. Human and recent wildfire (1946-2013) disturbance within the Yukon portion of the Carcross herd annual range.

Table 3. Summary of disturbance indicators for the Yukon portion of the Carcross herd annual, potential winter, and core winter seasonal ranges.

SEASONAL RANGE			AREAL DISTURBANCE												LINEAR DISTURBANCE	
			Total Direct Human Development Footprint (FT)			Total Human Development ZOI (Direct Footprint + Indirect Effects)			Total Area Burned by Recent Wildfire (1946 – 2013)			Total Area Disturbed (Total Human Development ZOI + Recent Wildfire)			Total Linear Features (km)	Average Linear Density (km/km ²)
Seasonal Range	Area (km ²)	Area (% annual range)	Area (km ²)	Area (% range)	Area (% total FT)	Area (km ²)	Area (% range)	Area (% total ZOI)	Area (km ²)	Area (% range)	Area (% total area burned)	Area (km ²)	Area (% range)	Area (% total area disturbed)		
Annual Range	12,237.06	100.00	202.00	1.65	100.00	1,833.92	14.99	100.00	882.33	7.21	100.00	2,601.58	21.26	100.00	4,058.79	0.33
Potential Winter Range	7,998.34	65.36	196.39	2.46	97.22	1,592.96	19.92	86.86	822.32	10.28	93.20	2,302.41	28.79	88.50	3,819.64	0.48
Core Winter Range	4,103.72	33.54	93.74	2.28	46.40	806.15	19.64	43.96	128.15	3.12	14.52	911.95	22.22	35.05	1,665.47	0.41

There is approximately 4,059 km of linear features (roads, trails, utility corridors, etc.) within the Yukon portion of the Carcross herd annual range, resulting in an average linear density of 0.33 km/km². 3,820 km of the linear features (94% of the total) are within the potential winter range, resulting in an increased average linear density of 0.48 km/km². The average linear density of the core winter range is 0.41 km/km². Within the winter range, there is large variation in the location of features—the City of Whitehorse and its periphery contain the majority of the roads and trails within the range and has a correspondingly high linear density of 1.80 km/km². Areas around Carcross, Tagish and Marsh Lake range between 0.30 and 0.60 km/km², while remote areas are less than 0.1 km/km².

4.1.2 Wildfire

Recently burnt areas are considered unsuitable caribou habitat as forest structure and lichen biomass has not adequately recovered to a suitable condition. Caribou may therefore avoid or use these lower quality recently burnt habitats less frequently. Recovery rates may differ between different areas of Yukon and by habitat type; it may also be influenced by fire intensity. The Environment Canada (2011) nation-wide boreal ecotype woodland caribou population viability model uses an average age of 40 years to define the period of time a fire affected area remains in a ‘recently burnt’ condition. Nagy (2011), working in central NWT, considered recently burnt areas to be up to 50-years of age.

There has been a relatively low amount of recent wildfire disturbance in the Yukon portion of the annual range. Since 1946, only 7.21% (882 km²) of this area has been affected by wildfire and almost all (93%, or 822 km²) has occurred within the potential winter range. Only 128 km² of the burned area is within the core winter range. The last major fire event was in 1958, which affected areas around Pilot Mountain-Hot Springs Road, the City of Whitehorse, and much of the area that currently falls within Agay Mene Natural Environment Park. A 1958 burn along Atlin Road and in Agay Mene has been very slow to recover, and currently receives limited use by the Carcross herd.

4.1.3 Total Disturbed Area

The combined direct and indirect effects of human footprint and recent burns have affected 21% (2,602 km²) of the Yukon portion of the Carcross herd annual range. Eighty-eight percent of the total disturbed area occurs in the winter range, resulting in 29% (2,302 km²) and 22% (912 km²) of the potential and core winter ranges being affected by disturbance, respectively.

The difference in area disturbed between the potential and core winter ranges (1,390 km²) reflects the response of caribou to disturbance—caribou are generally avoiding the City of Whitehorse and periphery (to the west of the Yukon River) and recently burned areas (this is especially evident in the 1958 burn around Atlin Road and Agay Mene Natural Environment Park). However, the area affected by human development is permanently lost from the winter range, while the area affected by recent wildfire is recovering and may once again become high value winter habitat.

Given the location and size of the currently identified core winter range, it appears that the level of human development footprint and associated activity within the City of Whitehorse and periphery is significant enough to generally displace caribou from this part of the winter range, while the human development nodes around Mount Lorne, Tagish and Marsh Lake still maintain some functional habitat. However, if these areas also receive increasing development and human activity, particularly along the South Klondike Highway corridor between Golden Horn Subdivision and Carcross, habitat effectiveness may decline to the point where these parts of the winter range are also largely abandoned by caribou.

Maintaining the remaining high quality habitat patches in these areas should therefore be viewed as a priority.

4.2 Carcross Herd Population Status

4.2.1 Size and Trend

The Carcross herd population is considered stable with an estimated 775 animals (Hegel and Russell 2013). Between 1997 and 2008, the years with the most recent population surveys, the Carcross herd approximately doubled in size from 400 to 800, but the population remains considerably lower than historical accounts, when the herd consisted of thousands to tens of thousands of animals.

4.2.2 Recruitment and Mortality

Based on a five-year average of fall cow/calf surveys, annual recruitment rates are 24 calves per 100 cows—which is considered adequate to continue a stable or slow rate of growth in the absence of additional mortality pressures. Given the density of grizzly bears, wolves, and other ungulate species (primarily moose) in the Southern Lakes region, adult caribou predation rates are uncertain but are considered to be average for woodland caribou. The natural annual adult mortality rate is estimated to be approximately 10% (Environment Yukon unpublished data).

In Yukon, the Carcross herd has not been harvested since 1992. This year marks when the community-based Southern Lakes Caribou Recovery Program stopped most hunting through a seasonal closure for licensed Yukon hunters, and First Nations implemented a voluntary harvest closure. A small licensed harvest of 5-10 animals (bull only) per year (6 per year based on five year average) continues in the British Columbia portion of the range.

The greatest direct source of human-caused caribou mortality in the Yukon portion of the Carcross herd range is from vehicle collisions, when caribou are either on their winter range or during the spring and fall migration periods. All of the recorded vehicle collisions have occurred along the Alaska and South Klondike Highways, where vehicles travel at high speeds. Over the past five years, there has been an average of 5-6 recorded caribou mortalities per year¹⁰. Approximately 65% of the caribou killed by vehicle collisions are pregnant females. The highest numbers of collisions occur in relatively predictable locations—Judas Creek-Jakes Corner, Golden Horn-Mount Lorne-Lewes Marsh, and Tagish-Crag Lake—highlighting the importance of these areas as wintering areas and migration routes (**Figure 6**).

¹⁰ In some years in the mid-2000's there were as many as 11 recorded vehicle-caused caribou mortalities annually.

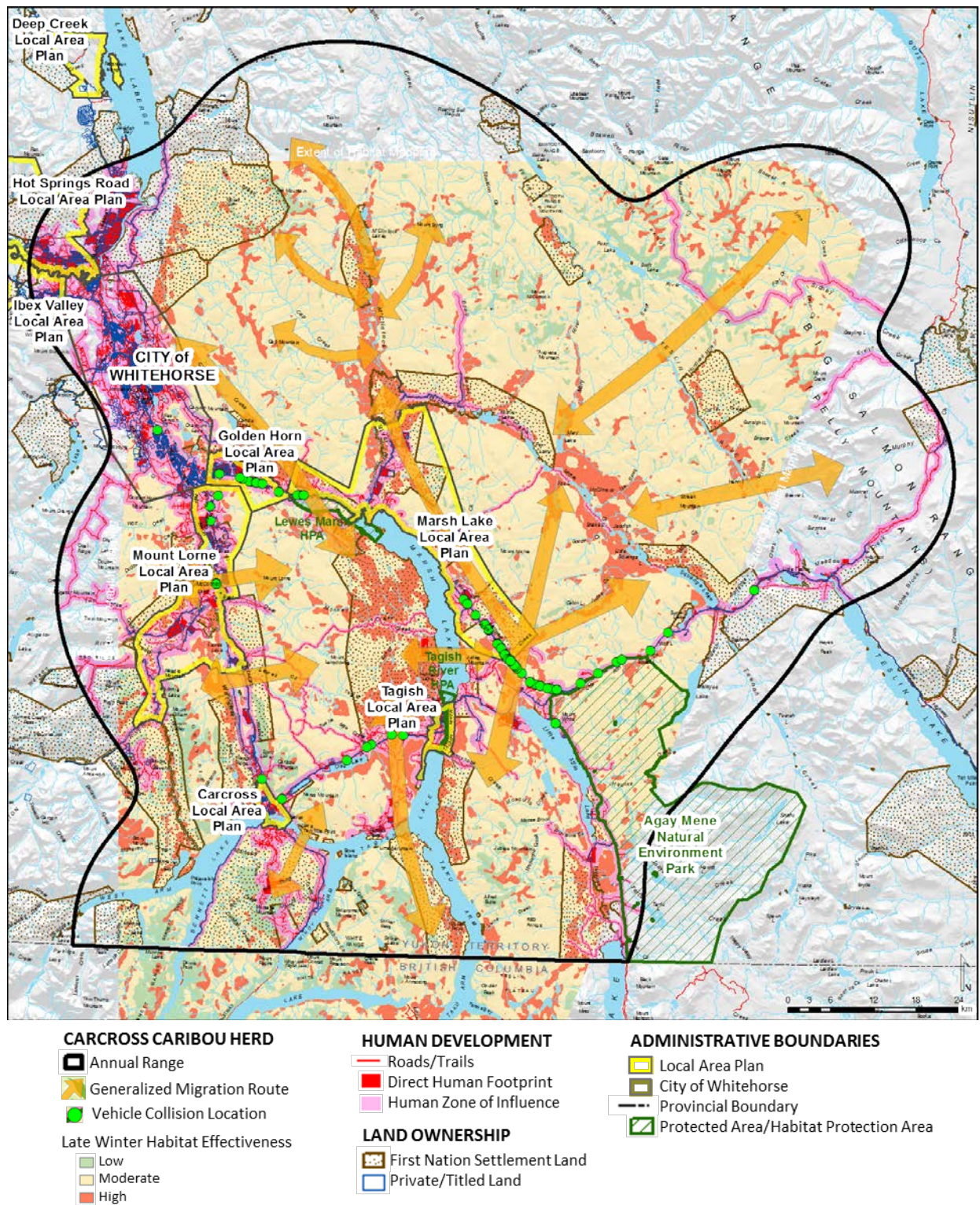


Figure 6. Location of documented caribou mortalities resulting from vehicle collisions in the Southern Lakes region for period 1991-2013. Source: Environment Yukon unpublished data.

Table 4. Risk assessment summary for the Carcross herd - current and potential future situation.

Factor	Current Situation	Future Situation (20-years future)	Discussion of Future Situation
HUMAN POPULATION AND ACCESS IN THE YUKON PORTION OF THE CARCROSS HERD RANGE			
Human population in range	29,000 (28,000 within City of Whitehorse municipal boundary).	35,000 – 40,000	• If human population continues to grow at 2.0-2.5% annually, the regional population will reach 35,000-40,000 people in 20-years. • Most growth is expected to continue to be within the City of Whitehorse municipal boundary.
Average linear density (amount of road and trail access)	Annual Range: 0.33 km/km² Potential Winter Range: 0.48 km/km² Core Winter Range: 0.41 km/km² 94% and 41% of the total length of linear features is within the potential and core winter ranges, respectively. However, there is large variation in the density of linear features, with Whitehorse and surrounding area at 1.80 km/km² while remote areas are <0.1 km/km².	Higher. (uncertain) The majority of new roads and trails will likely be located in the southern portion of the core winter range, in the Whitehorse, Mount Lorne, Carcross, Tagish and Marsh Lake areas.	• An expanding network of roads and trails, facilitating both motorized and non-motorized access, should be expected. • The pattern of new human residential development is the major factor affecting the amount and location of new roads in the winter range. Residential development nodes, that are close to existing roads and developed areas, should be encouraged. • An increasing human population will have increasing demands for outdoor recreation, which may include increased trail networks in the high elevation, summer range.
HABITAT AND DISTURBANCE-RELATED CONSIDERATIONS IN THE YUKON PORTION OF THE CARCROSS HERD RANGE			
Total direct human development footprint	Annual Range: 1.65% (202.00 km²) Potential Winter Range: 2.46% (196.39 km²) Core Winter Range: 2.28% (93.74 km²) 97% and 46% of the total direct human development footprint occurs in the potential and core winter ranges, respectively. However, there is large variation in the amount and pattern of direct human development footprint, with Whitehorse and surrounding area at 11% and more remote areas are less than 0.1%.	Higher. (uncertain) The majority of new direct human development footprint will likely continue to be located in the southern portion of the core winter range, in the Whitehorse, Mount Lorne, Carcross, Tagish and Marsh Lake areas.	• The amount of direct human development footprint (rural residential, agriculture, forestry, gravel extraction, and mineral exploration and development) is expected to grow. • In the Carcross herd range, human residential and agricultural developments are the major land uses causing direct habitat impacts. The majority of this new footprint is occurring on private lands (i.e., titled land parcels), resulting in permanent habitat loss and a limited ability for government to manage activities. • Some human developments (e.g., gravel pits, roads, and country residential) are preferentially located in high value pine-lichen habitats, increasing the significance of the habitat loss (Florkiewicz 2008).

Factor	Current Situation	Future Situation (20-years future)	Discussion of Future Situation
Total human development ZOI (direct footprint + indirect effects)	Annual Range: 14.99% (1,833.92 km²) Potential Winter Range: 19.92% (1,592.96 km²) Core Winter Range: 19.64% (806.15 km²) 87% and 44% of the total human development ZOI occurs in the potential and core winter ranges, respectively. However, within the winter ranges, there is large variation in the level of total human development ZOI. Whitehorse and its surrounding area is approximately 60% affected while remote areas are less than 3%.	Higher. (uncertain) Human ZOI will continue to expand if new roads, trails or other human developments are located outside of the existing ZOI. Human ZOI expansion is expected to be greatest in the Whitehorse, Mount Lorne, Carcross, Tagish and Marsh Lake areas.	- As the level of direct human development increases, the total human development ZOI is also expected to expand. - The amount of ZOI expansion is dependent on the location of new human development: - If new development and roads are located outside of current areas, the ZOI will expand accordingly. The location of new agricultural and country residential development is a major consideration. - Linear features have a relatively small direct footprint (i.e., low direct habitat loss) but have a large effect on ZOI.
Total area burned by recent wildfire (1946 – 2013)	Annual Range: 7.21% (882.33 km²) Potential Winter Range: 10.28% (822.32 km²) Core Winter Range: 3.12% (128.15 km²) 93% of the total area affected by recent wildfires has occurred in the potential winter range. Most of the core winter range has not experienced a large fire in the past 70 years. While only 10% (822 km²) of the potential winter range has been affected by recent wildfire, there is large variation in the amount of area affected (e.g., 40% of Agay Mene-Atlin Road area was burned in 1958).	Higher. (uncertain) The majority of future burned area is expected to affect the winter range, exacerbating the effects of increasing levels of human-caused habitat disturbance.	- Fire suppression and warming climate increases the risk of large fire events occurring. - The location of future wildfires cannot be predicted but due to fire suppression, the likelihood of a major event occurring in more remote areas, such as the Squanga-Michie Creek area, is higher than around Whitehorse and surrounding areas. - The length of time a burned area requires to return to functional caribou habitat is variable: - Environment Canada (2011) considers fire disturbances to be recovered at 40 years. - Some of the older burns included in this analysis may have recovered (e.g., 1946 fire on west side of Marsh lake). - Portions of the 1958 burn, particularly in Agay Mene Natural Environment Park and the Atlin Road/Tarfu-Snafu Lakes area have been very slow to recover.

Factor	Current Situation	Future Situation (20-years future)	Discussion of Future Situation
Total area disturbed (total human development ZOI + recent wildfire)	Annual Range: 21.26% (2,601.58 km²) Potential Winter Range: 28.79% (2,302.41 km²) Core Winter Range: 22.22% (911.95 km²) While the potential winter range contains almost 90% of the total area disturbed, there is large variation in the location and amount of disturbance. More than 60% of Whitehorse and its surrounding area is affected by the combined effects of human and fire disturbance, while some remote areas are less than 5%.	Higher. (uncertain) The majority of new human-caused disturbance will continue to be in the central and southern portion of the winter range, and will likely occur on private lands. While the location of future fires cannot be predicted, almost all future wildfire disturbances will also occur within the winter range.	- The total amount of disturbance in the herd's range is expected to increase due to the combined effects of an expanding human development footprint, an increasing human ZOI, and/or wildfires. - The winter range will continue to receive the highest levels of future disturbance, resulting in a disproportionately higher rate and amount of disturbance than will occur in the annual or summer ranges. - Most of the existing human development footprint occurs on private, titled lands and is therefore relatively permanent. Therefore, future development footprint will be additive to the existing.
Amount of range within a SMA (Territorial Park, Habitat Protection Area (HPA), or similar)	Only 2.7% (359 km ²) of the annual range is within a Territorial Park or HPA. Agay Mene Natural Environment Park accounts for almost all of this area. The level of habitat protection afforded by these areas depends on their management plans, which at this time are either not completed or have not been approved.	Same as current. (unlikely to increase substantially) The creation of new, large protected areas within the Carcross herd annual or seasonal ranges is unlikely.	- Agay Mene is the only significant SMA (334 km² of the 725 km² park is in the Carcross herd range). - Much of Agay Mene is potential winter range with extensive areas of pine forest. However, it was burned in 1958 and has been very slow to recover. It is currently not high value habitat, but may return to this condition in the future.
POPULATION-RELATED CONSIDERATIONS			
Population size	775 (2008 survey) Between 1997 and 2008, the Carcross herd doubled in size, from approximately 400 to 800 animals but remains lower than historical numbers.	Unlikely to increase substantially. (uncertain)	- A population recovery objective will depend on the outcome of Carcross herd harvest management planning. - The current population size is likely not adequate to support low harvest levels and maintain population increase.
Population trend	Stable to slow increase.	Unlikely to increase substantially. (uncertain)	- Population growth is vulnerable to additive sources of mortality and habitat disturbance. - If a no harvest policy remains in place, the population will likely continue as stable but may not increase substantially.
Recruitment	24 calves per 100 cows. (5 year average)	Unlikely to increase. (uncertain and susceptible to multiple factors)	- The current recruitment rate is considered average and at an adequate level to sustain a stable caribou population. - However, recruitment is very sensitive to adult cow mortality, anomalous late-winter and spring weather events and snow conditions, and predation.

Factor	Current Situation	Future Situation (20-years future)	Discussion of Future Situation
Harvest	Yukon: - No harvest since 1990. - Unauthorized harvest occurs, but is not quantified. British Columbia: - Five-year average of 6 bulls per year.	Yukon: - Low harvest desired. British Columbia: - No change.	- Population growth is vulnerable to additive sources of mortality and range disturbance. - Continued restrictions on hunting in Yukon will likely be required to sustain current caribou population numbers and facilitate slow population increases. - Hunting restrictions are recommended for consideration by B.C. wildlife authorities.
Other human-caused mortality	5-6 vehicle collision-caused mortalities per year (based on an average of the past 5 years).	Number of vehicle collision-caused caribou mortalities will likely be similar to current or higher. (uncertain)	- Vehicle traffic volumes are expected to grow with regional human population trends. - Large industrial or transportation developments in other areas of Yukon may result in increased industrial traffic on the Alaska and Klondike Highways. - Collisions with vehicles will continue to be a source of mortality to caribou, and may increase with increasing traffic levels, despite attempts for additional mitigation. - Approximately 65% of caribou mortalities are pregnant females, heightening the effect of caribou mortalities on population growth (i.e., affects recruitment rates).
Predator and other ungulate prey density	Predators: Low wolf (4.9 wolves/1,000 km ²), unknown grizzly bear and black bear densities. Other Ungulate Prey: Low moose and white tailed deer densities.	Low and potentially declining wolf and moose densities. White tailed deer populations often increase with increasing human development and natural forest habitat conversion.	- Wolf densities are expected to remain relatively low. - Grizzly and black bears have high mortality rates in the Southern Lakes. - Moose densities are expected to remain relatively low (moose are the primary prey of wolves). - Calf and adult caribou survivorship is expected to remain similar to current.
Sensory disturbance	Moderate levels of sensory disturbance.	Moderate or increasing levels of sensory disturbance.	Increasing vehicle traffic and levels of backcountry access and recreational use may result in higher levels of sensory disturbance, resulting in reduced use or avoidance of areas adjacent to these areas by caribou.
Weather events and snow conditions	Low frequency of anomalous winter and spring weather events and snow conditions.	Potentially increasing frequency of anomalous weather events and snow conditions. (uncertain)	- Calf survival is well correlated with late winter spring and early summer weather and snow conditions. - Increasingly variable weather events may result in decreased fitness of individual animals and poor recruitment.

4.3 Risk Assessment Summary

The overall assessment of risk factors suggests that despite the recent recovery to a population size of approximately 775 animals with a stable trend (Hegel and Russell 2013), the Carcross herd is still vulnerable as the habitat and the caribou themselves will likely be subject to continued and increasing habitat and population stressors. Current risk factors on habitat are related to high levels of human access (and potential sensory disturbance), and permanent loss of winter range habitat due to an expanding human footprint, mainly from the incremental expansion of residential, agricultural and industrial land parcels. Based on mapping results, it is likely that the Yukon portion of the Carcross herd range contains the highest level of direct and indirect human-caused habitat impacts of any woodland caribou herd range in Yukon. Our assessment suggests that when combined with the potential for increased wildfire (Weber and Flannigan 1997; Farnell 2009), total disturbance within the caribou range will likely increase resulting in a reduction in functional habitat with negative implications to population potential.

Based on this risk assessment, we suggest that the Carcross herd has relatively low ecological resilience¹¹, which is a state that the herd will likely continue into the future. Low resilience means that the caribou herd and the range have limited capacity to absorb additional stressors that reduce habitat conditions (i.e., amount, effectiveness and availability, and/or connectivity) or risk factors that directly affect the population through increased rates of mortality and/or decreased productivity. This vulnerability and reduced resilience is largely due to the cumulative and interacting effects of:

- Incremental and permanent habitat loss due to rural residential, agricultural and industrial development, and associated transportation features, primarily within the low elevation forested winter range (Florkiewicz et al. 2007);
- Increased disturbance and loss of habitat effectiveness resulting from:
 - timber and fuelwood harvesting;
 - an expanding road and trail network;
 - high levels of motorized and non-motorized recreational trail use; and
 - increasing demand for backcountry recreation opportunities from a large and growing human population in Whitehorse, the surrounding Southern Lakes communities, and tourism (Florkiewicz 2008);
- Ongoing and potentially increasing sources of mortality from vehicle collisions (Florkiewicz 2008; Hegel and Russell 2013); and

¹¹ In this context, resilience is the capacity of an ecosystem to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Folke et al. 2004, Walker et al. 2004). For caribou, a resilient population is able to recover from natural and anthropogenic disturbances, and be self-sustaining within the range of natural variation. A reduction or loss of resilience occurs due to negative, incremental and synergistic effects of changes in habitat conditions, climate, and predator-prey dynamics that result in a shift from a desired to less desired state. From a human perspective, an example of a less desired state is an ecosystem that has changed due to a combination of habitat and population stressors, such that the caribou population no longer has the capacity to support harvesting.

- A changing climate, and its effect on the frequency and magnitude of:
 - anomalous winter or spring weather events and snow conditions; and
 - severe wildfire events (and potentially insect outbreaks affecting forest ecosystems). Combined with the legacy of fire suppression, this contributes to an increased risk of large scale wildfire that would not only be damaging to human infrastructure, but could potentially eliminate a large area of caribou winter range in a single event (Farnell 2009).

Of these factors, human-caused habitat loss and disturbance within the winter range is likely the most important factor that can be managed through current and future land use planning, disposition, and assessment processes. Section 5 provides recommendations for managing the direct and indirect effects of human development and land use and activities within the Carcross herd winter range.

5 MANAGEMENT RECOMMENDATIONS

This section provides management recommendations for the Yukon portion of the Carcross herd range. Most recommendations are designed to address human-caused habitat impacts within the winter range. Recommendations are structured in the form of goals, objectives and strategies¹². Management recommendations discussed herein are consistent with the management objectives in the Management Plan for the Northern Mountain Population of Woodland Caribou (*Rangifer tarandus caribou*) in Canada (Environment Canada 2012).

5.1 Habitat-related Recommendations

The Carcross herd habitat management goal for the Yukon portion of the range is as follows:

HABITAT GOAL:

Maintain the Yukon portion of the Carcross herd annual range in a condition that will support the current or an increasing caribou population size.

As summarized in Section 4.3, above, human-caused habitat loss and disturbance within the Carcross herd winter range is considered to be the major factor affecting the recovery and long-term viability of the herd. The recommended habitat-related objectives and strategies provided here are therefore designed to address the key management concerns within the winter range—maintaining the integrity of the winter range is required to achieve the habitat goal. Three general strategies are suggested:

- Maintain the remaining large patches of intact, core winter habitat areas;
- Maintain the remaining amount and effectiveness of winter habitat; and
- Maintain important migration corridors between the core winter areas and the high elevation summer ranges.

These strategies reflect both landscape and local-scale approaches to maintaining the integrity of the winter range. Each strategy is discussed below. The human factors affecting winter range habitat can generally be managed through current and future planning, disposition, and assessment processes. While wildfire is an important natural disturbance agent affecting caribou habitat, and it was considered as part of the risk assessment, specific recommendations regarding wildfire management are not provided at this time.

¹² Goals are broad statements of desirable long-term condition. Objectives are specific desired conditions that contribute to achieving the goal, and are intended to address specific management concerns. Strategies are recommended approaches and actions that assist in achieving the stated objective. Specific recommendations are provided where appropriate.

5.1.1 Priority Core Winter Habitat Areas

The core winter range is the most intensively used part of the annual range by caribou (**Figure 3**). The size and location of the core winter range reflects the part of the potential winter range with low snow depths, a large amount of intact, high value lichen habitats, and lower levels of human and natural disturbance. The highest proportion of high value habitats is contained within the core winter range (**Table 2**). Approximately 20% of the core winter range is either directly or indirectly affected by human development and activity, and some areas that were historically winter range—mainly around the City of Whitehorse and surrounding area—have been permanently removed due to the expanding human footprint.

In order to maintain the long-term integrity of the winter range, a landscape-scale approach to identifying important habitat patches is required. The concept of **Priority Core Winter Habitat Areas** has been developed to identify the remaining patches of large, intact, high value winter habitat that provide secure areas for continued use by caribou within the winter range (**Figure 7**). **Appendix A** provides larger scale maps showing the location of priority core winter habitat areas in each caribou assessment area. Priority core winter habitat areas were delineated visually based on the largest patches of relatively intact, high value habitats shown on **Figure 4**, covering 1746 km² (14% of the Yukon portion of the annual range). At least one priority area is identified in each caribou assessment area. These priority habitat areas are envisioned to be the habitat patches that will support the long-term continued use of the different parts of the winter range by caribou.

As discussed in previous sections, many of the habitats with the highest lichen abundance are not just the result of mature seral stage forests. Rather, they are specific pine-lichen or pine/spruce-lichen forest ecosystems that occur only on coarse-textured soils and landforms of glacio-fluvial origin (Florkiewicz et al. 2007). The areas with the best potential lichen resources are therefore static in nature and limited in extent, and require special management consideration. Most of the priority core winter range habitat areas (as shown in **Figure 7**) are centered on the largest remaining patches of these forest ecosystem types with high lichen abundance or potential.

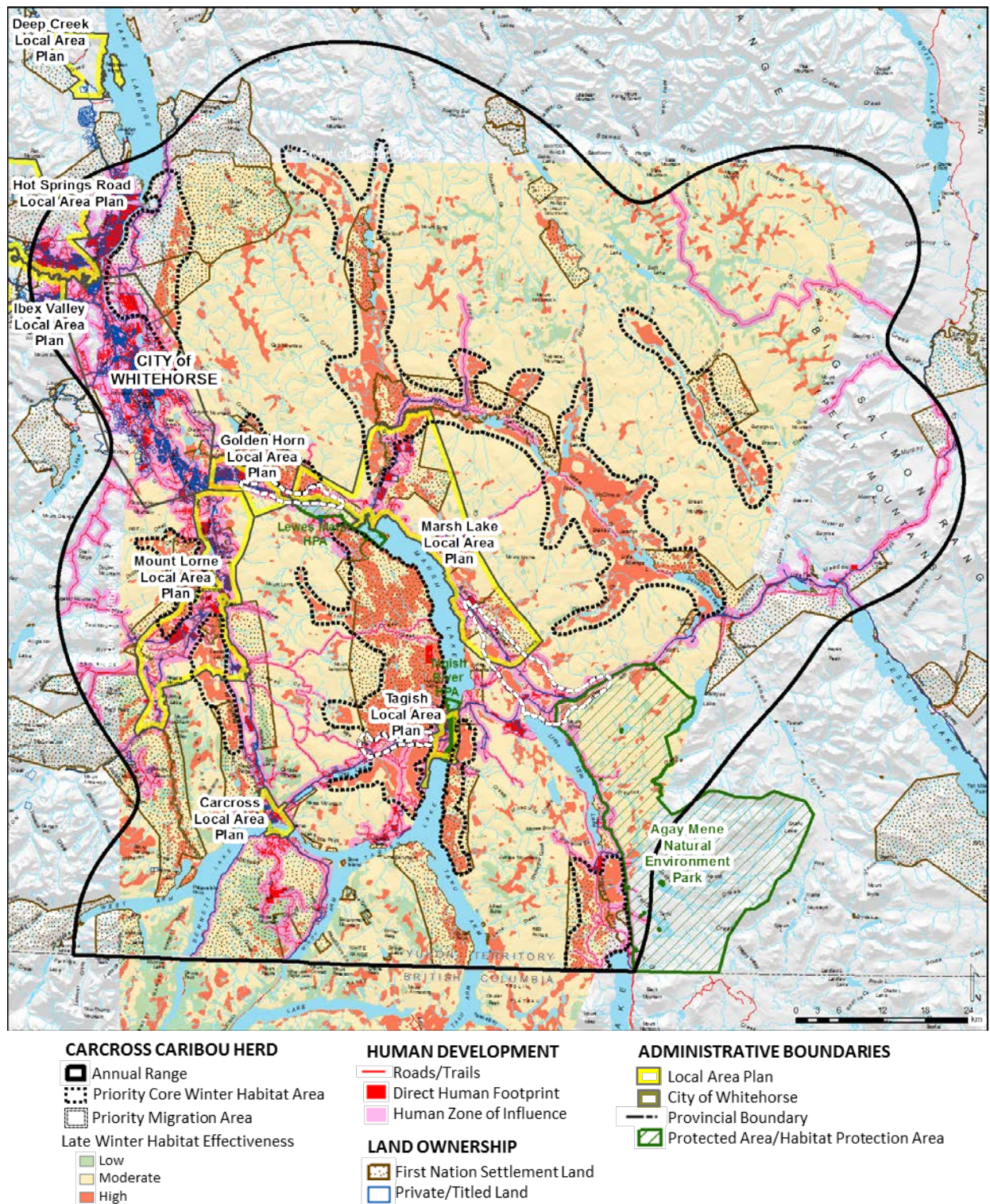


Figure 7. Recommended priority core winter habitat and migration areas within the Yukon portion of the Carcross herd range.

To maintain the long-term integrity of remaining intact, high value habitat patches within the Yukon portion of the winter range, the following strategies are recommended within the priority core winter habitat areas (as identified in **Figure 7**):

Objective	Strategies
Habitat Objective 1: Maintain the amount of remaining large, intact patches of high value winter habitat in the Yukon portion of the Carcross herd range. These priority core winter habitat areas represent 14% of the Yukon portion of the annual range (1746 km ²).	Habitat Strategy 1.1: Avoid new land dispositions in priority core winter habitat areas. New land dispositions (i.e., private titled land parcels) should not be allowed in the identified priority core winter habitat areas. • These areas should be kept intact with minimal human footprint. • Land disposition transfers land rights to private land holders, reducing Government's ability to manage areas for conservation.
	Habitat Strategy 1.2: Minimize fragmentation of priority core winter habitat areas. To minimize fragmentation, new all-season roads should be located outside of the priority core winter habitat areas. • If new access roads are required through these priority core winter habitat areas, they should be seasonal, temporary and managed.

5.1.2 Remaining Winter Habitat

In the southern part of the Yukon portion of the winter range, between 20% and 58% of the potential winter range has been affected by human development and activities. Within these areas, between 2% and 12% of the potential winter range has been permanently lost as a result of incremental expansion of the direct human development footprint. The combined effects of human development footprint and its associated zone of influence have resulted in a decline in the amount and quality of winter habitat (i.e., reduced habitat effectiveness). In many areas, the incremental reduction in winter range habitat effectiveness has generally occurred at a localized scale as a result of spot land applications, land parcel by land parcel. Around the Southern Lakes communities and surrounding country residential areas, remaining high quality habitats now exist as small patches fragmented by country residential properties, agricultural lands, gravel pits, roads, recreational trails and electrical utility corridors.

The pattern of residential and agricultural development in the Southern Lakes region has been a major contributing factor to the level and extent of habitat impacts within the Yukon portion of the Carcross herd winter range. To illustrate:

- While the City of Whitehorse and its periphery (including Hot Springs Road and North Klondike Highway) contains almost 50% (100 km²) of the total direct human development footprint in the Yukon portion of annual range, they contribute only 27% of the total zone of influence. Approximately 28,000 people reside within the municipal boundary, and most residences are in medium or high density subdivisions.

- In contrast, the country residential communities of Golden Horn and the Hamlet of Mount Lorne contain approximately 18% (37 km²) of the direct human development footprint, yet account for almost 20% of the total zone of influence. Approximately 600 people reside in the Golden Horn and Mount Lorne areas.
- The City of Whitehorse contains several large, medium to high density subdivisions, while low density country residential and agricultural lands are the main land uses outside the municipal boundary. A large number of dispersed residential properties and land parcels also require many access roads, resulting in a proportionally large zone of influence with greater indirect impacts on habitat quality. For comparison:
 - Proportionally, the ratio of direct footprint to human population for the City of Whitehorse and its periphery is 0.36 ha/person, while in Golden Horn and Mount Lorne it becomes 6.0 ha/person.
 - For the City of Whitehorse area, the ratio of total human zone of influence to human population is 1.79 ha/person, while in Golden Horn and Mount Lorne it becomes 60.0 ha/person.

To minimize the direct and indirect effects of future land development on remaining winter range habitat, a 'no net loss of high value winter habitat' concept is required: new private land parcels and residences should be located adjacent to existing parcels, and to the extent possible, they should be located in areas of lower quality winter habitat. The use of timing windows to minimize the amount of temporary land use activity during the late winter period is also required. These land planning principles are particularly important in the more heavily impacted southern portion of the winter range, where habitat effectiveness and habitat patch size has already experienced large reductions. In these areas, additional reductions in habitat effectiveness may result in portions of the winter range being abandoned, potentially affecting the carrying capacity of the range, and the population status of the herd.

To maintain the amount and effectiveness of remaining winter range habitat in the Yukon portion of the Carcross herd range, the following strategies are recommended:

Objective	Strategies
Habitat Objective 2: Maintain or increase the amount and effectiveness of remaining habitat in the Yukon portion of the Carcross herd winter range.	Habitat Strategy 2.1: Locate new land development within the existing human ZOI. New land dispositions and permanent human development (i.e., residential, agricultural, commercial and transportation) should be located within the existing human zone of influence (as shown in Figure 5). • This strategy is required to maintain or reduce the spatial extent of indirect human disturbance within the winter range. • New land development can be facilitated by increasing the population density of existing urban residential areas, through the use of planned country residential areas, or by allowing the subdivision of existing agricultural or country residential land parcels to accommodate higher population density.

Objective	Strategies
	Habitat Strategy 2.2: Within the existing human ZOI, locate new development in lower quality winter habitats. Within the existing human zone of influence, new dispositions and land development should be located in lower quality winter habitat types. • This strategy is required to reduce the amount of direct incremental loss of high value habitats, and further reduction of habitat effectiveness. • At this time, the fine-scale classification of remaining high quality habitats (e.g., mature pine-lichen forests) within the existing human zone of influence is not shown on Figure 4, as they are difficult to represent at viewing scales smaller than 1:50,000. <u>Site-specific habitat assessments will be required in areas being contemplated for future land disposition.</u>
	Habitat Strategy 2.3: Outside of the existing human ZOI, locate new temporary land uses in habitats with lower winter effectiveness. New temporary land use activities, such as forest harvesting or mineral exploration, that occur outside of the existing human zone of influence, should avoid areas with high winter habitat effectiveness (winter habitats with high effectiveness are shown in red on Figure 4).
	Habitat Strategy 2.4: In the core winter range and Priority Core Winter Habitat Areas, conduct temporary land use activities outside of the late winter period. When temporary land uses (e.g., fuelwood harvesting) are required within the core winter range or Priority Core Winter Habitat Areas, they should not occur during the late-winter period (January 1 – April 15). Such activity creates sensory disturbance that affects the use of these important winter habitat areas by caribou.

5.1.2.1 Habitat Reclamation and Enhancement

In addition to the habitat strategies listed above, habitat reclamation and enhancement may also contribute to maintaining or increasing the amount and quality of Carcross herd winter habitat. Habitat reclamation and enhancement assists in achieving the principle of ‘no net habitat loss’, and can assist in off-setting habitat loss or degradation in other areas.

However, it must be realized that it takes a significant amount of time for sites with high levels of soil disturbance to return to functional caribou habitat—potentially 50 to 70 years. For caribou, the reclamation efforts associated with land uses such as gravel pits, quarries, mineral exploration and development, and transportation may not be realized for decades. Caribou habitat reclamation and enhancement should therefore be viewed as a best management practice that is applied in all situations, as a complement to the habitat management strategies listed above.

Habitat reclamation and enhancement can be implemented where temporary land uses have been completed, or where legacy roads and trails, and use of them by people, are creating management concerns. Habitat reclamation and enhancement is already part of many land use practices that require assessment and permitting. It can be implemented in different ways:

- During the reclamation phase of mineral exploration, mineral development and their supporting transportation infrastructure;
- During forest or fuelwood harvest planning, reforestation and road decommissioning;
- Management of off-road vehicles and the establishment of designated trails or travel periods; and
- Reclamation of legacy roads and trails.

5.1.3 Migration Routes

The Carcross herd exists as a number of sub-groups that utilize discrete seasonal ranges during the summer and winter periods, with migration between the two ranges occurring in the spring and late-fall periods (**Table 1**). The summer range is generally in high elevation, subalpine and alpine areas, while the low elevation forested valley bottoms are used as the main wintering areas.

Seasonal movements provide increased forage availability and quality, as well as enhanced security from predation. The ability for northern mountain woodland caribou to move between seasonal ranges is vitally important. Barriers restricting these seasonal movements (e.g., roads, settlements or similar) may adversely affect caribou access to seasonally important food sources and areas used as refugia from predators and insects (Environment Canada 2012).

Generalized migration routes of the Carcross herd are shown in **Figure 3**. Given the configuration of the major mountain blocks, large lakes, and highways in the Southern Lakes region, some migration routes are critical to maintain connectivity between different areas of the winter range, and between the summer and winter ranges. The concept of **Priority Migration Areas** has been developed to identify these locations (**Figure 7**). **Appendix A** provides larger scale maps showing the location of priority migration areas in different parts of the range.

Three priority migration areas are identified:

- Judas Creek-Jakes Corner;
- Lewes Marsh-Golden Horn-Mount Lorne; and
- Tagish-Crag Lake.

These are areas with a high level of documented fall and spring use for caribou migration. The priority migration areas represent ‘funnel points’ across the Alaska, South Klondike and Tagish roads, and therefore also identify the locations of the highest number of recorded vehicle-caused caribou mortalities (**Figure 6**). These priority migration areas require special management consideration.

To allow continued caribou migration between different parts of the winter range, and between the summer and winter ranges, the following strategies are recommended:

Objective	Strategies
Habitat Objective 3: Maintain functional migration routes between Priority Core Winter Habitat Areas, and between the summer and winter ranges.	Habitat Strategy 3.1: Maintain Priority Migration Areas. New land dispositions and permanent human development should not be located in the Priority Migration Areas (priority migration areas are shown in Figure 7). • The priority migration areas, Judas Creek-Jakes Corner, Lewes Marsh-Golden Horn, and Tagish-Crag Lake, provide important migration corridors between many different areas of the Carcross herd range. • Keeping these areas as free of human-related barriers as possible will assist in maintaining the long-term connectivity of the Carcross herd range. • The large number of caribou mortalities resulting from vehicle collisions highlights the consistent and high level of use by caribou.
	Habitat Strategy 3.2: Maintain generalized migration routes. To the extent possible, avoid locating new private land parcels and permanent human development within identified generalized migration routes (generalized migration routes are shown in Figure 3). • Many of the generalized migration routes in the southern portion of the winter range are already affected by human development, roads and agricultural parcels. • In these areas, new permanent development may begin to create barriers to caribou movement, and site-specific assessment may be required.

5.2 Population-related Recommendations

Following the Southern Lakes Caribou Recovery Program, the Carcross herd population management goal is as follows:

POPULATION GOAL:

Avoid a decline in the Carcross herd population.

As summarized in Section 4.2, the current population size of the Carcross herd is considered to be approximately 775 animals, with a trend of stable or slowly increasing. The five-year average annual recruitment rate is 24 calves/100 cow caribou, which is considered adequate to maintain a stable population in the absence of additional mortality, increased habitat effects, or reduced cow fitness. While the herd has approximately doubled in size since 1997, the risk assessment conducted as part of this project suggests that it remains in a state of relatively low ecological resilience—a condition the herd will likely continue into the future¹³.

Low resilience means that the caribou herd and the range have limited capacity to absorb additional stressors that reduce habitat conditions (i.e., amount, effectiveness and availability, and/or connectivity) or risk factors that directly affect the population through increased rates of mortality and/or decreased productivity. In Yukon, the herd has not been harvested since 1992, removing one source of direct human-caused mortality. The largest remaining sources of direct human-caused mortality are vehicle collisions in Yukon and harvest in the British Columbia portion of the herd range. Hunting restrictions have been continually recommended for consideration in British Columbia. Population-related recommendations focus on vehicle collisions in Yukon.

5.2.1 Caribou Mortality Caused by Vehicle Collisions

Caribou mortality resulting from vehicle collisions is currently the largest source of direct human-caused mortality in the Yukon portion of the Carcross herd range. Most collisions occur when the herd is on the winter range or during its seasonal migration between the summer and winter ranges.

Over the past five years, an average of 5-6 caribou has been killed annually. The highest number of vehicle collisions occurs along the main highways of the Southern Lakes where vehicles travel at high speeds—the Alaska and South Klondike Highways. The highest number of collisions occurs in relatively predictable places where important migration routes cross the highways or where animals winter in the vicinity of the roads (**Figure 6**). The areas of highest concern are:

- Judas Creek-Jakes Corner;
- Golden Horn-Mount Lorne-Lewes Marsh; and
- Tagish-Crag Lake.

The Priority Migration Areas discussed in Section 5.1.3 (shown in **Figure 7**) include these areas where high numbers of vehicle collisions occur.

¹³ This finding is also supported by Florkiewicz (2008) and Hegel and Russell (2013).

Improved signage, vegetation clearing, and increased driver awareness has reduced the number of caribou mortalities from average historic levels of approximately 10 per year. While the number of annual caribou mortalities has been reduced, additional management intervention may not lead to further reductions. It is also possible that increasing traffic levels, resulting from a growing resident population or industrial activities, may lead to higher numbers of vehicle-caused caribou mortalities.

To reduce the potential number of future vehicle-caused caribou mortalities, and impacts on the Carcross herd population, the following strategies are recommended:

Objective	Strategies
Population Objective 1: Decrease the number of vehicle-caused caribou mortalities in the Carcross herd winter range.	Population Strategy 1.1: Continue existing efforts to reduce vehicle-caused caribou mortality in the Carcross herd winter range. Existing efforts to reduce vehicle-caused caribou should be continued: • Continue the efforts of the '<i>Preventing Yukon Wildlife Collisions Interdepartmental Working Group</i>' (Environment Yukon and Yukon Highways and Public Works). • Explore new innovations in signage technology that will better alert drivers to wildlife on highways. • Continue with existing vegetation clearing and management efforts. • Enhance the annual public awareness campaign with improved messaging and communication materials. • Target the long-haul trucking industry with educational materials and explore options for collision mitigation.

6 IMPLEMENTATION AND MONITORING

6.1 Implementation

Other plans (e.g., local area planning, forest management planning, regional land use planning, etc.), specific project reviews during YESAA and non-YESAA processes, and other initiatives (e.g., land use policy development and implementation) are intended to be the main implementation mechanism for recommendations contained in Sections 5 of this range assessment. This assessment is intended to complement and support these exercises by identifying management concerns in specific areas, and to provide recommendations that can then be considered during those other exercises.

6.2 Monitoring

Ongoing or periodic monitoring of the following indicators is suggested (**Table 5**).

Table 5. Suggested indicators for ongoing monitoring.

Indicator	Rationale	Frequency
CARIBOU HABITAT		
Direct human development footprint	• Direct human footprint is a consistent indicator of human-caused habitat change. • Direct human development footprint is the underlying human disturbance indicator in the Environment Canada (2011) suggested approach to assessing risk to woodland caribou population persistence. • The human footprint mapping developed for this project can be used as the basis for future comparison.	5 years
Wildfire activity (area burned)	• Wildfire is a major disturbance agent within woodland caribou ranges. • The area affected by wildfire is the main natural disturbance indicator in the Environment Canada (2011) suggested approach to assessing risk to woodland caribou population persistence. • The Yukon Wildfire Management Branch wildfire history database can be used for ongoing monitoring.	Annual
CARIBOU POPULATION		
Population size/trend	• Population estimates and trend monitoring is required to determine if a population decline is occurring and if management intervention may be required.	As resources allow or as determined necessary
Calf/cow ratios	• Calf/cow ratios are a reliable predictor of recruitment and population trend. • Fall surveys are used to determine calf/cow ratios.	Annual
Vehicle-caused mortality	• Vehicle-collisions are currently the largest source of human-caused caribou mortality in the Yukon portion of the range. • The location and number of caribou mortalities, and the sex of the animal killed, requires ongoing reporting.	Annual
LAND ADMINISTRATION		
Location of new approved land dispositions	• The location of new, approved land dispositions should be tracked to understand the location and pattern of change of new human development footprint within the winter range. • This indicator can be used as a proxy for changes in the amount and location of direct human development footprint.	Annual
Area of land with caribou conservation or protection zoning	• The area of land within parks, protected areas, or land use zoning bylaws that afford conservation or protection measures for caribou should be tracked. • These may include new parks or protected areas, or areas implemented through Local Area Plans, Development Regulations, or other agreements.	5 years or as planning processes are completed

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APPENDIX A: CARIBOU ASSESSMENT AREAS

Caribou assessment areas are part of the annual range used for more detailed assessment of disturbance, habitat, land use, land ownership or other factors affecting caribou. Eight assessment areas within the Yukon portion of the Carcross herd annual range have been identified (**Figure A1**):

1. **City of Whitehorse and Surrounding Area**
2. **Golden Horn - Hamlet of Mount Lorne**
3. **Carcross - South Klondike Highway - Bennett Lake**
4. **Marsh Lake - Lewes Marsh**
5. **Tagish - Taku Arm**
6. **Atlin Road - Jakes Corner - Johnsons Crossing**
7. **Squanga Lake - Michie Creek - M'Clintock Lakes**
8. **Teslin River - South Canol Road**

The caribou assessment areas were developed through consideration of human land use patterns and administrative boundaries (i.e., communities, existing land ownership, land management and land planning), and caribou seasonal ranges and habitats. **Table A1 - Table A4** display the status of disturbance and habitat indicators for the annual, potential winter and core winter ranges within each caribou assessment area. **Table A5** summarizes the current land ownership and management situation in each. A brief description and management recommendations, along with a series of larger scale maps showing the same information as in **Figure A1**, has also been developed for each caribou assessment area.

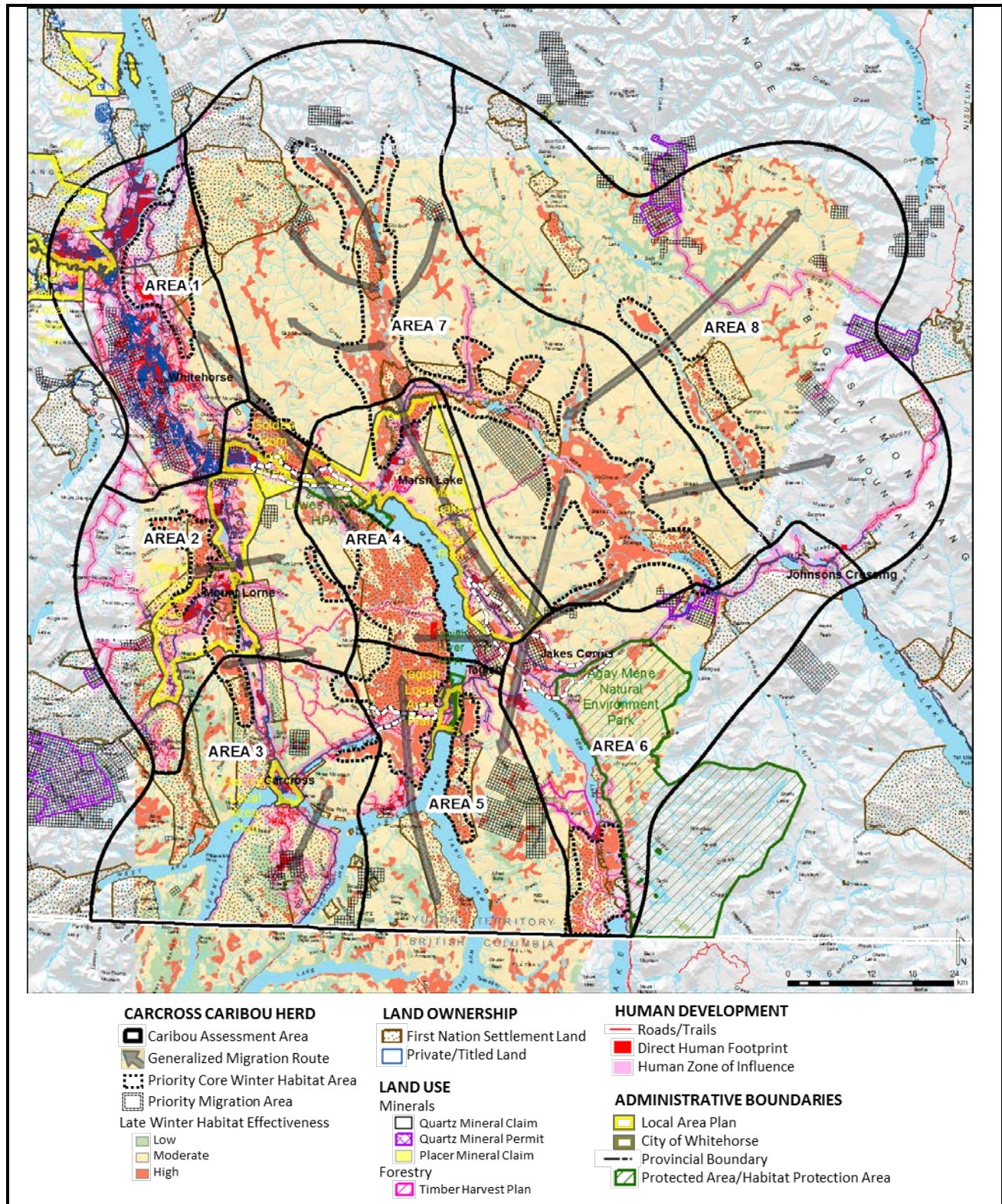


Figure A1. Overview of Carcross herd range caribou assessment areas (Areas 1 - 8).

Table A1. Summary of disturbance indicators for the Yukon portion of the Carcross herd **annual range**, reported by caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)			AREAL DISTURBANCE												LINEAR DISTURBANCE	
			Total Direct Human Development Footprint (FT)			Total Human Development ZOI (Direct Footprint + Indirect Effects)			Total Area Burned by Recent Wildfire (1946 – 2013)			Total Area Disturbed (Total Human Development ZOI + Recent Wildfire)			Total Linear Features (km)	Average Linear Density (km/km ²)
Assessment Area Name	Area (km ²)	Area (% annual range)	Area (km ²)	Area (% CAA)	Area (% total FT)	Area (km ²)	Area (% CAA)	Area (% total ZOI)	Area (km ²)	Area (% CAA)	Area (% total area burned)	Area (km ²)	Area (% CAA)	Area (%) total area disturbed)		
1. City of Whitehorse and Surrounding Area	918.39	7.50	100.07	10.90	49.54	501.92	54.65	27.37	112.09	12.21	12.70	552.69	60.18	21.24	1,655.61	1.80
2. Golden Horn - Hamlet of Mount Lorne	1,152.40	9.42	36.82	3.20	18.23	360.40	31.27	19.65	3.40	0.30	0.39	363.21	31.52	13.96	687.96	0.60
3. Carcross - South Klondike Highway - Bennett Lake	1,186.57	9.70	16.11	1.36	7.98	220.03	18.54	12.00	10.76	0.91	1.22	223.59	18.84	8.59	507.79	0.43
4. Marsh Lake - Lewes Marsh	914.42	7.47	18.04	1.97	8.93	205.84	22.51	11.22	46.77	5.11	5.30	247.94	27.11	9.53	350.69	0.38
5. Tagish – Taku Arm	996.38	8.14	11.99	1.20	5.94	137.03	13.75	7.47	3.68	0.37	0.42	139.50	14.00	5.36	304.03	0.31
6. Atlin Road - Jakes Corner - Johnsons Crossing	1,315.07	10.75	16.35	1.24	8.10	246.22	18.72	13.43	480.22	36.52	54.43	688.03	52.32	26.45	342.56	0.26
7. Squanga Lake - Michie Creek - M'Clintock Lakes	3,072.67	25.11	0.12	0.00	0.06	47.20	1.54	2.57	72.44	2.36	8.21	119.64	3.89	4.60	59.07	0.02
8. Teslin River - South Canol Road	2,681.17	21.91	2.49	0.09	1.23	115.27	4.30	6.29	152.96	5.71	17.34	266.97	9.96	10.26	151.07	0.06
ANNUAL RANGE TOTALS	12,237.06	100.00	202.00	1.65	100.00	1,833.92	14.99	100.00	882.33	7.21	100.00	2,601.58	21.26	100.00	4,058.79	0.33

Table A2. Summary of disturbance indicators for the Yukon portion of the Carcross herd **potential winter range***, reported by caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)			AREAL DISTURBANCE												LINEAR DISTURBANCE	
			Total Direct Human Development Footprint (FT)			Total Human Development ZOI (Direct Footprint + Indirect Effects)			Total Area Burned by Recent Wildfire (1946 – 2013)			Total Area Disturbed (Total Human Development ZOI + Recent Wildfire)			Total Linear Features (km)	Average Linear Density (km/km ²)
Assessment Area Name	Area (km ²)	Area (% annual range)	Area (km ²)	Area (% CAA)	Area (% total FT)	Area (km ²)	Area (% (CAA)	Area (% total ZOI)	Area (km ²)	Area (% CAA)	Area (% total area burned)	Area (km ²)	Area (% CAA)	Area (%) total area disturbed)		
1. City of Whitehorse and Surrounding Area	918.39	7.50	99.78	12.12	50.81	474.22	57.60	29.77	108.76	13.21	13.23	522.17	63.43	22.68	1,616.90	1.96
2. Golden Horn - Hamlet of Mount Lorne	1,152.40	9.42	36.14	5.06	18.40	294.75	41.30	18.50	3.40	0.48	0.41	297.57	41.70	12.92	605.25	0.85
3. Carcross - South Klondike Highway - Bennett Lake	1,186.57	9.70	12.13	1.99	6.18	154.86	25.47	9.72	8.62	1.42	1.05	156.28	25.70	6.79	426.50	0.70
4. Marsh Lake - Lewes Marsh	914.42	7.47	18.00	2.40	9.16	182.22	24.26	11.44	44.84	5.97	5.45	222.39	29.60	9.66	348.23	0.46
5. Tagish – Taku Arm	996.38	8.14	11.94	1.97	6.08	123.54	20.36	7.76	3.33	0.55	0.40	125.66	20.71	5.46	300.29	0.49
6. Atlin Road - Jakes Corner - Johnsons Crossing	1,315.07	10.75	16.27	1.45	8.29	233.77	20.84	14.68	448.62	39.99	54.55	644.59	57.46	28.00	341.89	0.30
7. Squanga Lake - Michie Creek - M'Clintock Lakes	3,072.67	25.11	0.12	0.01	0.06	47.19	2.44	2.96	65.24	3.37	7.93	112.43	5.81	4.88	59.07	0.03
8. Teslin River - South Canol Road	2,681.17	21.91	2.01	0.14	1.02	82.40	5.73	5.17	139.52	9.71	16.97	221.32	15.40	9.61	121.50	0.08
ANNUAL RANGE TOTALS	12,237.06	100.00	196.39	2.46	100.00	1,592.96	19.92	100.00	822.32	10.28	100.00	2,302.41	28.79	100.00	3,819.64	0.48

*The Carcross herd **potential winter range** is 7,998.34 km² in area, representing 65.36% of the Yukon portion of the herd's annual range.

Table A3. Summary of disturbance indicators for the Yukon portion of the Carcross herd **core winter range***, reported by caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)			AREAL DISTURBANCE												LINEAR DISTURBANCE	
			Total Direct Human Development Footprint (FT)			Total Human Development ZOI (Direct Footprint + Indirect Effects)			Total Area Burned by Recent Wildfire (1946 – 2013)			Total Area Disturbed (Total Human Development ZOI + Recent Wildfire)			Total Linear Features (km)	Average Linear Density (km/km ²)
Assessment Area Name	Area (km ²)	Area (% annual range)	Area (km ²)	Area (% CAA)	Area (% total FT)	Area (km ²)	Area (% CAA)	Area (% total ZOI)	Area (km ²)	Area (% CAA)	Area (% total area burned)	Area (km ²)	Area (% CAA)	Area (%) total area disturbed)		
1. City of Whitehorse and Surrounding Area	918.39	7.50	27.04	9.10	28.84	125.19	42.14	15.53	8.05	2.71	6.28	125.37	42.20	13.75	358.53	1.21
2. Golden Horn - Hamlet of Mount Lorne	1,152.40	9.42	25.78	4.32	27.51	178.86	29.96	22.19	3.40	0.57	2.65	181.67	30.43	19.92	376.38	0.63
3. Carcross - South Klondike Highway - Bennett Lake	1,186.57	9.70	8.30	2.29	8.86	98.66	27.24	12.24	0.39	0.11	0.30	98.73	27.26	10.83	192.49	0.53
4. Marsh Lake - Lewes Marsh	914.42	7.47	11.00	1.73	11.74	140.26	22.01	17.40	42.18	6.62	32.91	178.18	27.97	19.54	255.63	0.40
5. Tagish – Taku Arm	996.38	8.14	11.98	2.36	12.78	133.70	26.37	16.58	3.68	0.73	2.87	136.16	26.85	14.93	299.03	0.59
6. Atlin Road - Jakes Corner - Johnsons Crossing	1,315.07	10.75	9.55	2.83	10.19	96.06	28.42	11.92	20.77	6.14	16.21	108.71	32.16	11.92	143.71	0.43
7. Squanga Lake - Michie Creek - M'Clintock Lakes	3,072.67	25.11	0.08	0.01	0.08	33.43	2.45	4.15	49.69	3.64	38.77	83.12	6.09	9.11	39.71	0.03
8. Teslin River - South Canol Road	2,681.17	21.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ANNUAL RANGE TOTALS	12,237.06	100.00	93.74	2.28	100.00	806.15	19.64	100.00	128.15	3.12	100.00	911.95	22.22	100.00	1,665.47	0.41

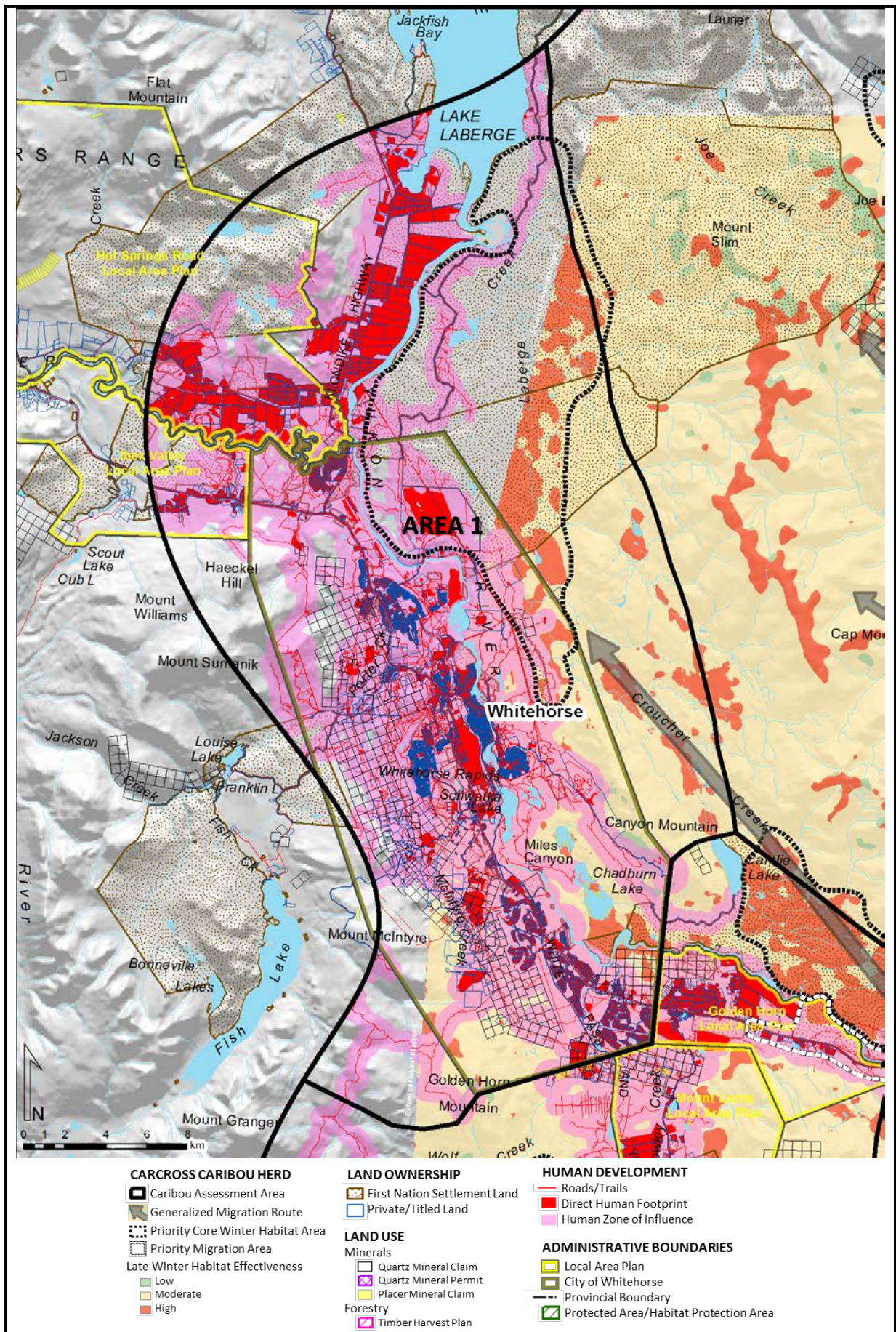
*The Carcross herd **core winter range** is 4,103.72 km² in area, representing 33.54% of the Yukon portion of the herd's annual range.

Table A4. Amount of mapped high value (i.e., high habitat effectiveness) late winter habitat in the Yukon portion of the Carcross herd annual range, reported by caribou assessment area (described in Section 3.2.2.1). In Figure A1 and the following larger scale caribou assessment area maps, high value habitats are shown in red.

CARIBOU ASSESSMENT AREA (CAA)					HIGH VALUE LATE WINTER HABITAT		
Assessment Area Name	Area (km ²)	Area (% annual range)	Extent of Habitat Mapping (km ²)	Extent of Habitat Mapping (% of CAA)	Area (km ²)	Area (% of habitat mapping)	Area (% total mapped high value habitat)
1. City of Whitehorse and Surrounding Area	918.39	7.50	374.08	40.73	49.30	13.18	3.72
2. Golden Horn - Hamlet of Mount Lorne	1,152.40	9.42	935.03	81.14	123.37	13.19	9.30
3. Carcross - South Klondike Highway - Bennett Lake	1,186.57	9.70	1,109.16	93.48	112.97	10.19	8.52
4. Marsh Lake - Lewes Marsh	914.42	7.47	913.31	99.88	193.29	21.16	14.58
5. Tagish – Taku Arm	996.38	8.14	994.97	99.86	185.50	18.64	13.99
6. Atlin Road - Jakes Corner - Johnsons Crossing	1,315.07	10.75	848.55	64.52	115.90	13.66	8.74
7. Squanga Lake - Michie Creek - M'Clintock Lakes	3,072.67	25.11	2521.45	82.06	392.02	15.55	29.57
8. Teslin River - South Canol Road	2,681.17	21.91	1677.60	62.57	153.48	9.15	11.58
ANNUAL RANGE TOTALS	12,237.06	100.00	9,374.15	76.60	1,325.83	14.14	100.00

Table A5. Summary of land ownership and management by caribou assessment area.

CARIBOU ASSESSMENT AREA (CAA)			LAND OWNERSHIP									LAND MANAGEMENT CONSIDERATIONS
			Yukon Public Land			First Nation Settlement Land			Private or Titled Land			
Assessment Area Name	Area (km ²)	Area (% annual range)	Area (km ²)	Area (% CAA)	Area (% total public land)	Area (km ²)	Area (% CAA)	Area (% total FN land)	Area (km ²)	Area (% CAA)	Area (% total private land)	
1. City of Whitehorse and Surrounding Area	918.39	7.50	518.66	56.48	5.48	260.85	28.40	10.16	138.88	15.12	67.17	Municipality: City of Whitehorse (400 km2); Local Area Plans: Hot Springs Road; Ibex Valley
2. Golden Horn - Hamlet of Mount Lorne	1,152.40	9.42	781.95	67.85	8.26	338.19	29.35	13.17	32.25	2.80	15.60	Local Area Plans: Golden Horn; Hamlet of Mount Lorne
3. Carcross - South Klondike Highway - Bennett Lake	1,186.57	9.70	728.17	61.37	7.70	447.20	37.69	17.41	11.20	0.94	5.42	Local Area Plan: Community of Carcross Local Advisory Area: South Klondike
4. Marsh Lake - Lewes Marsh	914.42	7.47	500.81	54.77	5.29	404.34	44.22	15.74	9.27	1.01	4.48	Local Area Plan: Marsh Lake (in prep.) Forest Management: Marsh Lake THP Habitat Protection Area: Lewes Marsh (20.5 km2)
5. Tagish – Taku Arm	996.38	8.14	712.74	71.53	7.53	275.70	27.67	10.73	7.94	0.80	3.84	Local Area Plan: Community of Tagish (in prep.) Local Advisory Area: South Klondike Habitat Protection Area: Tagish River (5.0 km2)
6. Atlin Road - Jakes Corner - Johnsons Crossing	1,315.07	10.75	1,082.88	82.34	11.44	225.04	17.11	8.76	7.16	0.54	3.46	Forest Management: Lubbock Valley THP Protected Area: Agay Mene Natural Environment Park (approximately half of park, 333 km2, is in Carcross herd range)
7. Squanga Lake - Michie Creek - M'Clintock Lakes	3,072.67	25.11	2,616.12	85.14	27.65	456.55	14.86	17.78	0.01	0.00	0.00	No specific considerations at this time.
8. Teslin River - South Canol Road	2,681.17	21.91	2,520.67	94.01	26.64	160.46	5.98	6.25	0.05	0.00	0.02	No specific considerations at this time.
ANNUAL RANGE TOTALS	12,237.06	100.00	9,461.99	77.32	100.00	2,568.33	20.99	100.00	206.74	1.69	100.00	

AREA 1: CITY OF WHITEHORSE AND SURROUNDING AREA

AREA 1: CITY OF WHITEHORSE AND SURROUNDING AREA**STATUS**

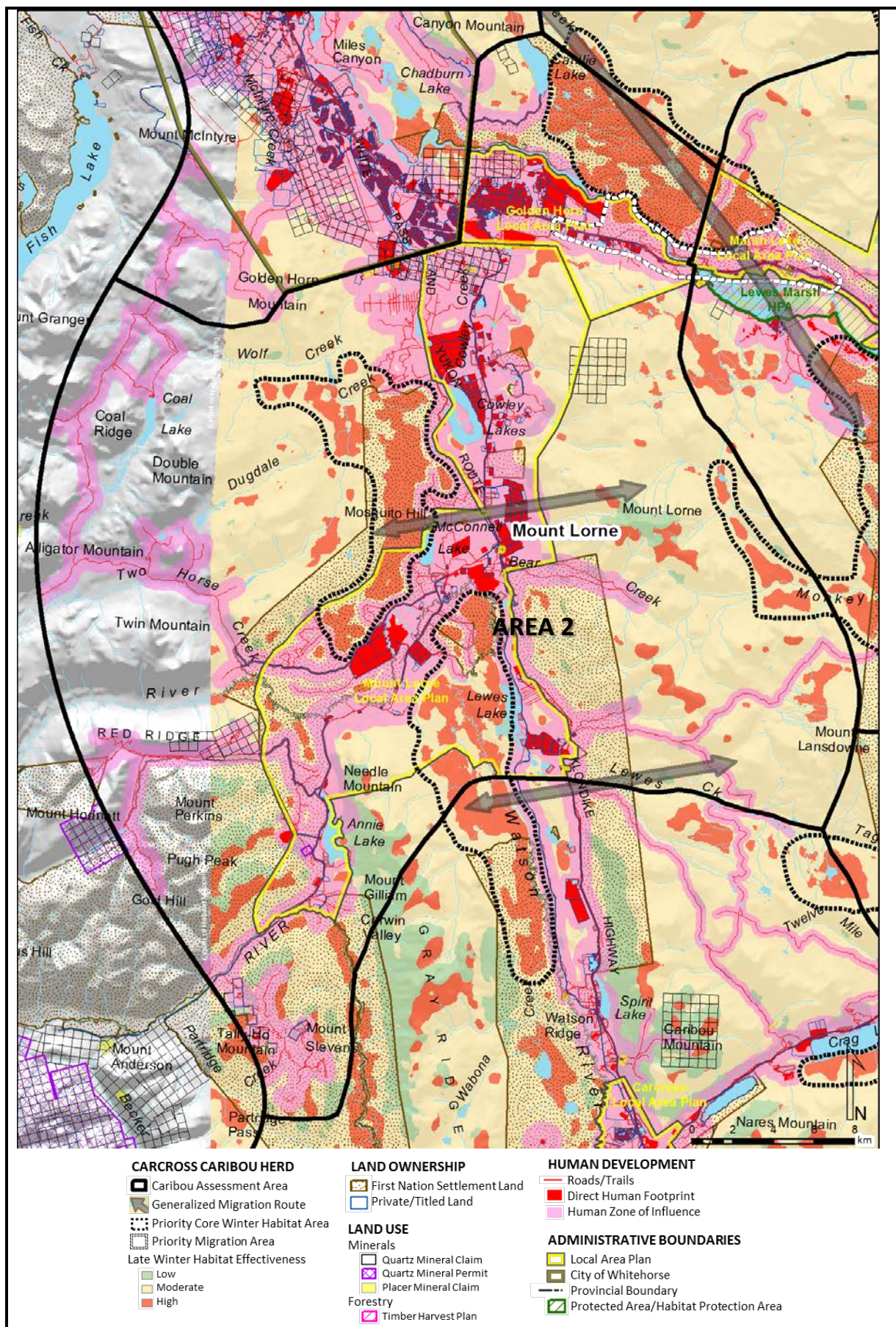
- The City of Whitehorse and its surrounding area is the most heavily developed part of the Carcross herd range. Approximately 60% (474 km²) of the area is affected by human activities, and 50% (100 km²) of the total direct human development footprint in the Yukon portion of the herd's range occurs in this area.
- This assessment area includes the City of Whitehorse municipal area, the Ibex Valley and Hot Springs Road Local Area Plan areas, as well as Mayo Road.
- The City of Whitehorse is home to 80% of Yukon's total human population, and 28,000 of the approximate 29,000 residents within the Carcross herd range.
- Approximately 70% (139 km²) of all private or titled lands are in the Whitehorse area.
- A large number of long standing mineral claims (e.g., the Whitehorse Copper Belt) are located on the west side of City of Whitehorse.
- Given the expanding human development footprint, most low elevation areas to the west of the Yukon River have largely been lost from the potential winter range. South of the Takhini River, residential, commercial, transportation, industrial and recreational land uses have removed or affected large areas of potential winter habitat. North of the Takhini River, along Hotsprings Road and the North Klondike Highway, large areas have been converted to agriculture.
- Infrastructure development, an expanding trail and road network, fuel wood cutting, and winter recreation around the City of Whitehorse sewage treatment facility and Livingstone Trail is affecting the last remaining large patch of high value winter habitat in the Whitehorse area.

MANAGEMENT CONSIDERATIONS**Winter Habitat**

- The Livingstone Trail area has been identified as a **Priority Core Winter Habitat Area**, and should be maintained in as natural a state as possible. New land dispositions and permanent development should not be located within the winter habitat area. This represents the last large patch of relatively contiguous, high value winter habitat in the Whitehorse area.
- Personal fuel wood harvesting should not occur in the Long Lake road / Livingstone Trail areas during the late winter period (January 1 to April 15), the time of year when caribou are most likely in the area.

Migration

- The Croucher Creek-Cantlie Lake area is an important migration route for caribou moving between the Livingstone Trail area, Marsh Lake, and other locations.

AREA 2: GOLDEN HORN – HAMLET OF MOUNT LORNE

AREA 2: GOLDEN HORN – HAMLET OF MOUNT LORNE**STATUS**

- With a resident population of approximately 600 people, this assessment area includes the Golden Horn Subdivision, the Hamlet of Mount Lorne, Annie Lake Road, and a number of residences along the South Klondike Highway.
- Given its proximity to the City of Whitehorse, this area has become a desirable location for country residential development.
- Two approved Local Area Plans, Golden Horn and Mount Lorne, provide management direction for parts of the assessment area.
- A dispersed pattern of country residential and agricultural parcels has affected a proportionally large amount of area for a limited human population size – over 40% of the potential winter habitat is within the human zone of influence.
- Carcross caribou winter in the Mount Lorne-Annie Lake Road areas; these areas are considered to be part of the core winter range.
- Additional agricultural and country residential expansion in this area may result in caribou abandonment of this part of the winter range.

MANAGEMENT CONSIDERATIONS**Winter Habitat**

- Two habitat patches to the west of Cowley Lakes and Lewes Lake-Watson River have been identified as **Priority Core Winter Habitat Areas**, and should be maintained in as natural a state as possible. New land dispositions and permanent development should not be located within this core winter habitat area. These Priority Core Winter Habitat Areas represent the last large patches of relatively contiguous, high value habitat in the Mount Lorne-Annie Lake Road areas.
- In addition to the Priority Core Winter Habitat Area, maintaining the remaining small patches of winter habitat is needed to ensure continued use of the area by caribou. New human development should therefore be located within the existing human zone of influence, and avoid high quality winter habitats.

Migration

- A **Priority Migration Area** has been identified on the Alaska Highway east of the Golden Horn subdivision. New land dispositions and permanent development should not be located within the migration area. A number of caribou mortalities resulting from vehicle collision also occur here.
- Caribou move between the forested valley bottoms and Mount Lorne in spring and fall, and are sometimes known to overwinter on Mount Lorne.

Vehicle Collisions

- Caribou mortalities resulting from vehicle collisions occur along the Alaska Highway near Golden Horn subdivision, and along the South Klondike Highway between the Alaska Highway and Bear Creek.

AREA 3: CARCROSS – SOUTH KLONDIKE HIGHWAY – BENNETT LAKE**STATUS**

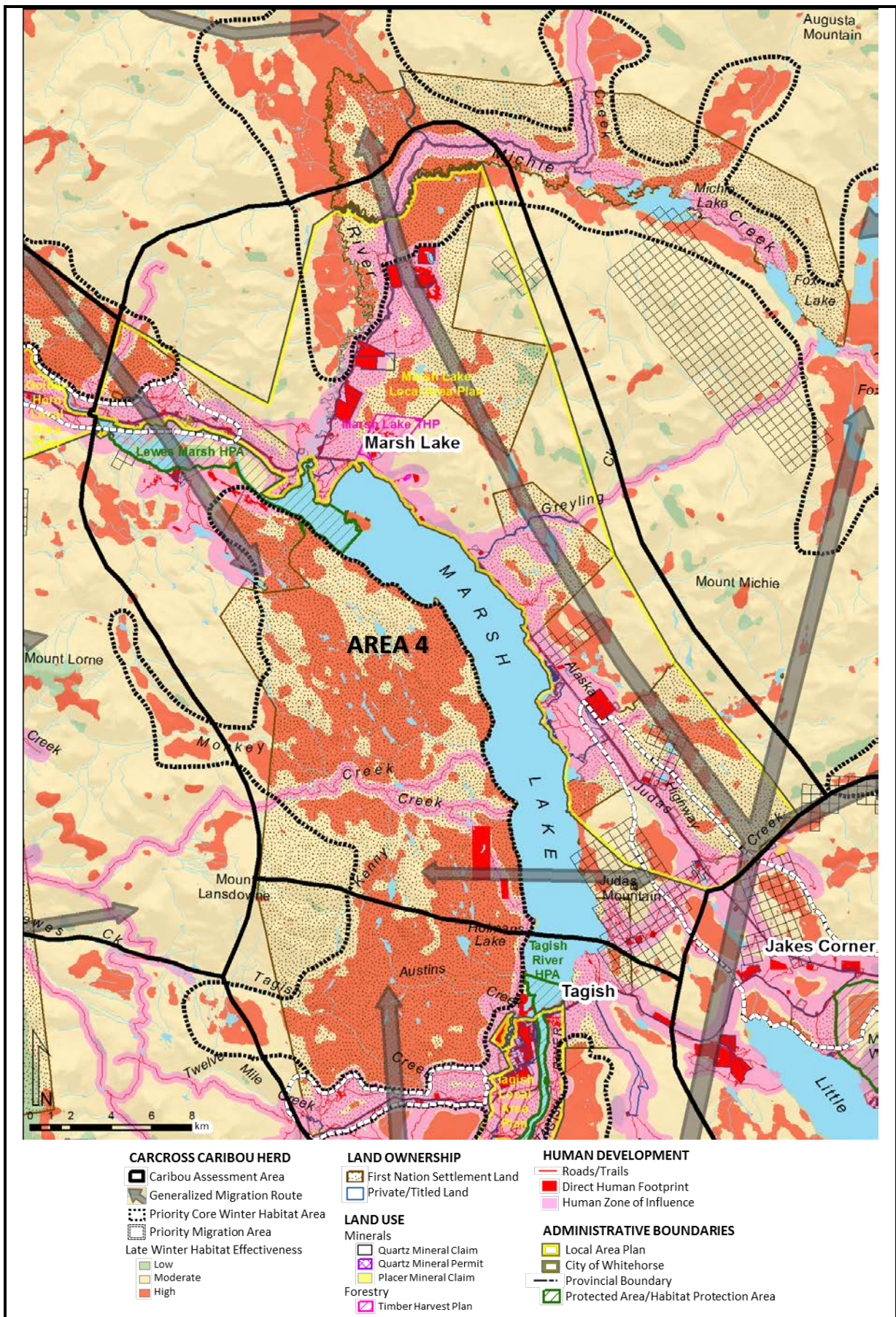
- With a resident population of approximately 500 people, this assessment area includes the Community of Carcross and residences along the South Klondike Highway.
- Given its proximity to the City of Whitehorse, this area has become a desirable location for country residential development, and is being promoted for tourism and recreation. There is ongoing interest in tourism facilities and lake-side recreational lots.
- The Community of Carcross Local Area Plan is approved and provides management direction for a small part of the assessment area.
- There are fewer country residential and agricultural parcels in this area than in the adjacent Hamlet of Mount Lorne-Annie Lake Road areas – approximately 25% of the potential winter habitat is affected by human activities.
- Carcross caribou winter in the vicinity of the South Klondike Highway, and sometimes also utilize Montana Mountain. These areas are considered to be part of the core winter range.

MANAGEMENT CONSIDERATIONS**Winter Habitat**

- The Lewes Lake-Watson River **Priority Core Winter Habitat Area** occurs in this assessment area, and should be maintained in as natural a state as possible. This area represents the last large patch of relatively contiguous, high value, valley bottom winter habitat in the Carcross area.
- In addition to the Priority Core Winter Habitat Area, maintaining the remaining small patches of winter habitat is needed to ensure continued use of the area by caribou. New human development should therefore be located within the existing human zone of influence, and avoid high quality winter habitats.

Migration

- The original name of the community of Carcross—*Caribou Crossing*—reflects the importance of the Tagish Lake-Carcross narrows area for caribou migration. The narrows remains an important spring and fall movement corridor between Montana Mountain and Crag Lake-Marsh Lake.

AREA 4: MARSH LAKE – LEWES MARSH

AREA 4: MARSH LAKE – LEWES MARSH**STATUS**

- With a resident population of approximately 500 people, this assessment area includes the various subdivisions of Marsh Lake and the Alaska Highway.
- Given its proximity to the City of Whitehorse, the area has become a desirable location for country residential and large-lot subdivision development.
- As of July 2014, the Marsh Lake Local Area Plan is in development.
- The Marsh Lake Timber Harvest Plan is located to the east of the M’Clintock River.
- Except for the M’Clintock River valley, most human development is located in a narrow band between the Alaska Highway and Marsh Lake. Several agricultural parcels and country residential properties are located in the M’Clintock valley.
- The Marsh Lake area is the ‘heart’ of the Carcross herd annual range in Yukon. Given the configuration of the mountains and large lakes, the area provides an important connection between the southern and northern parts of the range, and the seasonal summer and winter habitats.
- The area contains two important migration routes: Judas Creek and Lewes Marsh. The section of the Alaska Highway around Judas Creek has the highest number of recorded caribou mortalities resulting from vehicle collisions in the Southern Lakes region.
- The Marsh Lake assessment area contains a relatively large proportion of high value winter habitat. Two areas of note are: 1) the west shore of Marsh Lake, around Monkey Creek, and 2) the M’Clintock valley. The west shore of Marsh Lake is the largest remaining area of remaining intact, high value winter habitat in the central portion of the Carcross herd winter range.
- The Lewes Marsh Habitat Protection Area (HPA) is within this assessment area.

MANAGEMENT CONSIDERATIONS**Winter Habitat**

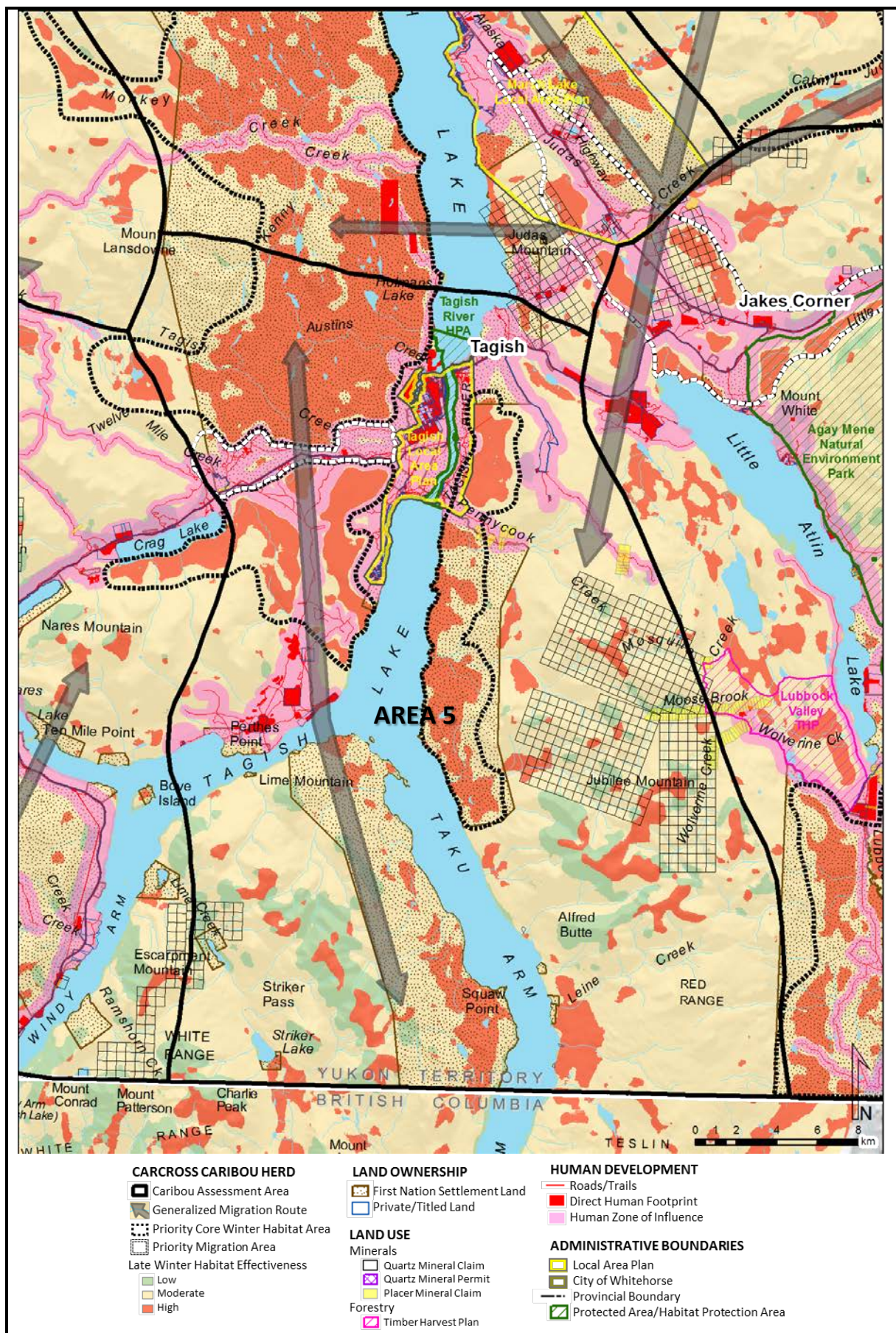
- The area on the west shore of Marsh Lake has been identified as a **Priority Core Winter Habitat Area**, and should be maintained in as natural a state as possible. New land dispositions and permanent development should not be located within the winter habitat area. The west shore of Marsh Lake is the largest remaining area of intact, high value winter habitat in the central portion of the Carcross herd winter range.
- In addition to the Priority Core Winter Habitat Areas, maintaining the remaining small patches of winter habitat is needed to ensure continued caribou use and migration through the area. New human development should therefore be located within the existing human zone of influence, and avoid high quality winter habitats.

Migration

- Two **Priority Migration Areas** have been identified on the Alaska Highway: one at Judas Creek, and the second at Lewes Marsh. New land dispositions and permanent development should not be located within these migration areas.
- Caribou also move north-south, parallel to the Alaska Highway, while traveling between the more remote winter areas near M’Clintock Lakes and summer ranges in the southern part of the range.

Vehicle Collisions

- A high number of caribou mortalities resulting from vehicle collision occur in the Priority Migration Areas, and along the Alaska Highway, in the vicinity of Marsh Lake.

AREA 5: TAGISH – TAKU ARM

AREA 5: TAGISH – TAKU ARM**STATUS**

- The community of Tagish has a resident population of approximately 250 people, but a much larger number own cabins and residences, and visit and recreate in the area seasonally.
- Given its proximity to the City of Whitehorse, there is ongoing demand for country residential / cottage lot development within the community of Tagish.
- Most human development is centered around the community of Tagish, along the Tagish Road between Carcross and Jakes Corner, and at Perthes Point, on the north shore of Tagish Lake, where a number of agricultural parcels are located. Large areas along Taku Arm are relatively unaffected by human development or activities.
- A number of quartz mineral claims, and a smaller number of placer claims, are located on Jubilee Mountain and along Moose Brook/Wolverine Creek, respectively.
- As of July 2014, the Tagish Local Area Plan is in development.
- Similar to Marsh Lake, the community of Tagish occurs at the ‘cross-roads’ of the northern and southern parts of Yukon portion of the annual range. The area contains at least two important migration routes: 1) along the Tagish Road, between Crag Lake and the community of Tagish, and 2) Jubilee Mountain to Little Atlin Lake-Judas Creek. There have been a high number of recorded caribou mortalities resulting from vehicle collisions at the Tagish Road crossing.
- Areas to the west of the community of Tagish, and along the west shores of Marsh and Tagish Lakes, contain relatively large areas of high value winter habitat. The area along Marsh Lake is contiguous with areas to the north in the Marsh Lake caribou assessment area (Area 4), forming the largest remaining area of intact high value winter habitat in the south-central portion of the winter range.
- The Tagish River Habitat Protection Area (HPA) is within this assessment area.

MANAGEMENT CONSIDERATIONS**Winter Habitat**

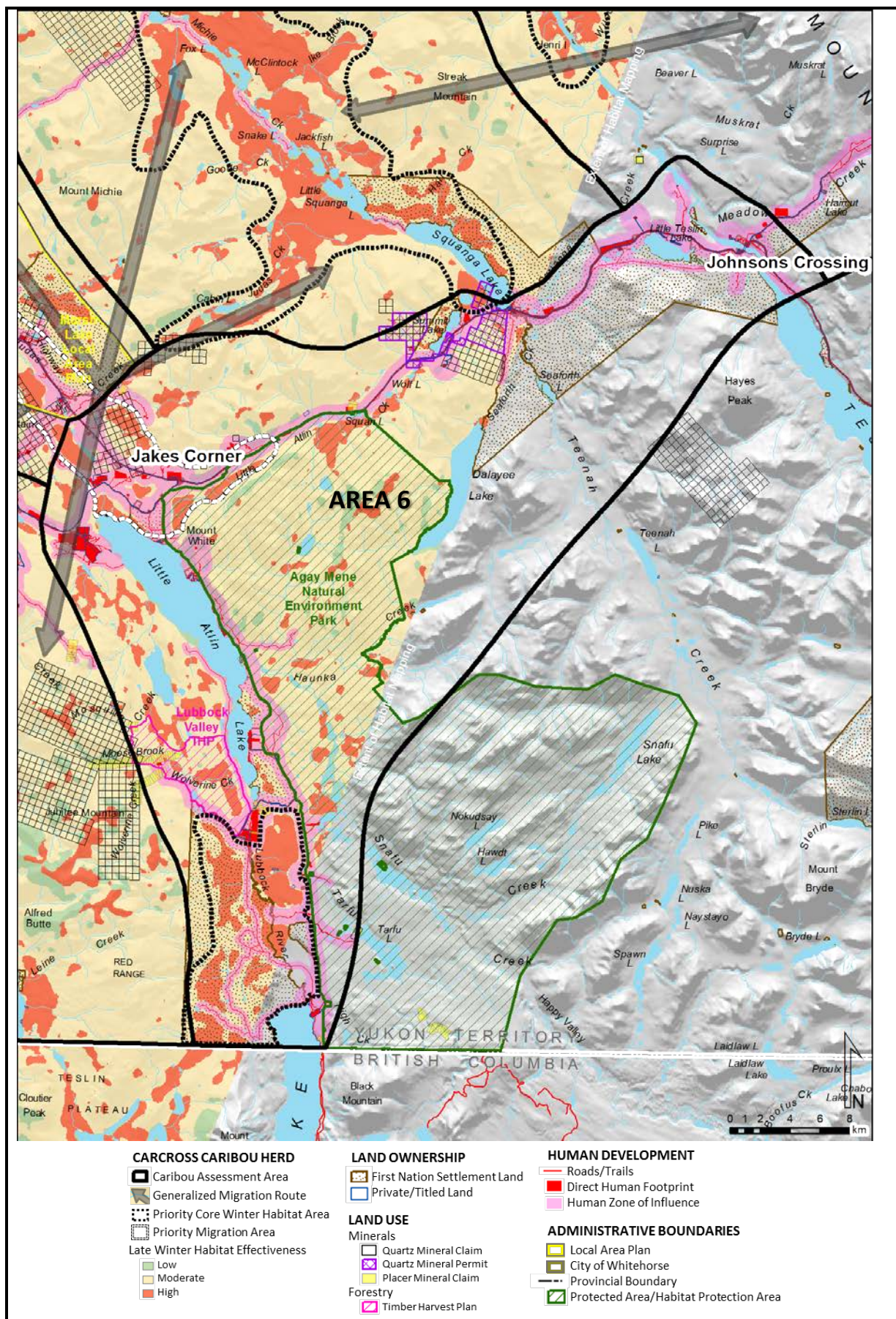
- Areas to the west of the community of Tagish and along the east shore of Tagish Lake have been identified as **Priority Core Winter Habitat Areas**. These should be maintained in as natural a state as possible. New land dispositions and permanent development should not be located within these winter habitat areas. The winter habitat area along the west shore of Marsh Lake is the largest remaining area of intact, high value winter habitat in the central portion of the winter range.
- In addition to the Priority Core Winter Habitat Areas, maintaining the remaining small patches of winter habitat is needed to ensure continued caribou use and migration throughout the area. New human development should therefore be located within the existing human zone of influence, and avoid high quality winter habitats. Maintaining these small patches is particularly important around the community of Tagish.

Migration

- The Tagish-Crag Lake **Priority Migration Area** occurs in this assessment area. New land dispositions and permanent development should not be located within this migration area. Also of note for its importance to caribou migration is the area between the community of Tagish and Little Atlin Lake, along the Tagish Road.

Vehicle Collisions

- A number of caribou mortalities resulting from vehicle collision occur along the Tagish Road, in the vicinity of the Tagish-Crag Lake Priority Migration Area.

AREA 6: ATLIN ROAD – JAKES CORNER – JOHNSONS CROSSING

AREA 6: ATLIN ROAD - JAKES CORNER – JOHNSONS CROSSING**STATUS**

- This area has a resident population of less than 100 people.
- A moderate amount (20%, or 246 km²) or of the area has been affected by human activities, and almost all human development (agriculture and country residential) is scattered along the Alaska Highway and Atlin Road.
- A small area of placer claims is located on Moose Brook and Wolverine Creeks. The Squanga Lake area has received a moderate level of quartz mineral activity, and active permits are in place.
- The Lubbock Valley Timber Harvest Plan (THP) is located at the south end of Little Atlin Lake. As of July 2014, one commercial timber operator was active in the THP area.
- While much of the area has not been affected by human activities, a large proportion (more than 50%) of this area was burned in a 1958 wildfire. Much of the area affected is potential winter range but the forests are recovering slowly and are currently considered low value winter habitat (i.e., large areas still remain as dense pine stands with limited understory development).
- The most significant feature in the area is Agay Mene Natural Environment Park, which accounts for almost 25% of the total assessment area. Approximately half of Agay Mene is within the Carcross herd range. This is the largest SMA in the Yukon portion of the annual range yet represents only 4.2% of the total potential winter range. As of July 2014, a management plan for Agay Mene had not been completed—the area is not currently withdrawn from land use disposition or other land uses. Therefore, at this time Agay Mene provides limited conservation value for the Carcross herd.
- The section of the Alaska Highway, between Jakes Corner and Squanga Lake, is an important migration route for caribou moving between the high elevation summer ranges such as Jubilee Mountain and the lower elevation winter range north of Squanga Lake. Caribou mortalities resulting from vehicle collisions occur in this area.

MANAGEMENT CONSIDERATIONS**Winter Habitat**

- An area around Lubbock Creek, along the Atlin Road, has been identified as a **Priority Core Winter Habitat Area**. This area should be maintained in as natural a state as possible. New land dispositions and permanent development should not be located within this winter habitat area.
- Much of the Agay Mene Natural Environment Park is potential winter range but has not yet recovered from a large 1958 wildfire. In the future, these areas may become high value winter habitat.
- In addition to the Priority Core Winter Habitat Area, maintaining the remaining small patches of winter habitat is needed to ensure continued use of the area by caribou. This is particularly important around the rural properties along Little Atlin Lake, Jakes Corner, and Squanga Lake.

Migration

- A portion of the Judas Creek-Jakes Corner **Priority Migration Area** is in this assessment area. New land dispositions and permanent development should not be located within this migration area.

Vehicle Collisions

- A number of caribou mortalities resulting from vehicle collisions occur along the Alaska Highway, between Johnsons Crossing and Judas Creek. The highest numbers of collisions are in the Judas Creek-Jakes Corner Priority Migration Area.

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AREA 7: SQUANGA LAKE – MICHIE CREEK – M’CLINTOCK LAKES**STATUS**

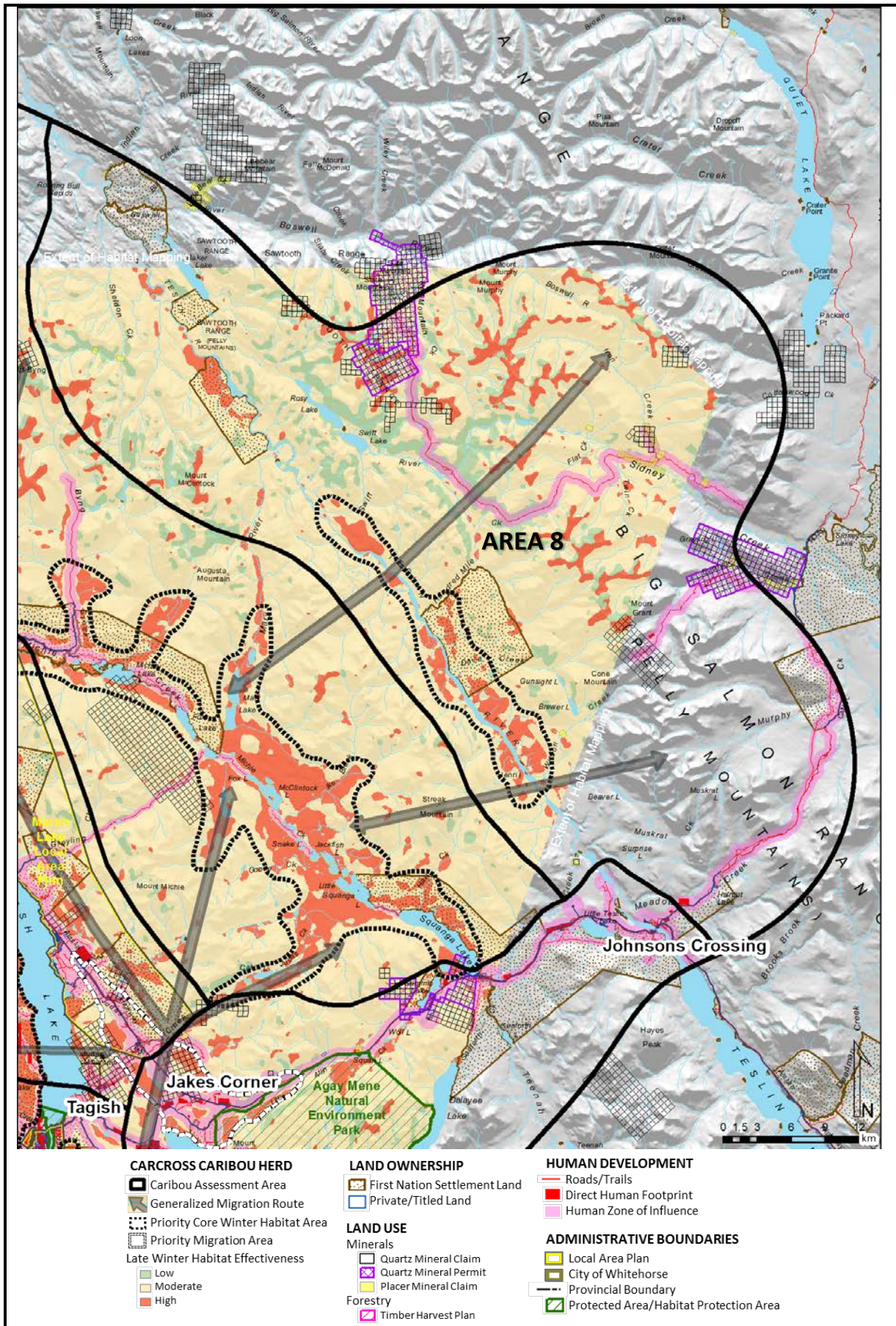
- This is the largest assessment area in the Carcross herd range, accounting for 25% (3,073 km²) of the Yukon portion of the herd’s annual range.
- Much of this assessment area is remote and receives limited human use—there are currently relatively few direct management concerns. Less than 3% (47 km²) of the area has been affected by human activities and there are no human settlements, residences, or permanent roads. A limited number of trails provide access to Michie and Byng Creeks. Quartz mineral claims are present in some high elevation areas.
- Less than 4% of the potential winter range has been affected by recent wildfire.
- This area contains the largest portion of the Carcross herd’s core winter range in Yukon, and the highest amount of high value winter habitat. Squanga Lake-Michie Creek and the upper M’Clintock valley and lakes are of special importance. Large areas of pine-lichen and pine/spruce-lichen forest occur in the valley bottoms.
- During the spring and fall migration periods, groups of Carcross caribou move between the surrounding high elevation summer ranges (Cap Mountain, Mount Byng and Joe Mountain) and the low elevation, high value winter habitats.

MANAGEMENT CONSIDERATIONS**Winter Habitat**

- Given the significance and extent of core winter range habitat, a large part of the Michie Creek and M’Clintock River valleys have been identified as a **Priority Core Winter Habitat Area**. These areas should be maintained in as natural and as intact a state as possible. New land dispositions and permanent development should not be located within these winter habitat areas.
- Given the currently low level of development, most management effort should be directed toward maintaining the large areas of intact, high value winter habitat, as represented by the Priority Core Winter Habitat Area. Any potential future road access into the area will require careful consideration.

Migration

- Within this assessment area, caribou move seasonally between the surrounding high elevation summer ranges and the low elevation, valley bottom winter habitats of the Priority Core Winter Habitat Area.
- The Judas Creek-Jakes Corner Priority Migration Area is the major migration route between this assessment area and the southern portion of the range.

AREA 8: TESLIN RIVER – SOUTH CANOL ROAD

AREA 8: TESLIN RIVER – SOUTH CANOL ROAD**STATUS**

- This is a large, remote assessment area in the northern part of the Carcross herd range, accounting for 22% (2,681 km²) of the Yukon portion of the annual range.
- Much of this assessment area is remote and receives limited human use—there are currently few immediate management concerns. Less than 6% (82 km²) of the area is within the human zone of influence (ZOI). The most significant human development features are the Canol Road, the Red Mountain mineral property and access road, and the Grant Mountain access road and mineral permit areas.
- Less than 10% (140 km²) of the potential winter range has been affected by recent wildfire.
- The Teslin River valley and Pelly Mountains receive higher amounts of annual precipitation and snow than the southern parts of the Carcross herd winter range, resulting in different forest ecosystems and higher winter snow depths. Therefore, Area 8 has proportionally lower amounts of high value winter habitat than other assessment areas.
- Groups of Carcross caribou move seasonally between the high elevation summer ranges in the Pelly Mountains and the low elevation Priority Core Winter Habitat Area of the adjacent Squanga Lake-Michie Creek-M'Clintock Lakes assessment area (Area 7).

MANAGEMENT CONSIDERATIONS**Winter Habitat**

- A series of pine-lichen benches along the Teslin River has been identified as a **Priority Core Winter Habitat Area**. This should be maintained in as natural and as intact a state as possible. New land dispositions and permanent development should not be located within these winter habitat areas.
- Given the currently low level of development, most management efforts should be directed to maintaining the **Priority Core Winter Habitat Area** and managing vehicle access on the Red Mountain and Grant Mountain access roads.