Appendix V4-9A

Hope Bay Belt Project: Wildlife Habitat Suitability Baseline, 2010

MAC RESOURCES

Hope Bay Mining Limited

HOPE BAY BELT PROJECT
Wildlife Habitat Suitability Baseline, 2010

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HOPE BAY BELT PROJECT

WILDLIFE HABITAT SUITABILITY BASELINE, 2010

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Prepared for:

NEWMONT NORTH AMERICA

Hope Bay Mining Limited

Prepared by:

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Vancouver, British Columbia

Executive Summary

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Executive Summary

This report presents the wildlife habitat suitability mapping study undertaken by Rescan Environmental Services Ltd. on behalf of Hope Bay Mining Limited (HBML) for the Hope Bay Belt Project. The Hope Bay Belt Property is located approximately 125 km southwest of Cambridge Bay, Nunavut, on the south shore of Melville Sound. The property consists of a greenstone belt running in a north/south direction, approximately 80 km long, with 3 main gold deposit areas. HBML plans to develop Phase 2 of the Project, which includes an expansion of additional deposits in the belt.

In 2010, ecosystem baseline studies were conducted to fill information gaps to support the permitting for the Phase 2 Project. An Ecosystems and Vegetation Baseline Report and a Terrain and Soils Baseline Report were produced (Rescan 2011a, 2011c). Suitable wildlife habitat and important habitat features for several species were identified through office- and field-based studies. The process of selecting species for habitat suitability modelling relied on identifying species of concern based on: (1) valued ecosystem components ([VEC] chosen for the Doris North Wildlife Mitigation and Monitoring Program [WMMP]); (2) conservation status; (3) biological importance (e.g., keystone species, umbrella species); and economic or social importance to regional governing agencies and Nunavut residents. Habitat suitability models were created in conjunction with ecosystem mapping of the 56,277 hectare Local Study Area (LSA) for the following six species and respective seasons:

- Caribou (*Rangifer tarandus*; Ahiak Population and Dolphin-Union herds) – late spring, summer (calving and post calving) and winter;
- Muskox (*Ovibos moschatus*) - late winter/early spring and early fall (rutting);
- Grizzly Bear (*Ursus arctos*) - spring, summer, and fall;
- Grey Wolf (*Canis lupus*) – spring (denning) and summer (pup rearing);
- Peregrine Falcon (*Falco peregrinus*) - spring (nesting) and summer (brood rearing); and
- Short-eared Owl (*Asio flammeus*) - spring (nesting) and summer (brood rearing).

The results of the suitably mapping indicate that the LSA contains a significant amount of suitable (high and moderate value) caribou calving habitat (75.3%), but little high value habitat (3.4%). High and moderate value caribou post calving habitat is abundant (34.9% and 49.9% respectively). There is less suitable habitat for caribou in the winter: 14.7% (high) and 20.4% (moderate).

Habitat for the muskox late winter/early spring season is predominately moderate value (53.1%), with 13% considered high value. High value rutting muskox habitat comprises 61.7% of the LSA, with moderate values given to the majority of the remaining area (19.5%).

Grizzly bear spring habitat is mainly moderate and low valued habitat (39.9% and 53.9% respectively), with only 3.3% considered high value. Summer grizzly bear habitat is mainly comprised of moderate value habitat (39%) and high value habitat (29.5%), while fall habitat is largely moderate (57.4%) value.

Little high value grey wolf denning habitat was identified (0.7%), with the majority of the LSA rated as having low denning suitability (59.2%). The amount of suitable pup rearing habitat is considerable; 88.5%, the remaining habitat is low (10.2%) and nil (1.3%).

High value tundra peregrine falcon habitat covered 12.0% of the LSA and was restricted to the immediate vicinity of known nesting sites and cliffs modelled in GIS. The majority of the LSA (81.2%) is considered to be low value peregrine habitat, while no part of the LSA was considered to have nil habitat value.

The majority of the LSA (75.3%) is considered to be suitable habitat for the short-eared owl, for the spring (nesting) season, while 78.5% is considered to be suitable for the summer (brood rearing) season.

Several important habitat features were identified that limit the ability of target species populations to expand in size or area. Eskers are considered important denning and rearing habitat for grizzly bear and grey wolf. Steep rock cliffs, particularly those over 7 m in height with a southern or western aspect, are required for tundra peregrine falcon nesting.

Acknowledgements

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Acknowledgements

This report was prepared for Hope Bay Mining Limited by Rescan Environmental Services Ltd. (Rescan). The wildlife habitat suitability work was coordinated by Greg Sharam (Ph.D.) and the report was written by Ryan Durand (B.Sc., Dipl. T., M.Sc. candidate, R.P.Bio.), Nicole Tennant, (B.Sc., Dipl. T., BiT), Brian Milakovic (Ph.D.), and Christine Kent (B.A., B.Ed., Dipl. T.). GIS support was provided by Michael Stead, Monika Belko, and Kevin Lesk-Winfield. Deborah Muggli (Ph.D., M.Sc., R.P.Bio.) was the Project Manager for the Baseline Studies.

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HOPE BAY BELT PROJECT
WILDLIFE HABITAT SUITABILITY BASELINE, 2010

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

CAFF	Conservation of Arctic Flora and Fauna
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
DEM	Digital Elevation Model
ELC	Ecological Land Classification
Focal Species	Organism(s) of ecological and/or human value that is of priority interest for management
GN DOE	Government of Nunavut Department of Environment
GIS	Geographical Information System
HBML	Hope Bay Mining Limited
HSR	Habitat Suitability Rating: final rating assigned to an ecosystem unit with all assumptions and adjustments taken into account
IQ	Inuit Quajimajatuqangit
Keystone Species	A keystone species is a species that plays a critical role in maintaining the structure of an ecological community and whose impact on the community is greater than would be expected based on its relative abundance or total biomass
Life Requisite	Specific activities of an animal that are critical for sustaining and perpetuating the species and that depend on particular habitat attributes or conditions. Life requisites include feeding, cover, breeding, migration, hibernation, etc.
LSA	Local Study Area
MBCA	Migratory Birds Convention Act
Model	A graphical representation of a species' habitat use over a defined landscape. It is based on the species account and is used to develop the assumptions, rating tables, and adjustments
NWA	Nunavut Wildlife Act
NWT	North West Territories

Rating	A relative estimate or evaluation; a value assigned to a map unit to express the suitability of that unit to support a wildlife species for a particular life requisite and season. The rating is based on assumptions about the species' habitat requirements as defined in the model
Rating (e.g., high, low)	Ratings are compared to the territorial benchmark of capable habitat for that species to fulfill a particular life requisite in a particular season
Rescan	Rescan Environmental Services Ltd.
RISC	Resources Information Standards Committee. RISC establishes standards for collection, storage, analysis, interpretation and reporting of inventory data
RSA	Regional Study Area
SARA	Species at Risk Act
Species Account	A summary of geographic distribution, life requisites, seasonal use of habitats, limiting factors, and habitat attributes for an animal species within a geographic range
Suitability	Ability of the habitat in its current condition to provide life requisites of an animal
Umbrella Species	Species selected for making conservation-related decisions, typically because protecting these species indirectly protects the many other species that make up the ecological community of its habitat
VEC	Valued Ecosystem Component
WAPPRIITA	Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act
WHR	Wildlife Habitat Rating: preliminary rating assigned to an ecosystem unit
WKSS	West Kitikmeot/Slave Study
WKRLUP	West Kitikmeot Region Land Use Plan
WMMP	Wildlife Mitigation and Monitoring Plan

1. Introduction

1. Introduction

1.1 PROJECT OVERVIEW

The Hope Bay Belt Property is located approximately 125 km southwest of Cambridge Bay, Nunavut, on the south shore of Melville Sound (Figure 1.1-1). Other than Ikaluktutiak, the nearest communities to the property are Omingmaktok and Bathurst Inlet which are 75 km and 160 km to the southwest of the property, respectively.

The property consists of a greenstone belt running in a north/south direction, approximately 80 km long, with 3 main gold deposit areas. The Doris and Madrid deposits are located in the northern portion of the belt, and the Boston deposit is located in the southern end. The northern portion of the property consists of several watershed systems that drain into Roberts Bay, and a large river (Koignuk River) that drains into Hope Bay. Watersheds in the southern portion of the belt ultimately drain into the upper Koignuk, which drains into Hope Bay.

Hope Bay Mining Limited (HBML) is proceeding with the development of the Doris North Project. Required licences and permits are in place for the development of the Doris North Gold Mine, and construction of the project commenced in 2010.

HBML plans to develop additional deposits in the belt, and planning for this Phase 2 Project development has commenced. Baseline studies to support the permitting of the Phase 2 Project were carried out in 2009, and were continued in 2010. The environmental baseline program conducted in 2010 was intended to fill information gaps to support the permitting process for the Phase 2 Project. The site layout options considered for the 2010 Phase 2 environmental baseline program are shown in Figure 1.1-2.

Results from the 2010 Phase 2 Project environmental baseline program are being reported in a series of reports. These include:

- 2010 Hydrology Baseline Report;
- 2010 Freshwater Baseline Report;
- 2010 Freshwater Fish and Fish Habitat Baseline Report;
- 2010 Marine Baseline Report;
- 2010 Marine Fish and Fish Habitat Baseline Report;
- 2010 Terrain and Soils Baseline Report;
- 2010 Country Foods Baseline Report; and
- 2010 Ecosystems and Vegetation Baseline Report; and
- 2010 Marine Wildlife Baseline Report.

In addition, numerous reports are being produced as part of the Doris North Project compliance requirements, and many of these reports cover the geographical areas of the proposed Phase 2 Project.

Figure 1.1-1

Hope Bay Belt Project Location

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PROJECT # **1009-002-17** GIS # **HB-15-038** *February 1, 2011*

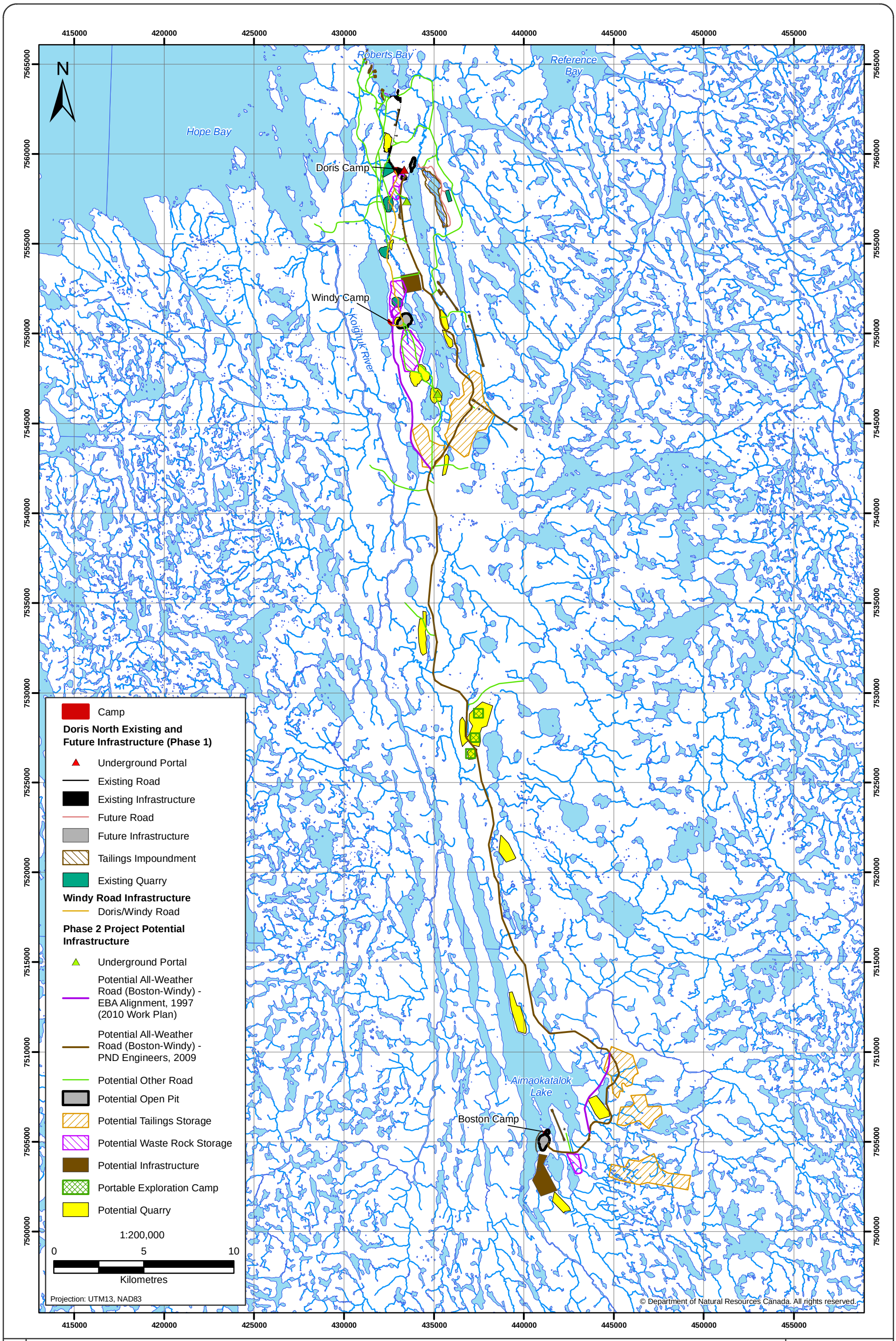

Figure 1.1-2

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Site Layout Options Considered for Phase 2 Baseline Program, 2010

Figure 1.1-2

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Examples of Doris North Project compliance reports generated in 2010 that are relevant to the proposed Phase 2 Project include:

- 2010 Meteorology Compliance Report, Doris North Project;
- 2010 Hydrology Compliance Report, Doris North Project;
- 2010 Wildlife Monitoring and Mitigation Report, Doris North Project;
- 2010 Wildlife DNA Study, Doris North Project;
- 2010 Air Quality Compliance Reports, Doris North Project; and
- 2010 Aquatic Effects Monitoring Program Report, Doris North Project.

Archaeology work was also conducted in 2010 and is being reported separately.

This report presents the results from habitat suitability modelling conducted as part of the 2010 Phase 2 Project environmental baseline program. Suitable wildlife habitat and important habitat features for several species were identified through office and field-based studies. The process of selecting species for habitat suitability modelling relied on: (1) valued ecosystem components ([VEC] chosen for the Doris North Wildlife Mitigation and Monitoring Program [WMMP]); (2) conservation status; (3) biological importance (e.g., keystone species, umbrella species); and economic or social importance to regional governing agencies and Nunavut residents.

1.2 OBJECTIVES

The overall goal of the wildlife habitat suitability modelling was to evaluate wildlife habitat in the Phase 2 Project Local Study Area (LSA).

The specific objectives were to:

- inventory and rate the habitat types for select wildlife species (focal species) within the Phase 2 Project LSA;
- quantify suitable habitat available for these focal species within the Phase 2 Project LSA; and
- identify key and important wildlife habitat and habitat features within the Phase 2 Project LSA.

1.3 STUDY AREA

1.3.1 Boundaries

Habitat suitability modelling has been conducted at two scales. The Regional Study Area (RSA) was modelled in 2005 (Miramar 2005) and covers approximately 370,000 ha. The RSA boundary provides a regional ecological context for wildlife species that may come into contact with proposed Project infrastructure during the course of a season or a lifetime. In 2010, a Local Study Area was defined to include the potential Phase 2 Project infrastructure (Figure 1.3-1). The LSA includes an area approximately 1 km from proposed Phase 2 Project infrastructure and existing infrastructure, covering a total of 56,277.5 hectares. The results presented in this report are for the Phase 2 Project LSA only, but they were developed in relation to the RSA and were compared to results from the modelling conducted in the RSA where applicable.

1.3.2 Ecological Overview

The Project falls within the Southern Arctic Ecozone as defined by the Natural Resources Canada website (2009). An ecozone represents an area containing a particular set of climatic features, landforms, plants, wildlife, and human activities. Of the three Arctic ecozones defined, the Southern Arctic Ecozone supports the highest diversity of species (both plant and wildlife) and has the most extensive vegetative cover.

This Ecozone is further divided into Ecoregions. The study area falls within the Queen Maud Ecoregion. The physiography of the area is represented by broad, sloping uplands that reach approximately 300 m in elevation in the south, and subdued undulating plains near the coast. This Ecoregion is characterized by shrub tundra vegetation such as dwarf birch (*Betula nana*), willow (*Salix* sp.), Labrador tea (*Ledum decumbens*), avens (*Dryas* sp.), and blueberries (*Vaccinium* sp.). Warm sites consist of tall dwarf birch, willow, and alder (*Alnus* sp.) while wetter sites consist of sphagnum moss and sedge tussocks. A more detailed description of the Ecoregion's ecology is provided in the Hope Bay Belt Project: 2010 Ecosystems and Vegetation Baseline Report (Rescan 2011a).

Ecosystem and vegetation baseline field studies were conducted in July and August, 2010. Part of these studies included mapping ecological communities based on the field results and air photo interpretation. A final ecosystem map was developed for the LSA (Rescan 2011a) to identify the spatial distribution and types of ecosystems across the landscape. Table 1.3-1 outlines the habitat types for vegetated and non-vegetated ecosystem units mapped in the LSA as well as the distribution of Ecosystem Units within the LSA. Ecosystem mapping of the LSA indicates that eriophorum tussock meadow, lakes and ponds, betula-ledum-lichen, and wet meadow are the most common ecosystem units. More details are provided in Rescan (2011a).

PROJECT #1009-002-10 GIS # HB-23-084 December 21 2011

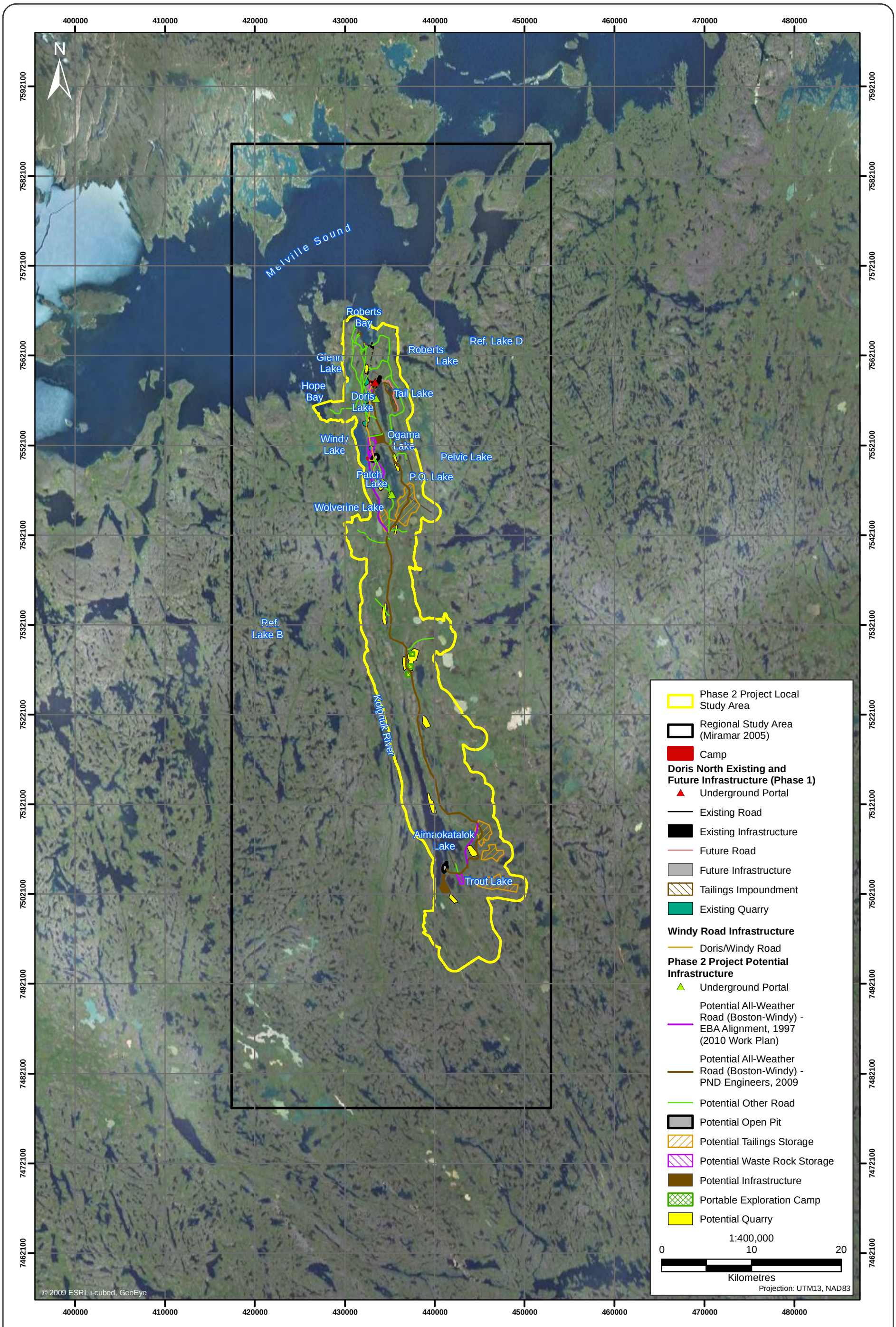

Figure 1.3-1

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Regional and Local Study Areas used for Wildlife Habitat Suitability Modelling

Figure 1.3-1

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Table 1.3-1. Ecosystem Units Mapped within the LSA

Ecosystem Units	Map Code	Description	Total LSA (ha)	Percent of LSA
Vegetated				
Eriophorum Tussock Meadow	TM	Moist to wet, medium to rich nutrient, widespread community type characterized by deep tussocks of sheathed cotton-grass and a variety of dwarf shrubs (on drier tussock tops), herbs, and mosses found in low lying plain of organic material overlying fine textures marine and lacustrine materials (permafrost almost always occurs at the organic – mineral transition).	11,628	20.66%
Betula-Ledum-Lichen	BL	Dry to mesic, poor to medium nutrient community occurring on hillslopes of glacial till containing thick covers of low dwarf birch, Labrador tea and a variety of dwarf shrubs, sedges, herbs and lichens.	8,775	15.59%
Wet Meadow	WM	Wet to very wet, medium to rich nutrient community occurring on plains and gentle lower slopes with constant water seepage dominated by thick covers of cotton-grass and sedges, few shrubs and lichens, and limited moss cover.	7,275	12.93%
Dryas-Herb Mat	DH	Dry to mesic, poor to medium nutrient community occurring on very thin, poorly developed soils on bedrock outcrops and moirainal deposits dominated by Arctic avens and a high diversity of dwarf shrubs and herbs.	4,892	8.69%
Riparian Willow	RW	Wet to very wet, medium to rich nutrient community restricted to active floodplains and seasonally fluctuating water tables with a thick cover of willow species and variable (often extensive) cover of sedges, cotton-grass, and moss species.	2,098	3.73%
Betula-Moss	BM	Mesic to moist, poor to medium nutrient community located in depressions or gently sloping fluvial and lacustrine plains typified by a high cover of dwarf birch (and often willow) and a thick moss layer, with few herbs or lichens present.	2,017	3.58%
Polygonal Ground	PG	Mosaic of disjunct communities comprised of drier communities (raised palsa mounds with communities similar to birch-ledum-lichen or birch-moss) and wet depressions (normally wet meadows) which typically occur in depressions and valley bottoms near lakes and ponds.	1,870	3.32%
Dry Willow	DW	Mesic, medium nutrient community occurring on steep slopes (typically fluvial, marine or lacustrine) with a thick cover of willow (occasionally dwarf birch) and few other species.	1,690	3.00%
Emergent Marsh	EM	Permanently saturated rich to very rich communities which are rarely extensive and dominated by sedges, some hydrophilic herbs, and no shrubs of lichens, typically occurring along watercourses and ponds.	1,344	2.39%
Dwarf Shrub-Heath	SH	Mesic, poor to medium nutrient community restricted to moderate to steep slopes of glacial till over bedrock (often containing frost mounds) containing arctic heather and a highly variable assemblage of dwarf shrubs, herbs, moss and lichen in response to microtopography and aspect.	1,111	1.97%
Dry Carex-Lichen	CL	Dry, nutrient poor community restricted to exposed bedrock outcrops characterized by a sparse cover of sedges, lichens and dwarf shrubs.	667	1.19%
Low Bench Floodplain	FP	Permanently wet, medium to rich community restricted to active floodplains of rivers, streams and lake outlets lacking shrub and lichen cover and containing hydrophilic herbs and water tolerant mosses.	128	0.23%

(continued)

Table 1.3-1. Ecosystem Units Mapped within the LSA (completed)

Ecosystem Units	Map Code	Description	Total LSA (ha)	Percent of LSA
Marine Backshore	MB	Dry, nutrient poor community occurring directly upslope of marine backshore communities characterized by extensive deposits of washed marine sands with highly variable (but generally sparse) herb layer and few shrub, moss or lichen species.	68	0.12%
Marine Intertidal	MI	Wet, medium nutrient marine community strictly limited to intertidal flats and shorelines containing low floral diversity of salt-tolerant herbs, with no shrubs, mosses or lichens.	4	0.01%
Non-Vegetated				
Rock outcrop	RO	A gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover.	5,032	8.94%
Lakes and Ponds	LA and PO	Lake: A naturally occurring static body of water, greater than 2 m deep in some portion; larger than 50 ha in size. The boundary for the lake is the natural high water mark. Pond: A naturally occurring static body of water, greater than 2 m deep in some portion; but less than 50 ha in size. The boundary for the pond is the natural high water mark.	5,859	8.01%
River	RI	A watercourse formed when water flows between continuous, definable banks. The flow may be intermittent or perennial. An area that has an ephemeral flow and no channel with definable banks is not considered a river.	779	1.38%
Blockfield	BI	Level or gently sloping areas that are covered with moderately sized or large, angular blocks of rock derived from the underlying bedrock or drift by weathering and/or frost heave, and that have not undergone any significant downslope movement.	346	0.61%
Exposed soil	ES	Any area of exposed soil that is not included in any of the other definitions. It includes areas of recent disturbance, such as mud slides, debris torrents, avalanches, and human-made disturbances (e.g., pipeline rights-of-way) where vegetation cover is less than 5%.	103	0.18%
Salt water	SW	Any body of water that contains salt or is considered to be salty.	451	0.80%
Beach	BE	The area that expresses sorted sediments reworked in recent time by wave action. It may be formed at the edge of fresh or salt water bodies.	87	0.15%
Rubble	RU	Rubble is common on the ground surface in and adjacent to alpine areas, on ridgetops, gentle slopes and flat areas due to the effects of frost heaving.	20	0.03%
Mine spoils	MS	Discarded overburden or waste rock moved so that ore can be extracted in a mining operation.	16	0.03%
Shallow open water	OW	A wetland composed of permanent shallow open water and lacking extensive emergent plant cover. The water is less than 2 m deep.	11	0.02%
Barren	BA	Land devoid of vegetation due to extreme climatic or edaphic conditions.	6	0.01%
TOTAL			**56,277**	**100.00%**

A RSA was assessed in 2005 (Miramar 2005) using the West Kitikmeot/Slave Study (WKSS) Ecological Land Classification (ELC) data (Matthews, Epp, and Smith 2001). Table 1.3-2 presents the correlation of the WKSS ELC units to those used in the 2010 LSA ecosystem mapping based on local ecosystem unit classification developed in 1997 (Rescan 2011a). The ELC units are broad representations of vegetation communities and often include multiple local ecosystem units which were refined at a finer scale.

Table 1.3-2. Modified Correlation of Regional Classification Units with the 2010 LSA Ecosystem Units, WKSS and Rescan 1997 Classification

ELC Code	WKSS ELC Unit	Local Study Area Ecosystem Unit
0	Unclassified	N/A
1	Lichen Veneer	Carex-Lichen (CL)
2	Deep Water	Lakes (LA) and Salt Water (SW)
3	Esker Complex	Carex-Lichen (CL) and Dwarf Shrub-Heath (SH)
4	Wetland (Sedge Meadow)	Wet Meadow (WM), Polygonal Ground (PG) and Emergent Marsh (EM)
5	Shallow Water	Ponds (PD) and Shallow Open Water (OW)
6	Tussock/Hummock	Eriophorum Tussock Meadow ™
7	Heath Tundra	Dryas Herb Mat (DH) and Betula-Ledum-Lichen (BL)
10	Bedrock Association	Rock Outcrop (RO) and Carex-Lichen (CL)
11	Riparian Tall Shrub	Riparian Willow (RW)
13	Heath/Boulder	Carex-Lichen (CL) and Dwarf Shrub-Heath (SH)
14	Heath/Bedrock	Dryas Herb Mat (DH) and Carex-Lichen (CL)
15	Boulder Association	Blockfield (BI)
16	Bare Ground	Barren (BA) and Exposed Soil (ES)
17	Low Shrub	Dry Willow (DW) and Betula-Moss (BM
18	Gravel Deposit	Barren (BA) and Exposed Soil (ES)

2. Valued Regional Wildlife

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2. Valued Regional Wildlife

2.1 SPECIES OCCURRENCE IN THE RSA

The Queen Maud Gulf Lowland ecoregion supports a wide variety of wildlife species, including migratory bird species, caribou, muskox, polar bear, grizzly bear, moose, wolverine, grey wolf, hare, Arctic fox, red fox, raptors, walrus, seals, and whales. To determine the potential wildlife species occurring within the RSA, the following resources were consulted:

- local Inuit knowledge;
- Birds of North America online (Lab of Ornithology Cornell 2010);
- Species Listing Database (COSEWIC 2009);
- Natureserve Explorer: An Online Encyclopedia of Life (NatureServe 2010);
- The Sibley Guide to Birds (Sibley 2000);
- Complete Birds of North America (National Geographic 2006); and
- Doris North Gold Mine Project: 2010 Wildlife Mitigation and Monitoring Program (Rescan 2011b).

Wildlife species potentially occurring in the RSA were assigned to one of five categories based on the above resources:

- Confirmed;
- Likely;
- Possible;
- Unlikely; and
- Very Unlikely.

Confirmed species were those that had been observed in the LSA or RSA during 2010 or recorded in previous baseline studies. Likely species included those that are known to occur within the LSA or RSA from local sources or Inuit Traditional Knowledge, but were not documented during baseline work. Possible and Unlikely species were assessed according to range extent. Possible species were those with documented ranges coming to within 200 km or less of the LSA; species whose range fell outside of this 200 km extent were listed as Unlikely. Possible species have the potential to occur in the RSA, while Unlikely species would be rare. However, species ranges are constantly fluctuating and reliable species range information is often not available or based on very limited data. Very Unlikely species are those whose documentation in Nunavut has most likely resulted from a few anomalous or anecdotal observations, as their ranges do not normally extend into Nunavut.

From this species search, 15 species of mammals and 55 species of birds were confirmed in the RSA. Six bird species were identified as Likely and 20 species were identified as Possible, the majority of which are birds. There are 25 species that are Unlikely and seven species whose occurrence would be Very Unlikely. Full results of this species search can be found in Appendix 1 (Tables 1-1 and 1-2).

2.2 SPECIES OF CONSERVATION CONCERN IN THE RSA

The Kitikmeot region has several species of conservation concern, as designated by national bodies. Two bird species, the peregrine falcon (subspecies *tundrius*) and the short-eared owl, are ranked as species of special concern by COSEWIC, and are listed on SARA Schedule 3. Schedule 3 is a list of species of special concern that SARA tracks as needing reassessment and monitoring; however, only those species listed on Schedule 1 are protected by SARA. Three mammal species, the grizzly bear, wolverine, and the Dolphin-Union caribou, are ranked by COSEWIC as species of special concern. The grizzly bear and wolverine are also on the SARA Schedule 3.

Ungulates of the Kitikmeot Region are species of cultural and economic importance. Local Inuit rely on caribou and muskox as a major food and clothing source. Culturally, caribou occupy a significant role in traditional Inuit life. Knowledge of caribou and their relationship to the Inuit and the land is shared among generations. Caribou and muskox are also highly valued by sport hunters and guide outfitters, and caribou are important prey for other wildlife species such as wolves, fox, wolverine and grizzly bear. Two herds of barren ground caribou can be found in the Kitikmeot Region throughout the year: the Dolphin and Union and the Ahiak.

The biology of these groups is explained in greater detail in Section 5 and Appendices 2 to 7. The conservation status of all species is shown in Tables 1-1 and 1-2 in Appendix 1.

2.3 WILDLIFE LEGISLATION

Many wildlife species and their habitats are protected under several forms of federal and territorial legislation. Table 2.3-1 lists the territorial, national, and international acts, regulations, and working groups concerning the protection of wildlife and wildlife habitat in Nunavut used to identify focal species chosen for habitat suitability modelling in this report.

Table 2.3-1. Overview of Territorial, National, and International Wildlife Legislation

Wildlife Habitat Management Legislation	Summary
Territorial	
*Nunavut Wildlife Act (*NWA *2003)*	The purpose of this Act is to protect certain species of animals and plants, particularly by regulating international and interprovincial trade in animals and plants. Sections 65, 66, 67, and 72 pertain to wildlife habitat and nest protection afforded by this Act.
National	
Canadian Biodiversity Strategy (BCO 1995)	Nunavut's commitment to the biodiversity strategy is reflected in the provisions of the *Nunavut Wildlife Act*. This strategy places emphasis on the use of ecosystem approach to conserving biodiversity and managing resource use.
Species at Risk Act (SARA 2002)	SARA is a federal government commitment to prevent wildlife species from becoming extinct and secure the necessary actions for their recovery. It provides for the legal protection of wildlife species and the conservation of their biological diversity. SARA requires the identification and protection of critical habitat for endangered or threatened species.
Wild Animal and Plant Protection and Regulation of International Trade and Inter-provincial Trade Act (WAPPRIITA 1992)	WAPPRIITA is the legislative tool by which Canada meets its obligations under CITES. The NWA was designed to provide systems for environment, licensing and permitting that address those required under WAPPRIITA.
Migratory Birds Convention Act (MBCA 1994)	The MBCA is Canada's legislative tool by which Canada meets its obligations under the Convention for the Protection of Migratory Birds. Migratory birds occupy significant portions of Nunavut on a seasonal basis.

(continued)

Table 2.3-1. Overview of Territorial, National, and International Wildlife Legislation (completed)

Wildlife Habitat Management Legislation	Summary
International	
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES 1975)	Ensures that international trade in wild animals and plants does not threaten their survival. GN is designated as the CITES Management for Authority and Scientific Authority for Nunavut. Responsibility includes ensuring that there is adequate information available to prove that export of a listed species is not detrimental to the survival of the species.
Arctic Environmental Protection Strategy (AEPS 1991)	AEPS is an agreement among Arctic states aimed at protecting the Arctic environment through monitoring, assessment, protection, emergency preparedness/response, and conservation of the Arctic zone.
Arctic Council Conservation of Arctic Flora and Fauna (CAFF, under AEPS)	The CAFF program is a biodiversity working group of the Arctic Council under the Arctic Environmental Protection Strategy (AEPS). One of the guiding principles of CAFF is the use of a broad, ecosystem-based approach to conservation and management. The federal government is a member of the Council.
Convention on Biological Diversity (1993)	The Convention on Biological Diversity (CBD) is an international legally-binding treaty with three main goals: conservation of biodiversity; sustainable use of biodiversity; fair and equitable sharing of the benefits arising from the use of genetic resources. Its overall objective is to encourage actions which will lead to a sustainable future. In 1992, Canada became one of 193 (countries) parties obliged to implement its provisions.

The Nunavut *Wildlife Act* (2003) protects wildlife habitat features on a local scale. It affords protection to the nest and/or residence of bird species, including raptors, as well as selected species within the territory. The Canada *Migratory Birds Convention Act* (1994) protects the nests of selected migratory birds on all federal lands and contains provisions that prevent the deposition of harmful substances in habitat frequented by migratory birds.

Both the Canada *Species at Risk Act* (SARA 2002) and the *Nunavut Wildlife Act* (2003) protect the critical habitat of those species present on the "List of Wildlife Species at Risk." The *Species at Risk Act* also stipulates that Environmental Assessments must always consider the effects of potential projects on listed wildlife species, their critical habitat, and their residences.

3. Wildlife Habitat Suitability Modelling Methodology

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3. Wildlife Habitat Suitability Modelling Methodology

3.1 MODELLING APPROACH

3.1.1 Overview

Modelling baseline wildlife habitat enables the identification of areas that contain suitable habitat for chosen wildlife species. Maps are developed which can be used to assess the effects of development on wildlife habitat.

Habitat suitability modelling methodology was guided by BC RISC standards (RIC 1999). As defined by these standards, suitability models identify areas which, in their current condition, provide suitable (i.e., functioning) habitat for a particular species. Suitable habitat generally means that the physical attributes (e.g., elevation, slope, aspect, soil texture, and geographical location) and the biological components (e.g., vegetation species composition, structure, and age) of an area are likely appropriate for the species in question. In summary, these standards guide the interpretation of data derived from ecosystem maps and other biophysical information to spatially inventory wildlife habitat and to facilitate land management planning.

The development of the Phase 2 Project wildlife habitat suitability models requires three steps:

1. Development of species accounts with description of wildlife species' ecology, including habitat characteristics (variables) appropriate to the RSA.
2. Development of habitat suitability models for each species of interest using local data such as topography, slope, and vegetation (from the ecosystem maps) and the identified habitat variables.
3. Testing of habitat suitability models against field observations of habitat quality and wildlife use of the area; this was done during the 2010 field season.

3.1.2 Selection of Species for Habitat Suitability Modelling

Prior to model development, the wildlife species for which habitat suitability modelling is being conducted were selected. Species were selected based on: (1) valued ecosystem components ([VEC] chosen for the Doris North Wildlife Mitigation and Monitoring Program [WMMP]); (2) conservation status; (3) biological importance (e.g., keystone species, umbrella species); and (4) economic or social importance to regional governing agencies and Nunavut residents.

Habitat suitability models were created in conjunction with the ecosystem maps produced in 2010 for six species:

- caribou;
- muskox;
- grizzly bear;
- grey wolf;
- peregrine falcon; and
- short-eared owl.

Three species (or groups of species) were considered candidates for habitat suitability modelling but were not included for various reasons: wolverines, waterfowl, and Arctic fox. Wolverine was initially planned for habitat mapping but no reliable habitat associations could be linked to the ecosystem mapping or other spatial features to distinguish between high and low class habitat ratings. This species is ranked as special concern by COSEWIC and the population is currently being monitored as part of the Doris North WMMP through DNA surveys rather than habitat mapping. Waterfowl was considered as a focal wildlife group; however, there was little reliability in predicting high to low suitable habitat based on vegetation or terrain features.

Grey wolf was added to the list of species for habitat suitability modelling because of its presence in the LSA, its large home range, and its importance as a top predator in maintaining ecosystem biodiversity. In addition, habitat features important for wolf denning are similar to those for fox, therefore, wolf ratings would also capture the important denning features for fox. Ground and cliff nesting raptors were added to the list of focal species because the short-eared owl (ground-nesting) and peregrine falcon (cliff-nesting) are species of special concern and their habitat can be predicted with reliability.

3.2 MODEL DEVELOPMENT

3.2.1 Development of Species Accounts (Step One of Model Development)

Species accounts are summaries of the geographic distribution, life requisites (i.e., the special requirements of an animal for survival and reproduction), seasonal use of habitat, limiting factors, and habitat attributes for an animal species within a geographic range (RIC 1999). The species accounts (Appendices 2 to 7) were primarily developed from literature reviews, with particular emphasis on the ecology of the RSA and LSA. This information helped guide the formulation of Wildlife Habitat Ratings (WHRs) and habitat models.

Past wildlife studies within the RSA have been utilized wherever possible for this report. Wildlife studies were conducted from 1994 to 2004 for the Doris North EIS. Ongoing Wildlife Mitigation and Monitoring Programs (WMMP) have been implemented since the project certificate was issued in 2006.

Data from the following wildlife reports have been implemented in this Phase 2 wildlife habitat suitability report where applicable:

- *Data Report Wildlife Studies: June – July 2003, Hope Bay Nunavut* (Calef and Hubert 2003);
- *Supporting Document D5 Doris North Gold Mine Project Habitat Suitability Models 2005* (Miramar 2005);
- *Doris North Gold Mine Project: Wildlife Mitigation and Monitoring Program, 2010* (Rescan 2011b); and
- *Doris North Gold Mine Project: Wildlife Mitigation and Monitoring Program, 2009* (Rescan 2010).

In addition to wildlife studies, the following reports were used:

- *Hope Bay Belt Project: 2010 Ecosystems and Vegetation Baseline Report* (Rescan 2011a);
- *Hope Bay Belt Project: 2010 Terrain and Soil Baseline Report* (Rescan 2011c); and
- Doris North Gold Mine Project: Fisheries Authorization Monitoring Report 2010 (Rescan 2011d).

3.2.2 Habitat Suitability Modelling (Step Two of Model Development)

The second step of model development is to identify suitable habitat used by each species. This step has two stages. In the first stage, ecosystem mapping is used to identify a variety of ecosystems throughout the study area, termed ecosystem units. A wildlife habitat rating (WHR) is then assigned to each ecosystem unit, based on the characteristics of each species and season and its requirements for food, security, and thermal protection. For instance, eskers could be given a high rating for wolves because they provide denning habitat, but a low rating for peregrine falcons. The WHR is a preliminary rating which may be quite different from the final rating used in the model. The final rating is called the Habitat Suitability Rating (HSR). The second stage takes the ecosystem units and their assigned WHRs, and adds other important variables specific to the species of interest. These variables include, but are not limited to, elevation, slope, aspect, and distance to a terrain feature or waterbody.

For each season and species, the ability of the habitat to meet their life requisites is rated, providing the basis for the WHR. RISC standards define a WHR as "the value assigned to a habitat for its potential to support a particular species for a specified season and life requisite compared to the best habitat in the province (used by that species for the same season and life requisite)."

Ratings are based on assumptions regarding the habitat requirements of the species and are defined in the species-habitat model. Life requisites have been divided into two categories, living and reproducing. Living refers to habitat used for food, cover, and security. Reproducing refers to habitat used specifically for giving birth to live young, rutting, building nests, laying eggs, incubation, hatching, and feeding non-mobile young. These preliminary WHRs were developed for ecosystem units within the LSA (Table 1.3-1 in Section 1).

The WHRs developed for this study were ranked according to either a four-class (high, moderate, low, nil) or a two-class system (suitable, not suitable), depending on the level of knowledge of the species ecology and habitat requirements (Table 3.2-1). Habitats used by each species were evaluated for specific seasons and life requisites and ratings assigned to each ecosystem unit were developed relative to one another within in the LSA. For habitat rated using the four class scheme, ratings were as follows:

- High (Habitat Suitability Rating [HSR] 1): ecosystem units representing critical habitat or with preferred habitat characteristics, the best available habitat within the LSA for the species to meet its life requisites (and reproduce where applicable);
- Moderate (HSR 2): ecosystem units that provide some benefit to the species, but may not meet all of their requirements;
- Low (HSR 3): ecosystem units that provide little benefit to the species for living (e.g., cover, food); and
- Nil (HSR 4): ecosystem units that are avoided or not used by the species and that have no positive value.

Habitat suitability modelling of the RSA also utilized a four scheme rating system for all target species (Miramar 2005).

For habitat rated using the two class scheme, the ratings were as follows:

- Suitable (U): ecosystem units that are preferred or represent usable habitat; and
- Not suitable (X): ecosystem units that have very little or no positive value for the species.

Table 3.2-1. Focal Species, Habitats Rated, and Rating Schemes

Common Name	Scientific Name	Rating Scheme	Season(s) Rated	Life Requisite	Specific Time Period	Additional Modelling[a]
Caribou	*Rangifer tarandus*	4 class	Late Spring (Calving)	Living[1] and Reproducing[2]	June 5 - 15	No
			Summer (Post-calving)	Living[1] (will include insect avoidance)	June 16 - July 25	No
			Winter	Living[1]	December - April	No
Muskox	*Ovibos moschatus*	4 class	Late Winter/ Early Spring (Calving)	Living[1] and Reproducing[2]	March and April	No
			Early Fall (Rutting)	Living[1] and Reproducing[2]	September and October	No
Grizzly bear	*Ursus arctos horribilis*	4 class	Spring (Growing)	Living[1] - food only	May and June	No
			Summer (Growing)	Living[1] - food only	June - September	Arctic char streams
			Early Fall	Living[1] - food only	September - October	No
Grey Wolf	*Canis lupis*	4 class	Spring (Denning)	Living[1] and Reproducing[2]	May - July	Topography (eskers)
			Summer (Pup Rearing)	Living[1]	August - October	Topography (eskers)
Cliff-nesting raptors (Peregrine Falcon)	*Falco peregrinus*	4 class	Spring/Summer (Nesting, Brood Rearing)	Living[1] and Reproducing[2]	May to August	Topography
Ground-nesting raptors (Short-eared Owl)	*Asio flammeus*	2 class	Spring (Nesting)	Living[1] and Reproducing[2]	May and June	No
			Summer (Brood Rearing)	Living[1]	July and August	No

[a]Refers to a modelling layer added after the ecosystem units were mapped out
[1]Living: food and cover provided by vegetation composition and physical structure of habitat
[2]Reproducing: includes nest/den locations, changes in home range and forage consumption by pregnant/lactating females

3.2.3 Field Evaluations (Step Three of Model Development)

The final step of model development is to test the model in the field. This step is used to evaluate the model's ability to predict actual field conditions (i.e., for the model to predict the suitability of the habitat on the ground for a particular species). Field testing requires the collection of data at a sample of the mapped locations in representative habitat types. The model evaluation can be supplemented with wildlife surveys (e.g., aerial or ground surveys) to evaluate use and local habitat selection. For example, peregrine falcon nesting models can be evaluated for their ability to predict areas of high habitat quality by overlaying aerial observations of nesting individuals.

Field surveys were carried out during July and August 2010 in conjunction with ecosystem and soils mapping. Data collection used Wildlife Habitat Assessment field cards (FS 882 [5] HRE 98/5) and were recorded using BC RISC standards (RIC 1999) where applicable.

Habitat models are limited by knowledge gaps of species' habitat preferences (RIC 1999). Field evaluations serve to fill the gap between local field conditions and literature-based predictions of habitat values. The resulting map incorporates actual field conditions, increasing the ability of the map to predict high and low habitat values (RIC 1999). Field surveys also allow for wildlife sightings and associated links to local habitat features. The collection of ecosystem descriptions and the associated field wildlife habitat assessments are used to direct the habitat suitability modelling.

3.2.4 Model Adjustments

Once the preliminary WHRs were assigned to each habitat type, field data were compared to the modelled WHRs of each species for evaluation of accuracy. This comparison was achieved by overlaying the location of field plots onto habitat suitability maps and analyzing each rating predicted at that location. Model adjustments were subsequently applied where necessary and sometimes a few iterations were made before the final ratings were decided (HSRs). If consistent patterns in misclassification were identified, the habitat model was adjusted accordingly to assign the final HSRs. Model ratings were compared to field ratings again after adjustments were made to ensure consistency.

Wildlife habitat rating adjustments were also made to the habitat models for grey wolf, grizzly bear, and peregrine falcon to include important non-vegetation features. These features included habitat characteristics that were not standard components of the ecosystem units (i.e., eskers, Arctic char (*Salvelinus alpines*) and lake trout (*Salvelinus namaycush*) inhabited streams, and suitable cliff topography for nesting). The adjustments are described in detail in Chapter 4.

Eskers were modelled from terrain mapping data (Rescan 2011c). Eskers are comprised of glacial fluvial material; however, field checks were not performed on all potential terrain polygons to confirm if they were eskers. Therefore, a GIS platform was used to assess the total area of potential eskers in the LSA by selecting all terrain polygons that contained a glacial fluvial component. The analysis indicated that 42 polygons (395 hectares) of the terrain mapping may contain eskers and are known to contain glacial fluvial material. The habitat suitability values of these areas were considered an additional important feature for wolves that use eskers for denning and for caribou that use eskers for travel and insect avoidance.

The final HSR values were used to rank each ecosystem polygon by a weighted average of the decile values (percent of a polygon classified as a given ecosystem unit) of the representative composition of each polygon (Table 3.2-2). It was important to ensure that polygons that supported high value habitat (HSR 1) were identified and that the process of averaging the decile value did not mask the high valued component. As such, the HSR 1 class was given a parameter value that exceeded the midway mark between HSR 1 and 2 accounting for the ecological value these habitats represent. The calculation of

the top rank can never be less than 1, which would have the potential to skew the results to represent lower quality HSR values.

Table 3.2-2. Habitat Suitability Ratings and Weighted Averages

HSR	HSR Value	HSR Average Value
High	1	1.00 - 1.75
Moderate	2	1.76 - 2.50
Low	3	2.51 - 3.25
Nil	4	3.26 - 4.00

The RSA habitat suitability modelling was based on raster imagery (as opposed to vector polygons in the LSA) with each cell containing a single HSR value (Miramar 2005). As each RSA cell was in effect a pure ecosystem type, weighted averages were not required to assess the suitability of the associated VECs. The RSA four class rating scheme was equally distributed with nil = 0, low = 0.1 to 0.33, moderate = 0.34 to 0.66, and high = 0.67 to 1.0 (Miramar 2005).

3.2.5 Sources of Error and Limitations

Limitations in the resolution of the maps present difficulties in assessing habitat, particularly for species that exploit home ranges and habitat features at smaller spatial scales. Considering the limitations, the habitat suitability maps presented should provide sufficient accuracy to evaluate potential impacts from the Project on the wildlife species at a landscape level of resolution. The maps are not intended to be used for fine scale level management (i.e., for attributes within an ecosystem unit polygon).

The modelling of eskers using terrain mapping may not have detected all eskers (or esker-like features) in the LSA. While extensive field verification of terrain mapping was completed (Rescan 2011c), there is the possibility that additional esker habitat exists in the LSA.

One limitation of the methods used is that there is no formal evaluation of the final model fit. Typically, there are two options for evaluating model fit. In the, first option, the modeller can use all of the field data to update and refine the model. This leads to a model that better fits the available data, and the wildlife habitat, but does not allow for a formal evaluation of how well the model fits the data. In the second option, half of the data is used to refine the model, while the other half of the data is used to test the model fit. This second option invariably leads to a less well-fit model, but has the benefit of providing a formal evaluation of model fit. In this case, the first option was chosen such that the fit of individual models was maximized.

4. Results

4. Results

4.1 SUMMARY OF HABITAT SUITABILITY MAPPING RESULTS

The results of habitat suitability mapping for candidate species are summarized in Table 4.1-1. More detailed information, as well as the HSRs used in the species-habitat models, can be found in the following sections and within species accounts (Appendices 2 to 7). These HSRs represent the quality of each ecosystem type in providing the seasonal life requisites for the species in question (e.g., forage opportunities for grizzly bears, appropriate denning ecosystem types for grey wolf). For species where no additional modelling was available or required, these HSRs are the same as the WHRs given to the identified ecosystem units within the LSA. For grizzly bears, these HSRs represent the vegetation potential of ecosystem types to provide for the feeding life requisite only, and do not take into account the additional distance to rivers modelling.

Table 4.1-1. Habitat Suitability Amounts Available (Area and Percent) in the LSA for Focal Species

Species	Season	High	%*	Moderate	%*	Low	%*	Nil	%*
Caribou	Late Spring (Calving)	1,897.1	3.4%	40,472.4	71.9%	6,978.4	12.4%	6,929.2	12.3%
	Summer (Post-calving)	19,640.0	34.9%	28,086.3	49.9%	7,746.2	13.8%	804.5	1.4%
	Winter	8,283.4	14.7%	11,495.5	20.4%	25,313.9	45.0%	11,184.2	19.9%
Muskox	Late Winter/ Early Spring (Calving)	7,327.5	13.0%	29,901.9	53.1%	11,962.1	21.3%	7,085.5	12.6%
	Early Fall (Rutting)	34,729.1	61.7%	10,982.1	19.5%	4,157.9	7.4%	6,407.9	11.4%
Grizzly Bear	Spring (Growing)	1,846.4	3.3%	22,440.3	39.9%	30,325.8	53.9%	1,664.5	3.0%
	Summer (Growing)	16,577.5	29.5%	21,939.4	39.0%	6,772.4	12.0%	10,987.7	19.5%
	Early Fall	8,731.5	15.5%	32,276.0	57.4%	5,616.9	10.0%	9,652.6	17.2%
Wolf	Spring (Denning)	395.3	0.7%	19,112.0	34.0%	33,329.1	59.2%	3,440.6	6.1%
	Summer (Pup Rearing)	6,719.8	11.9%	43,080.6	76.6%	5,730.1	10.2%	746.5	1.3%
Peregrine Falcon	Spring/Summer (Nesting and Brood Rearing)	6,755.4	12.0%	3,809.0	6.8%	45,712.7	81.2%	0.0	0.0%
Short-eared Owl				**Suitable**			**%***	**Not Suitable**	**%***
	Spring (Nesting)			42,404.4			75.3%	13,872.6	24.7%
	Summer (Brood Rearing)			44,171.6			78.5%	12,105.4	21.5%

**Percent of Habitat per Total Study Area (Study Area = 56,277 ha)*

4.2 CARIBOU

4.2.1 Background

Caribou are an important component of Nunavut's biodiversity and are a biological and cultural keystone species in the Arctic. The Dolphin-Union herd is ranked by COSEWIC as a sub-population of special concern. In addition, caribou were identified as a Valued Ecosystem Component (VEC) for the Doris North EIS and are monitored as part of the Doris North WMMP. For these combined reasons, caribou were selected as a candidate species for habitat suitability modelling.

Caribou are the main prey item of grey wolves and are an important component of the diets of grizzly bears, wolverines, and other carnivores. Caribou also alter the Arctic landscape, changing the

composition of plant communities and seasonal distribution of predators. Historically, the Inuit have relied on caribou for food and clothing. Caribou, and caribou hunting, are central to Inuit culture, identity, recreation, and kinship. The Inuit have a long history of observing caribou behaviour, movement, and life cycles during their hunting activities. Details of the distribution, movement, habitat, and demographics of caribou in the RSA and LSA and how they relate to the suitability modelling are provided in Appendix 2. Additional information can be found in the Doris North Gold Mine Project Wildlife Mitigation and Monitoring Program, 2010 report (Rescan 2011b).

Two caribou herds have been found in the RSA during certain periods of the year and may interact with the Phase 2 Project: the Ahiak and Dolphin-Union herds. General descriptions of the two herds are provided below.

4.2.1.1 Ahiak Caribou

The Ahiak herd winters over a broad area from Bathurst Inlet to northern Saskatchewan and migrates north to the Arctic coast on Queen Maud Gulf for calving and summer foraging. Few data exist on this herd and their ecology has not been well described; however, baseline survey data documenting the distribution of caribou suggest that the RSA and LSA lie within the seasonal ranges of the Ahiak herd. Although the herd is generally not found in the study areas during calving (Gunn and D'Hont 2002), they may occur in the RSA and LSA during spring migration, post-calving, summer, fall migration, and winter (Rescan 2011b; Plate 4.2-1).

Plate 4.2-1. Ahiak caribou observed in the LSA during the summer (post-calving) season.

The calving season has been divided into two stages: the calving period when cows are giving birth (defined by the peak of calving as June 5 to June 15), and a five to six week post-calving period which extends until calves are weaned (typically June 16 to July 25). More detailed information on the demography and distribution of the Ahiak caribou herd is provided in Appendix 2.

4.2.1.2 Dolphin-Union Caribou

Dolphin-Union caribou winter on the Nunavut mainland along the Coronation Gulf, on the Kent Peninsula, and along the western extent of the Queen Maud Gulf (COSEWIC 2009). This herd migrates across the sea ice to its calving grounds on Victoria Island.

Dolphin-Union caribou have recently been recognized as a genetically distinct population from Peary caribou and barren-ground caribou (COSEWIC 2009). The COSEWIC designation of the Dolphin-Union herd as a sub-population of special concern is based on high harvest rates without recent population estimates. Potential threats to this herd come from climate warming and shipping activity along the herd's migration route (COSEWIC 2009). Climate warming may shorten the time caribou have on the mainland between the fall and spring migrations, since this movement is dependent on ice formation. Furthermore, if shipping activity breaks ice in Dease Strait or the Queen Maud Gulf, Dolphin-Union caribou migration may be blocked or animals may fall through the broken ice.

Shipping and icebreaking make Dolphin-Union caribou "vulnerable to die-offs similar to those that have affected Peary caribou" (COSEWIC 2009). The draft West Kitikmeot Regional Land Use Plan (WKRLUP) also expresses concern for caribou at ice crossings between Victoria Island and the mainland, and conformity requirement 6.2 stipulates that shipping "may not take place outside the normal open water season between July 1 and October 15" (NPC 2005). The herd is pending addition to Schedule 1 of SARA.

More detailed information of the demography and distribution on the Dolphin-Union caribou herd is provided in Appendix 2.

4.2.2 Habitat Suitability Model Development

Caribou habitat suitability was assessed for late spring (calving; June 5 to June 15), late spring/summer (post-calving; June 16 to July 25), and winter (November to April). The life requisites assigned to the two seasons are shown in Table 4.2-1. Ongoing wildlife monitoring in the RSA and LSA indicates that both Dolphin-Union and Ahiak caribou primarily calve outside of the LSA (Rescan 2011b); therefore, the habitat suitability model for spring (calving) is largely based on forage potential.

Table 4.2-1. Seasonal Life Requisites of Caribou

Season	Date	Life Requisite	Habitat Preference
Late Spring (Calving)	June (5-15)	Living and Reproducing	Caribou calve on open, flat tundra with bare ground to allow feeding on cottongrass flower buds and green sedge leaves. Lichen is eaten before vascular plant green-up.
Summer (Post-calving)	June - July (16 - 25, extending into August)	Living	Caribou use eskers for insect and heat relief, lakes for predator avoidance, insect, and heat relief, eat green plants from riparian and sedge communities. Cows require high quality forage to replenish fat reserves.
Winter	November - April	Living	Caribou rely heavily on lichens in winter because they provide digestible carbohydrates and are generally abundant. Caribou concentrate in areas that provide foraging opportunities with limited snow depths.

4.2.2.1 Model Assumptions

The HSRs for the ecosystem units are listed in Appendix 2 (Tables 2-1 and 2-2). The following general assumptions were made to define HSRs:

Spring (Calving) Habitat

Habitat with nitrogen and protein rich forage is especially important during the calving season for pregnant and lactating cows. Caribou actively search out emerging vegetation, typically in exposed areas that have early snow melt. As in winter, lichens continue to be an important food source for caribou. Habitat suitability was assessed for the spring (calving) season as follows:

- High value spring (calving) habitat (primarily assessed for forage) includes ecosystem units that are snow free early, and those that contain a significant cover of lichen and shrubs. During the spring (calving) season, caribou are known to have a high preference for lichen veneers, heath tundra and low shrub habitat (Johnson, Boyce, Case, et al. 2005). High value habitat in the LSA was limited to two ecosystem units: dry carex-lichen and riparian willow.
- Moderate value habitat includes a variety of ecosystem units that contain suitable early forage such as cottongrass flower buds, sedges, and various shrub species. Eleven ecosystem units were considered to contain moderate calving habitat: betula-ledum-lichen, betula-moss, dry willow, dwarf shrub-heath, emergent marsh, wet meadow, polygonal ground, eriophorum tussock meadow, lake, pond, and river.
- Low value habitat includes ecosystem units that are more likely to retain snow packs or have limited suitable forage. Six ecosystem units were considered to contain low spring (calving) habitat suitability: blockfield, dryas-herb mat, exposed soil/barren, low bench floodplain, rock outcrop, and shallow open water.
- Nil value habitat includes ecosystem units that do not provide forage for caribou during the spring (calving) season. Four ecosystem units were considered to contain no suitable habitat: disturbance features (e.g., camp, road, operating and old mine sites), beach materials, steep rubble, and salt water (ocean).

Summer (Post-calving) Habitat

Habitat use during the summer (post-calving) season is variable as caribou leave calving grounds and search out preferred foraging habitat. In addition to forage, caribou require habitat that provides relief from insects, heat and predators. During this period forage includes willow, grass, sedges, cottongrass and other green vegetation that provides important protein sources (VanEgmond and Rowell 1998; Griffith et al. 2001; Thorpe et al. 2001). Cool, moist areas are often selected, including riparian areas and wetlands. Insect and heat relief is important throughout the summer (post-calving) season, particularly in late June and early July. Relief is found in cool, windy and shaded areas, and includes swimming in ponds and lakes (Thorpe et al. 2001). Habitat suitability was assessed for the summer (post-calving) season as follows:

- High value late spring/summer (post-calving) habitat includes six ecosystem units that offer wet areas and shrub dominated areas: dry willow, emergent marsh, wet meadow, polygonal ground, lake, pond, and riparian willow.
- Moderate value habitat is diverse and includes seven ecosystem units: betula-ledum lichen, betula-moss, dryas-herb mat, dwarf shrub-heath, eriophorum tussock meadow, and low bench floodplains. These ecosystem units provide forage opportunities, but generally have limited insect and heat relief relative to the high value habitat.
- Low value habitat includes five ecosystem units: blockfield, dry carex-lichen, exposed soil and barren areas, rock outcrops, and shallow open water. These units have limited vegetation and preferred summer forage. Shallow open water is also considered low value as vegetation cover is limited and water is not deep enough to provide insect relief.

- Nil value habitat includes ecosystem units that do not provide forage for caribou during the calving season. Four ecosystem units were considered to contain no suitable habitat: disturbance features (e.g., camp, road, operating and old mine sites), beach materials, steep rubble, and salt water (ocean).

Winter Habitat

Habitat use during the winter season is concentrated in areas that provide lichen foraging opportunities and limited snow depths. While lichens are relatively low in protein, they provide digestible carbohydrates and are generally abundant (Cooperrider, Boyd, and Stuart 1980). Using their keen since of smell, caribou locate snow covered lichens and dig them out with their hooves (CWS 2005). Habitat suitability was assessed for the winter season as follows:

- High value winter habitat is restricted to ecosystem units that contain abundant lichens and have low snow cover. Ecosystem units rated as contain high habitat potential include dry carex-lichen and dryas-herb mat.
- Moderate value habitat includes ecosystems that contain substantial lichen cover, but are located in topographical locations where snow is expected to accumulate (as opposed to the generally windswept locations considered to have high values). Ecosystem units include birch-ledum-lichen and dwarf shrub-heath. In addition, rock outcrops are considered to have moderate values as they are generally in crest positions that accumulate little snow cover, but contain sparse lichen cover. The dry willow ecosystem unit was also considered to have moderate values due to potential winter shrub browse.
- Low value habitat includes the majority of the remaining vegetated ecosystem types. These areas may be used by caribou during the winter season, but contain little or no lichen cover and a deeper snowpack.
- Nil habitat is limited to disturbed sites (current and old camps, operating mine site, roads, etc.) and ecosystem units that are largely un-vegetated. These areas either repel caribou due to human activity, or do not contain forage opportunities.

Eskers are also considered important habitat features for caribou. HSRs for eskers were low for calving, high for post-calving, and high for winter.

4.2.3 Results and Discussion

The majority (71.9%) of habitat occurring in the LSA was found to have moderate habitat suitability for calving, and very little (3.4%) was found to have high habitat suitability for calving (Table 4.2-2; Figure 4.2-1). The LSA was considered to contain summer (post-calving) habitat, with 34.9% rated as high value and 49.9% rated moderate value (Table 4.2-2; Figure 4.2-2). In winter, much of the habitat was rated low in the LSA (45%). The remainder of the LSA was rated as moderate (20.4%), nil (19.9%), and high (14.7%) (Table 4.2-2; Figure 4.2-3).

In addition to the HSRs, potential esker features include an additional 395 hectares of low value calving habitat and high value post-calving habitat.

Habitat suitability results indicate that the LSA contains less high value spring (calving) habitat relative to the larger RSA. It also indicates that nil value habitat is significantly more common in the RSA, likely due to the finer scale of ecosystem unit classification in the LSA and the assignment of heat and insect relief values to lakes and ponds in the LSA.

Table 4.2-2. Area and Proportion of High, Moderate, Low, and Nil-rated Habitat within the LSA for Caribou

Suitability Rating	Amount of Habitat			
	Area in LSA (ha)	Percent of LSA (%)	Area in RSA* (ha)	Percent of RSA* (%)
Spring (Calving)				
High	1,897.1	3.4%	100,810.0	27.0%
Moderate	40,472.4	71.9%	131,435.0	35.1%
Low	6,978.4	12.4%	19,046.0	5.1%
Nil	6,929.2	12.3%	122,761.0	32.8%
Summer (Post-calving)				
High	19,640.0	34.9%	10,658.0	2.8%
Moderate	28,086.3	49.9%	211,910.0	56.7%
Low	7,746.2	13.8%	28,724.0	7.7%
Nil	804.5	1.4%	122,761.0	32.8%
Winter				
High	8,283.40	14.7%	n/a	n/a
Moderate	11,495.50	20.4%	n/a	n/a
Low	25,313.90	45.0%	n/a	n/a
Nil	11,184.20	19.9%	n/a	n/a

**RSA area and percent totals from Doris North Mine Project Wildlife Habitat Suitability Models (Golder 2005).*

4.3 MUSKOX

4.3.1 Background

Muskoxen are distributed across most of the Kitikmeot Region of Nunavut (Gunn and Adamczewski 2003), including the LSA (Appendix 3). The Muskox is the only other large ungulate species (aside from caribou) that occupy tundra habitats year round. Unlike caribou, muskox do not migrate long distances. Ongoing ungulate surveys of the RSA indicate that muskoxen are consistently present throughout the area, with higher densities in the spring and fall periods and lower densities during winter months (Rescan 2011b; Plate 4.3-1).

Muskoxen are biologically and culturally significant. Muskoxen are particularly sensitive to disturbance during the calving season (late March through May). Disturbance to herds may culminate in stampeding behaviour that can cause calves to be trampled or abandoned (Gunn and Case 1984). Muskoxen are an important prey item for carnivores and are valued by the Inuit as a source of food, leather, and meat for commercial export. These ungulates also attract tourists to Nunavut for guided sport hunting and wildlife viewing. Muskoxen were close to extinction in the late nineteenth and early twentieth centuries due to overhunting (Fournier and Gunn 1998; Campbell and Setterington 2001), but numbers have generally increased over the last three decades and the historic range has been recolonized (Fournier and Gunn 1998; Campbell and Setterington 2001). The Inuit have also remarked on the expansion and numbers of the muskox since the 1960s. Muskoxen are presently designated as secure in Nunavut (CESCC 2006).