Mr. Alex Power
Regulator Research Specialist
Yellowknives Dene First Nation
PO BOX 2514
YELLOWKNIFE NT X1A 2P8

JUN 0 6 2017

Dear Mr. Power:

EA1617-01 Tłı̨chǫ All Season Road Request for Clarification from May 25, 2017 Adequacy Statement Response Technical Review Session

The Government of the Northwest Territories' (GNWT) Department of Infrastructure is following up on the face-to-face Tłı̨chǫ All-Season Road (TASR) Adequacy Statement Response Technical Review Session held on May 25, 2017 in Yellowknife. The GNWT appreciates the Yellowknives Dene First Nation's (YKDFN) participation in the session and sharing of YKDFN concerns.

The GNWT is seeking clarification from YKDFN to better understand YKDFN's specific concerns regarding the potential impact to caribou from the proposed TASR project that may adversely impact YKDFN's asserted or established Aboriginal and/or Treaty rights. The GNWT understands that the asserted territory and the proposed TASR project do not overlap.

The GNWT looks forward to receiving the YKDFN's response in writing to Michael_Conway@gov.nt.ca or by facsimile at (867) 873-0257, by June 20th, 2017. If you have any questions, please do not hesitate to contact me at (867) 767-9089 ext. 31194 or by email at Michael_Conway@gov.nt.ca.

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In closing, I would like to take this opportunity to thank you for sharing YKDFN's concerns and the GNWT would like to encourage your continued participation in the environmental assessment process.

Thank you for your attention to this matter.

Sincerely,

Michael Conway
Regional Superintendent
North Slave Region
Department of Infrastructure

c Chief Ernest Betsina
Yellowknives Dene First Nation (Ndilǫ)

Chief Edward Sangris
Yellowknife Dene First Nation (Dettah)

Mr. Mark Cliffe-Phillips
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June 14,2017

Michael Conway
Regional Superintendent
North Slave Region
Department of Infrastructure
Government of the Northwest Territories

Re: YKDFN Interest in Tlicho All Season Road project

In your letter dated June 6, 2017 you requested that I clarify YKDFN's interests in the Tlicho All Season Road (TASR) project and its potential impact on caribou. As I stated at the in-person technical meeting May 25th, 2017 the Yellowknives have significant traditional knowledge of the area arising from a long history of travelling the area to harvest caribou, fish, and fur bearing mammals.

The simplest way to represent this information is visually. I have included a map from the Dene Mapping Project in 1997. The map shows traditional and contemporary trails and routes used by YKDFN elders and land users, in red. As you can see, this map shows heavy use of the area surrounding the TASR by YKDFN.

I would like to point out that this map is quite course grained, at a 1:50,000 scale. While a map of this scale is useful for giving a broad overview of activity on the land it necessarily leaves out many details. Important hunting area, wildlife migratory routes, trapping routes, archeological sites, cultural sites, and burial grounds are all absent from this map; however, YKDFN does have this information with respect to the area in question.

Your letter has raised serious concerns with our office and with leadership. Your letter belies either a major gap in understanding of aboriginal rights and title or a willful ignorance. Regardless, YKDFN is apprehensive about the GNWT's role in this project. As such, I feel it is necessary to take this opportunity to clarify the origin and scope of YKDFN's aboriginal rights.

As you know section 35(1) of the Canadian Charter of Rights and Freedoms states that "The existing aboriginal and treaty rights of the aboriginal peoples of Canada are hereby recognized and affirmed.". The Judiciary has interpreted this recognition and affirmation as a fiduciary duty on the part of the Crown to consult and accommodate when undertaking actions with the potential to impact aboriginal rights. There are several important aspects of this duty to consult that bare articulating.

Firstly, the duty of the Crown is delegated to the Territorial government, with the Boards also fulfilling some aspects of consultation. This means that if a project has the potential to impact aboriginal rights, the GNWT is responsible for ensuring that consultation is discharged appropriately. This means that potentially impacted parties are consulted, and if need be, accommodated in a manner proportional to the potential impact.

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The second feature of the duty to consult I want to address here is that it does not hinge on aboriginal title. That is to say, aboriginal rights can be affected irrespective of whether or not the proposed activity lies within a settled land claim area. This can be seen in action throughout the Northwest Territories. For example, the Tlicho government has been consulted extensively on projects undertaken by Dominion Diamond Ekati Corp. and Diavik Diamond Mine Inc. even though both of these projects lie within Treaty 8 territory.

The potential for this project to adversely impact the Yellowknives aboriginal rights as referred to in 1982 Constitution Act is clear enough, based solely on the map attached to this letter. However, the rights of the Yellowknives were not created by the 1982 Constitution Act. The Act merely recognized pre-existing aboriginal and treaty rights. As I'm sure you are aware, the Yellowknives are signatories to Treaty 8.

Treaty 8 was conceived as a treaty in the classical sense, a treaty between two nations. In recent years there has been an attempt to inject a legal fiction, in the form of *the Sovereignty of the Crown*, into the discussion of the numbered treaties between First Nations and the Crown. However, YKDFN still holds out Treaty 8 as the first articulation of the relationship between itself and the Crown (and the GNWT as delegated by the Crown).

If should be noted that numbered treaties, Constitutional Rights, and settled land claim areas all very much instruments of the Common Law tradition. As a result of their application of First Nations (and other indigenous people) we are left with curious artifacts. The artifact most relevant to this discussion is the delineation of hard boundaries between nations.

Traditionally, First Nations in the North had their core use areas or territories. However, the boundaries between these territories were more fluid than current land claim boundaries. There was frequent movement by members into adjacent territories. This practice was a widespread and well documented practice. Again, this can be easily understood from the maps produced through the Dene Mapping Project.

Finally, I would like to repeat that much of what is written here was stated in the May 25, 2017 Adequacy Statement Response Technical Review Session. In that session I stated that YKDFN has a historic and ongoing interest in the area by virtue of YKDFN members' use of the area. This history of his being evidenced by YKDFN's traditional knowledge. I also stated that the only reason we had not yet submitted a traditional knowledge report was for lack of resources. It's because of this that I find myself a bit discouraged by the GNWT decision to question the legitimacy of YKDFN's claim to their aboriginal rights being potentially impacted by the TASR.

I would like to close by reiterating my concern about the approach that the GNWT has taken to this project, thus far. During the initial consultation for this project YKDFN was excluded. Our office, Land and Environment, was not contacted directly to participate in the Adequacy Statement Response Technical Review session. Instead, the Chiefs were invited to the meeting when this meeting is clearly directed at technical staff. Now, I find myself responding to a discouraging letter questioning the most basic assertion of YKDFN's aboriginal rights.

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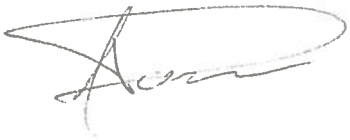
I hope that going forward with this process the GNWT adopts a more inclusive and informed tone. If you have any other questions or concerns our office is always open to engagement.

Sincerely,



Alex Power M.Sc.
Regulatory and Research Specialist
Land and Environment
Yellowknives Dene First Nation

Yellowknives' Land Use

Wha Ti

Edzo

Ndilo

Yellowknife

Dettah

Dene Mapping Project

Dettah Trails

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Prepared by
NWT Treaty #8 Tribal Corporation
March 13, 1997
AKAITCHO\detahtr.wmf

JUN 26 2017

Mr. Alex Power
Regulator Research Specialist
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Dear Mr. Power:

EA1617-01 Tłı̨chǫ All Season Road Follow up to June 14, 2017 Letter from Yellowknives Dene First Nation

Thank you for your June 14, 2017 letter. As noted in the June 6, 2017 letter from the Government of Northwest Territories (GNWT) to Yellowknives Dene First Nation (YKDFN), the GNWT would like to better understand YKDFN's concerns regarding potential impacts to barren-ground and woodland caribou from the proposed Tłı̨chǫ All Season Road (TASR) that may adversely impact YKDFN's asserted or established Aboriginal and/or Treaty 8 rights. To facilitate this consultation, I have appended to this letter the concerns that have been raised by YKDFN and other parties regarding potential impacts to both barren-ground and woodland caribou and the steps that the GNWT will take to avoid or mitigate any potential adverse impacts to YKDFN's asserted or established Aboriginal and/or Treaty 8 rights regarding barren-ground and woodland caribou.

Please review the materials appended to this letter and respond to me by e-mail Michael_Conway@gov.nt.ca or fax 867-873-0257 by July 17, 2017 to advise of the specific outstanding concerns of YKDFN, if any, that remain regarding potential impacts to barren-ground and/or woodland caribou. The GNWT understands that in assessing the appended materials and responding to this letter, YKDFN will take into account, among other factors, the important hunting areas and wildlife migratory routes that your June 14, 2017 letter indicated is information that YKDFN possesses with respect to the area around the proposed TASR.

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The GNWT aims to adequately accommodate any concerns related to the TASR regarding potential impacts to barren-ground and woodland caribou prior to technical reports being prepared and certainly prior to the Mackenzie Valley Review Board issuing its recommendation to the responsible ministers under section 128 of the *Mackenzie Valley Resource Management Act*.

Sincerely,

Michael Conway
Regional Superintendent
North Slave Region
Department of Infrastructure

Attachment

c Chief Ernest Betsina
Yellowknives Dene First Nation (Ndilǫ)

Chief Edward Sangris
Yellowknives Dene First Nation (Dettah)

Mr. Mark Cliffe-Phillips
Executive Director, MVEIRB

Potential Caribou Impact - Tłı̨chǫ All Season Road

The Review Board's *Reasons of Decision for Referral to Environmental Assessment for the Tłı̨chǫ All Season Road* (PR#2) described the key areas of concern that might result in a significant adverse impact on the environment or be a cause of public concern. The impact to caribou was identified as one of the key areas of concern and was refined into the following four subcategories: increased harvesting pressure, increased predation resulting from new access, increased road-induced mortality, and barrier effects to caribou (linear impediments, dust, noise, and reduced air quality).

Section 5.2 of the Review Board's *Adequacy Statement* (PR#70) clarified the specific information that was lacking from the Developer's application and the information that would be necessary in order to assess the potential project-related impacts to caribou and to gauge the effectiveness of the proposed mitigation measures. Table 5-2 (PR#70) indicated that the following topics required further assessment:

- Barren-ground caribou: Mortality
- Boreal caribou: Mortality risk, habitat, and population health

The Developer's *Adequacy Statement Response* (PR#110), which was submitted on April 13, 2017, provided the necessary details to satisfy the Review Board's request for additional information. Section 4 and portions of Section 5 address the four caribou-related subcategories that were identified in PR#2. The caribou-specific sections of PR#110 have been extracted and appended here for your reference.

Once PR#110 was posted to the Review Board's public registry, reviewers had the opportunity to review and consider the material. In instances where reviewers had additional questions, reviewers were able to submit Information Requests (IRs) to the Developer. The Developer is currently drafting responses to these Irs and expects to submit responses in two parts; the first being on June 29 and the second on July 7, 2017.

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These IR responses further discuss barren-ground and woodland caribou and will include supplemental information in the form of an updated commitments table. These additional details should help in addressing the concerns that have been raised to date regarding the potential impacts to barren-ground and woodland caribou and should further clarify the steps that the GNWT will take to avoid or mitigate potential adverse impacts to caribou; however, the bulk of these details have been described in PR#110.

References

PR#2 – MVEIRB Reasons for Decision – Tłı̨chǫ All-Season Road EA Referral
http://reviewboard.ca/upload/project_document/EA-1617-01_Reasons_for_Decision_-_Tlicho_All_Season_Road_EA_referral.PDF

PR#70 – MVEIRB Adequacy Statement for TASR EA1617-01
http://reviewboard.ca/upload/project_document/EA-1617-01_MVEIRB_Adequacy_Statement_for_TASR__EA1617-01.PDF

PR#110 – Developer's Adequacy Statement Response
http://reviewboard.ca/upload/project_document/EA-1617-01_Developer_s_Adequacy_Statement_Response.PDF

To Table of Contents

4.0 ASSESSMENT OF EFFECTS TO WILDLIFE

4.1 Introduction

4.1.1 Purpose and Scope

The purpose of the Wildlife Section of the ASR for the Project is to meet the requirements outlined in the TOR (PR#69) and the Adequacy Statement (PR#70) issued by MVEIRB. This section includes a comprehensive assessment of direct and indirect effects on all applicable life stages of wildlife within the temporal and spatial boundaries defined for wildlife. Direct effects occur as the result of changes from the physical disturbance of terrestrial and aquatic habitats from human activities and developments, and natural factors (e.g., fire). Sensory disturbance from human developments, such as noise, lights and smells, can change habitat quality and the movement and behaviour of animals, which produces indirect effects on wildlife abundance and distribution.

The effects assessment evaluates the construction and operation phases of the Project on wildlife species identified as VCs (Section 4.1.2) within the spatial and temporal boundaries defined for the assessment (Section 4.1.3). Cumulative effects are incorporated throughout the wildlife assessment, where applicable. Given the large home ranges of some species, the effects from the Project must be considered in combination with other previous, existing and RFDs and natural factors that influence wildlife within the assessment boundaries.

4.1.2 Valued Components, Assessment Endpoints and Measurement Indicators

Valued components (VCs) refer to environmental features that may be affected by a Project and have been identified to be of concern by the proponent, scientists, government agencies, Aboriginal peoples, or the public (Canadian Environmental Assessment Agency 2014). Wildlife VCs were selected from the suite of species with ranges that overlap spatially with the Project.

Wildlife species at risk with ranges overlapping the Project were identified as VCs, and these species make up the majority of the wildlife VCs for the Project (Table 4.1-1). Plant and amphibian species at risk did not have ranges that overlapped with the Project. However, some wildlife species identified as important in the TK Report (PR#28) and the PDR (PR#7) were also selected as VCs (Table 4.1-1).

Many of the VCs selected for the Project represent a broader group of species or a particular habitat type important for a variety of wildlife. For example, olive-sided flycatcher (*Contopus cooperi*) and common nighthawk (*Chordeiles minor*) represent a guild of species that forage on insects while flying through the air, but nest in different habitats; olive-sided flycatcher nest in trees, whereas common nighthawk nest on the ground. Bank swallow (*Riparia riparia*) and barn swallow (*Hirundo rustica*) are also aerial insectivores, and will nest on man-made structures, such as quarries, and buildings and bridges, respectively. Little brown myotis (*Myotis lucifugus*) occupy mature forests that contain wildlife trees (e.g., dead or decaying trees that provide opportunities for refuge and nesting cavities), whereas horned grebe (*Podiceps auritus*) prefer marshes and ponds, and rusty blackbird (*Euphagus carolinus*) occupy wetland and riparian habitats. Understanding the potential effects of the Project on VCs therefore permits inferences about effects on other wildlife species or guilds with similar life history traits and habitat requirements.

Some of the wildlife VCs selected for the Project can represent conservation values that extend beyond the species itself (i.e., indicator, umbrella, or keystone species; Sergio et al. 2006; Estes et al. 2011) or are highly interactive and have a large influence on the ecosystem (Soulé et al. 2005). For example, species such as woodland caribou (*Rangifer tarandus*) and wolverine (*Gulo gulo*) may act as umbrella species, which require sufficiently large habitat

To Table of Contents

areas that their conservation automatically improves conservation prospects for some other species such as American marten (*Martes americana*) and lynx (*Lynx canadensis*) (Carroll et al. 2001). Highly interactive species such as moose have large home ranges, represent key sources of protein and energy for predators (natural and human) and scavengers in the boreal ecosystem, and can have strong influences on the dynamics and persistence of boreal caribou populations (Wittmer et al. 2005; Festa-Bianchet et al. 2011).

Table 4.1-1: Rationale for Selected Wildlife VCs

Valued Components	Conservation Status			Rationale for Selection
	SARC[a]	COSEWIC[b]	SARA[c]	
Boreal caribou	Threatened	Threatened	Threatened	■ importance to hunters, including First Nations ■ federally and territorially listed ■ social/cultural importance ■ relies on large areas of well-connected mature coniferous forest and bog-fen habitat ■ considered an umbrella species to support conservation of other wildlife and regional biodiversity
Barren-ground caribou	Not assessed	Threatened	Under consideration	■ importance to hunters, including First Nations ■ federally listed ■ social/cultural importance ■ highly interactive species in tundra environments
Moose	Not assessed	No status	No status	■ importance to hunters, including First Nations ■ highly interactive species in boreal environments (i.e., large source of protein and energy for predators and scavengers) ■ increase in local moose density could negatively affect woodland or barren-ground caribou populations by increasing carnivore density
Wood bison	Threatened	Special Concern	Threatened	■ federally and territorially listed ■ social/cultural importance ■ large source of energy and protein for predators and scavengers in boreal environments with mixed wood/coniferous forest interspersed with lakes and large open sedge wetlands and meadows
Wolverine	Not At Risk	Special Concern	No status	■ federally listed ■ indicator of large areas of well-connected mature coniferous forest; umbrella species for conservation of regional diversity
Little brown myotis	Not assessed	Endangered	Endangered	■ federally listed ■ dependent on standing dead and live trees for maternity roosts in mature deciduous and mixed stands ■ hibernacula may be limited ■ represents a species that requires open forest/edge habitat in wetter areas, and is a surrogate for other federally listed bats (e.g., northern myotis)
Peregrine falcon	Not assessed	Special Concern	Special Concern	■ federally listed ■ breeding habitat is limited ■ sensitive to noise and human activity during nesting ■ as a top avian predator can be a keystone species
Short-eared owl	Not assessed	Special Concern	Special Concern	■ federally listed

To Table of Contents

Table 4.1-1: Rationale for Selected Wildlife VCs (continued)

Valued Components	Conservation Status			Rationale for Selection
	SARC[a]	COSEWIC[b]	SARA[c]	
Bank swallow	Not applicable	Threatened	No status	■ federally listed ■ aerial insectivore that nests in cliffs or eroding stream-side banks, and human-made sites such as sand and gravel quarries
Barn swallow	Not applicable	Threatened	No status	■ federally listed ■ aerial insectivore that nests on human-made structures such as buildings and bridges
Common nighthawk	Not applicable	Threatened	Threatened	■ federally listed ■ aerial insectivore that forages and nests recently disturbed (fire, logged) and open habitats ■ nests on the ground
Olive-sided flycatcher	Not applicable	Threatened	Threatened	■ federally listed ■ aerial insectivore that requires coniferous forest, edges and openings near meadows and ponds ■ nests in trees
Horned grebe (western population)	Not applicable	Special Concern	No status	■ federally listed ■ nests on the surface of marshes and ponds
Red-necked phalarope	Not applicable	Special Concern	No status	■ federally listed
Rusty blackbird	Not assessed	Special Concern	Special Concern	■ federally listed ■ occupy wetlands and low-shrubby riparian areas along edges of lakes, beaver impoundments and watercourses
Yellow rail	Not applicable	Special Concern	Special Concern	■ federally listed ■ prefer wetland habitats with no or little standing water, but soil is saturated
Gypsy cuckoo bumble bee	Not assessed	Endangered	No status	■ federally listed
Yellow-banded bumble bee	Not assessed	Special Concern	No status	■ federally listed

a) Northwest Territories Species at Risk Committee (SARC 2016a). Note that species included in the *Migratory Bird Convention Act* are not covered by the *Species At Risk (NWT) Act*, and are labelled 'Not applicable'.

b) Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2016).

c) *Species at Risk Act*.

Assessment endpoints represent the key properties of each VC that should be protected. Self-sustaining and ecologically effective populations are the assessment endpoints applied to wildlife. Self-sustaining populations are healthy and viable populations, which are by definition robust and capable of withstanding environmental change and accommodating stochastic population processes (Reed et al. 2003). Maintaining viable populations is a conservation target frequently applied by conservation biologists and resource managers (Nicholson et al. 2006; Ruggiero et al. 1994; With and Crist 1995). For example, achieving and maintaining self-sustaining woodland caribou populations are goals of the Recovery Strategy for Woodland Caribou in Canada (Environment Canada 2012; CMA 2017).

Achieving viable populations may not be sufficient to meet conservation objectives for other species or ecosystems that interact with the VC being assessed (Soulé et al. 2005). For highly interactive wildlife VCs that have strong effects on ecosystem structure and function, the concept of ecologically effective populations was applied as an

assessment endpoint. This includes interaction with humans, such as through harvest. An ecologically effective population differs from a self-sustaining population if the number of individuals needed to maintain ecological function is greater than the number required to maintain a viable population for the long term. Self-sustaining populations can also lose ecological function if animal behaviour changes. The application of the concept of self-sustaining and ecologically effective populations to significance determination for the wildlife assessment is described in Section 4.6.1.

Measurement indicators represent attributes of the environment and VCs that, when changed, can be used to characterize effects to an assessment endpoint in a meaningful way. The measurement indicators for wildlife VCs are defined as follows:

- **Habitat availability** (i.e., quantity and quality): changes to the amount of different quality habitats (e.g., hectares), and animal use of available habitat.
- **Habitat distribution** (i.e., arrangement and connectivity): changes to spatial configuration and connectivity of habitats, and the spatial distribution and movement of animals.
- **Survival and reproduction**: changes to animal abundance from altering survival and/or recruitment.

Each indicator was assessed quantitatively where sufficient information existed to support a numerical assessment, and qualitatively, where necessary.

4.1.3 Assessment Boundaries

4.1.3.1 Spatial Boundaries

The spatial boundaries selected for the wildlife assessment were defined to provide a description of existing conditions in sufficient detail to identify and understand potential Project effects on VCs, including the contribution of the Project to cumulative effects. The wildlife assessment used two spatial boundaries:

- the Project footprint
- VC-specific Regional Study Areas (RSA)

The Project footprint accounts for direct physical disturbance and alteration of wildlife habitat. The Project footprint is comprised of the preferred route and is approximately 94 kilometres (km) in length with a 60 m ROW. A further 3 km of upgrades are required within CGW lands, bringing the total assessed Project footprint to 97 km. The footprint also includes laydown areas, construction camps, and borrow sites with associated access roads with a 30 m ROW. The total predicted area of the Project footprint is 2,198.6 ha. Up to 13 borrow sites may be developed with access roads. Construction camps and laydown areas will be located in either borrow sites or within the 60 m ROW, so neither are expected to require additional land clearing. Almost all access roads are planned to overlap the preferred route ROW and borrow sites, one may be accessed from the existing community access road from Whatì. Thus, access roads to borrow sites should not create additional direct physical disturbance to the landscape.

The cleared driving surface of the preferred route is anticipated to be approximately 8.5 m wide. The Project predominately follows a pre-existing overland winter road route to minimize new disturbance to the landscape. The Project will also include 15 water crossings; 4 of these require bridge structures, 3 require structural culverts

and 8 will have banks with drainage culverts. To be conservative and not underestimate the effects from habitat loss where there is uncertainty in the road alignment, a 100 m buffer was applied to edge of the preferred route ROW at the La Martre River crossing and a 50 m buffer was applied to the remaining preferred route ROW and anticipated borrow sites (which are to contain construction camps). The buffers should include any physical disturbance to habitat that may occur immediately adjacent to the expected Project footprint. The Project footprint with associated buffers is 3,414.3 ha (55.6% larger than the actual anticipated area of the Project).

The RSAs for wildlife VCs were identified to capture and assess the significance of incremental and cumulative effects from the Project and other previous, existing and RFDs. The VC-specific RSA is the scale at which cumulative effects can be appropriately assessed for each VC.

No information is available to delineate the population boundaries for many of the VCs, particularly bumble bees, birds and little brown myotis. Due to the length of the Project, a number of populations of each of these VCs could be potentially influenced by the Project along the route, and likely have patchy to continuous distributions. Populations intersected by the Project may be discrete or, more likely, exhibit variable connectivity through dispersal and movement.

Without estimates of population boundaries, the analysis of effects on assessment endpoints (self-sustaining and ecologically effective populations) necessarily involves uncertainty, but can still be ecologically appropriate (Table 4.1-2). For bumble bees, the RSA was defined by a 2.5 km buffer around the Project footprint, which is predicted to be large enough to capture the direct and indirect effects from the Project on these species that have small daily movement distances (range: 17 m to 1,286 m [Hagen et al. 2011]). For wildlife VCs with small to moderate breeding home ranges (i.e., bat and bird species), the RSA was also defined by a 2.5 km buffer around the Project footprint (Figure 4.1-4, note also duplicate maps in Appendix G). The assessment area for each wildlife VC is anticipated to be large enough to contain important cumulative effects on populations of bat and bird VCs that are distributed inside the assessment area, but probably also extend beyond its boundaries. A recent meta-analysis showed that effects from infrastructure on bird and mammal populations typically extended over distances of up to approximately 1 km and 5 km, respectively (Benítez-López et al. 2010).

The boreal (woodland) caribou RSA was defined by the Northwest Territories (NT) Range 1 (PR#38) (Figure 4.1-1). Following discussions with Environment and Climate Change Canada (ECCC), GNWT-ENR, and Wek'èezhìı Renewable Resource Board (WRRB), the ASR also includes an assessment of changes to boreal caribou habitat in the WRMA (PR#107).

The RSA for barren-ground caribou, moose and wolverine was largely based on TK information, and included potential ecological interactions among the VCs. Although radio-collar location data for the Bathurst and Bluenose East caribou herds from 1996 to 2015 suggest that barren-ground caribou have not occupied the area around the Project during this period of time, TK observed barren-ground caribou in the area during 1996 to 1998 (PR#28) (Figure 4.1-2). During this period, the Bathurst herd was at high numbers and may have expanded their winter range to include this area of boreal forest. The area near the northern end of the Project was also identified by TK as quality moose habitat (Figure 4.1-2) (PR#28). Based on the above information, the RSA for barren-ground caribou and moose was defined by a 35 km buffer around the Project footprint, which includes areas for these VCs identified by TK. The RSA also includes the western boundary of the winter range of the Bathurst herd, delineated by animal collar locations. Including caribou and moose in the same RSA is ecologically relevant because they are both wide-ranging animals whose ranges may overlap with the potential to interact during winter.

To Table of Contents

Similarly, wolverine population(s) that overlap the RSA would rely on scavenging moose and caribou as food sources.

The RSA for wood bison included the Mackenzie Bison Range and the RSA for barren-ground caribou (moose and wolverine). The Project intersects a very small part of the northeastern boundary of the Mackenzie Bison Range and the RSA for barren-ground caribou was included to address the potential for bison to disperse north along the TASR and expand their range (Figure 4.1-3). Traditional Knowledge also identified bison habitat adjacent to James and Marian lakes in the RSA (PR#28).

4.1.3.2 Temporal Boundaries

The Project is planned to occur during two phases:

- **construction phase:** the period from the start of construction to the start of operation (estimated at two to four years)
- **operation phase:** encompasses operation and maintenance activities throughout the life of the Project, which is anticipated to be indefinite

The assessment of the Project on wildlife considers effects that occur during the construction and operation phases. This timeframe is sufficient to capture the effects of the Project. Temporal boundaries also include the duration of effects from previous and existing developments that overlap with residual effects of the Project, and the period of time that residual effects from the Project overlap with effects from future developments and activities. The assessment considered three assessment cases, as described in Section 2.

To Table of Contents

Table 4.1-2: Spatial Boundaries for Wildlife VCs

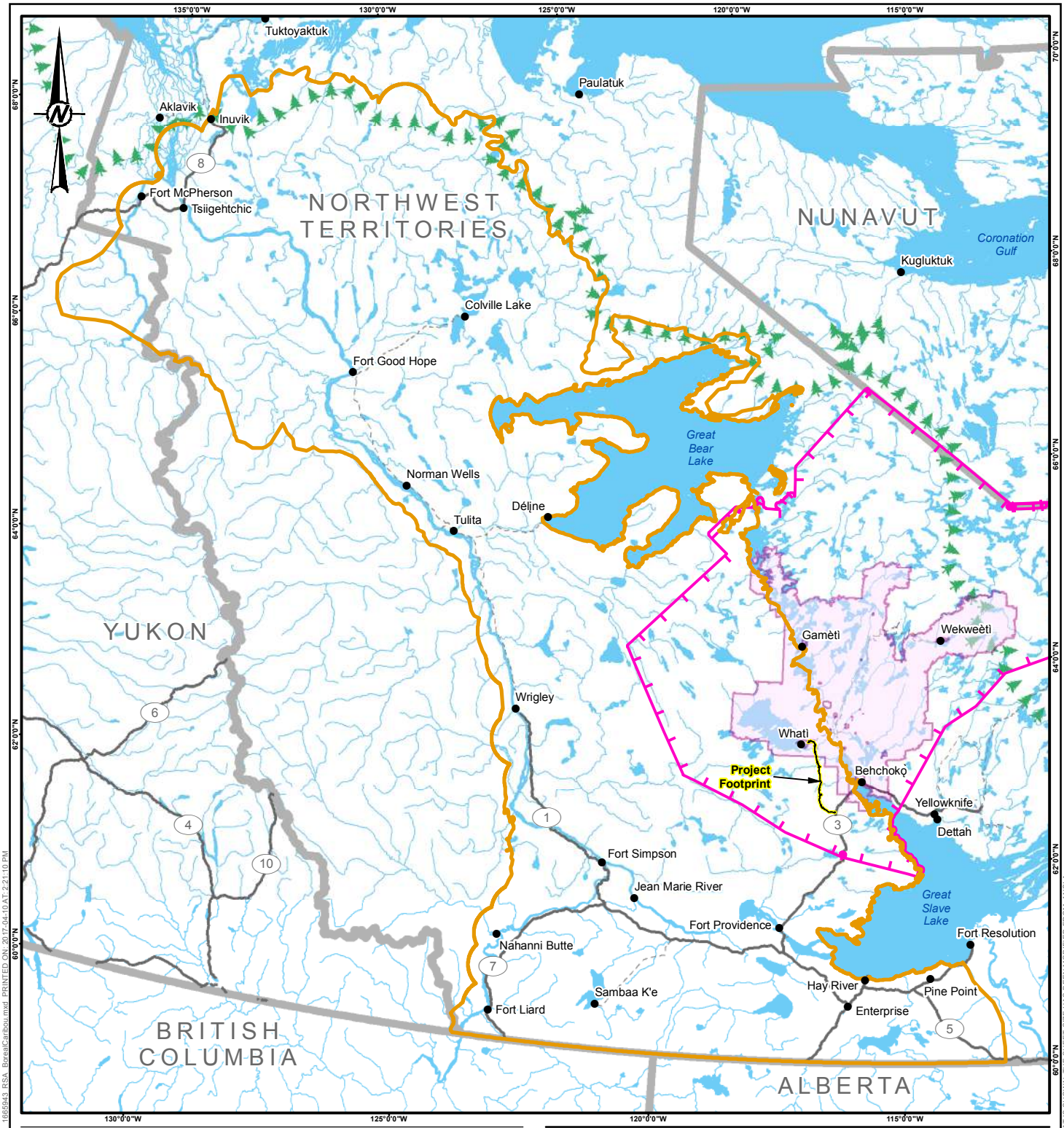
Valued Component	Study Area	Area	Description	Rationale
All VCs	Project footprint	3,414.3 ha (34.1 km^2)	The Project footprint is the preferred route ROW, laydown yards, construction camps, borrow sites and associated access roads. A 100 m buffer was applied to preferred route at the La Martre River Crossing and a 50 m was applied to the remaining portion of the route and borrow sites.	Designed to capture the direct effects of the physical footprint of the Project.
■ Bumble bees ■ Little brown myotis ■ Peregrine falcon ■ Short-eared owl ■ Bank and barn swallows Common nighthawk ■ Olive-sided flycatcher ■ Horned grebe ■ Red-necked phalarope ■ Rusty black bird ■ Yellow rail	RSA	55,572 ha (555.7 km^2)	A 2.5 km buffer around Project footprint.	■ Defined as an ecologically relevant scale for wildlife species with small to moderate breeding home ranges. ■ Provides a large enough area to assess the cumulative effects on populations of bumble bee, bat and bird VCs that are likely to be distributed inside but extend outside the RSA, and is the scale at which significance is determined.
Boreal caribou	RSA	41,718,686 ha (417,186.9 km^2)	Encompasses the NT1 Boreal Woodland Caribou Range, and includes Wek'èezhìı Resource Management Area.	■ Defined using regional population management boundaries established by GNWT-ENR. ■ Appropriate scale for a cumulative effects assessment on woodland caribou and the scale at which significance was determined. ■ Wek'èezhìı Resource Management Area within NT1 Range assessment was requested by parties.
■ Barren-ground caribou ■ Moose ■ Wolverine	RSA	1,001,520 ha (10,015.2 km^2)	A 35 km buffer around the Project footprint.	■ Defined using Traditional Knowledge and an ecologically relevant scale for wide-ranging mammal VCs that can interact with each other. ■ Appropriate scale for a cumulative effects assessment on these VCs and the scale at which significance was determined.

To Table of Contents

Table 4.1-2: Spatial Boundaries for Wildlife VCs

Valued Component	Study Area	Area	Description	Rationale
Wood bison	RSA	1,001,520 ha (10,015.2 km^2)	Mackenzie Bison Range plus a 35 km buffer around the Project footprint.	■ Defined using regional population management boundaries established by GNWT-ENR, TK and potential range expansion due to the Project. ■ Appropriate scale for a cumulative effects assessment on wood bison and the scale at which significance was determined.

Note: ROW = right-of-way; RSA = Regional Study Area.



LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- WINTER ROAD
- TREELINE
- WATERCOURSE
- PROVINCIAL/TERRITORIAL BOUNDARY
- TŁĮCHǪ LAND
- WATER BODY
- BOREAL CARIBOU RSA
- PROJECT FOOTPRINT
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

0 120 240
1:6,000,000 KILOMETRES

REFERENCE(S)

1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. BOREAL CARIBOU RANGE OBTAINED FROM ENVIRONMENT CANADA, 2012.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: CANADA LAMBERT CONFORMAL CONIC

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
RSA FOR BOREAL CARIBOU

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-10
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO.	REV.	FIGURE
1665943	0	4.1-1

To Table of Contents

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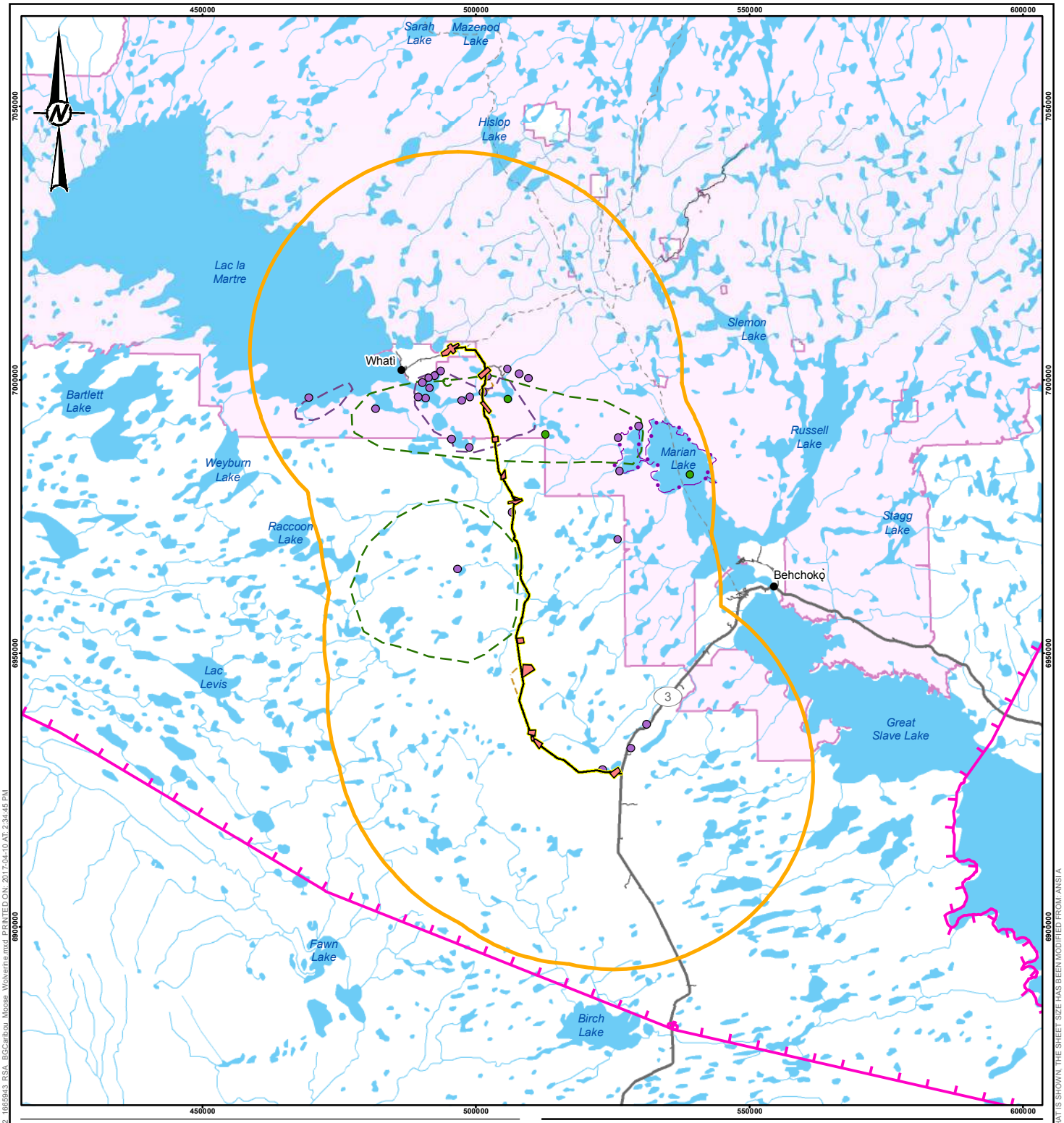

LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- LOCAL ROAD
- WINTER ROAD
- OLD AIRPORT ROAD
- WATERCOURSE
- TŁĮCHǪ LAND
- WATER BODY
- BARREN-GROUND CARIBOU, MOOSE, AND WOLVERINE RSA
- PROJECT FOOTPRINT - BORROW SOURCE
- PROJECT FOOTPRINT - ROAD
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

TRADITIONAL KNOWLEDGE DATA

- BARREN-GROUND CARIBOU HUNTING/KILL SITE
- MOOSE HUNTING/KILL SITE
- MOOSE HUNTING
- BARREN-GROUND CARIBOU HABITAT
- MOOSE HABITAT

0 20 40

1:1,000,000 KILOMETRES

REFERENCE(S)

1. TRADITIONAL KNOWLEDGE DATA OBTAINED FROM THE TLICHO GOVERNMENT, 2016 .
2. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
RSA FOR BARREN-GROUND CARIBOU, MOOSE, AND WOLVERINE

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-10
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO. 1665943 | REV. 0 | FIGURE 4.1-2

To Table of Contents

4.2 Description of Existing Conditions (Base Case)

4.2.1 General Approach

For each VC, the existing conditions were described to provide context for the assessment. Existing conditions identified at Base Case are the outcome of past and present developments and activities, and natural factors that cause environmental change. Consequently, the Base Case describes the current environmental conditions of each VC given the combined effects of past and present developments and activities. The Base Case is supported by existing studies that were completed in the Project area to better understand the existing conditions that may be influenced by the Project, and summarizes results from the Environmental Overview of the Project Description Report (PR#7) and the TK Report (PR#28).

The description of existing conditions considered each indicator for each VC. The importance of combined changes from past and present developments depends on how they have affected the integrity of each VC at the population level. The Base Case assessment therefore seeks to understand the status of each wildlife VC population in its VC-specific RSA at Base Case, which provides context for understanding the sensitivity of the VC to future development. The status of each VC population was considered using the known or inferred ability of the criterion to tolerate disturbance.

The ability of a VC to tolerate disturbance was evaluated using the concepts of ecological adaptability and resilience. Adaptable wildlife species are those that can change their behaviour, physiology, or population characteristics (e.g., reproduction rate) in response to a disturbance such that the integrity of the population remains more or less unchanged. For example, certain wildlife populations can accommodate loss of some individuals without a change in overall population status or trajectory (known as compensatory mortality; Connell et al. 1984), or can adjust their physiology or behaviour to accommodate disturbance (Knopff et al. 2014; Chapron et al. 2015). Adaptable species can accommodate substantial disturbance and sometimes thrive in highly modified environments, whereas species with low adaptability can accommodate little or no disturbance.

Resilience is a concept that is distinct from, yet closely related to, adaptability. Biological populations often have inertia and will continue to function after disturbance up to the point where the disturbance becomes severe and long enough that the population undergoes a fundamental change. Adaptability influences the duration and magnitude of the effect required for this to happen, whereas resilience defines the ability of a species or ecosystem to recover or bounce back from disturbance. Highly resilient wildlife species have the potential to recover quickly from disturbance (e.g., after reclamation is achieved or a mortality source is removed), whereas species with low resilience will recover more slowly or may not recover at all (Weaver et al. 1996).

Ideally, effect threshold values for adaptability and resilience limits of a VC are known (e.g., boreal caribou), and changes in measurement indicators can be quantified accurately with a high degree of confidence to evaluate whether or not a threshold has been exceeded. However, critical thresholds such as amount or distribution of habitat required to maintain a self-sustaining population, or the specific number of individuals required to maintain an ecologically effective population size, are rarely available for wildlife. Moreover, ecological thresholds vary by species, landscape type, and spatial scale (Swift and Hannon 2010; Environment Canada 2013a). Consequently, a detailed and transparent account of likely effects associated with estimated cumulative changes to each measurement indicator was provided for each VC using available scientific literature, data collected in the VC-specific RSA, and logical reasoning (i.e., a weight of evidence, or reasoned narrative approach).

To Table of Contents

4.2.2 Habitat Mapping

Availability and distribution of wildlife habitat was estimated and mapped using Landsat SPOT 4/5 (SPOT) imagery data (Olthof et al. 2015). The SPOT data represented a collection of imagery from 2005 to 2010 with a spatial resolution of 20 metres (m). Based on comparison with reference data, accuracy of these data was 85% (Olthof et al. 2015). The SPOT data included 16 different land cover classes. Historical fire data from 1965 to 2016 for the study areas were acquired from the GNWT Centre for Geomatics website. A separate layer was created that identified areas of burn age that were related to patterns of wildlife use. These categories included 0 to 5 years (2011 – 2016), 6 to 10 years (2006 – 2010), 11 to 20 years (1996 – 2005), 21 to 40 years (1976 – 1995) and greater than 40 years (1975 and earlier). While some sections of the Project footprint are already disturbed (as indicated in the ECCC 2010 boreal caribou disturbance data), the data analysis conservatively assumed that the entire Project footprint would be new disturbance.

The GNWT Cumulative Impact Monitoring Program (CIMP) Inventory of Landscape Change data was used to characterize existing human developments on the landscape through 2016. These data included both linear (i.e., all-season and winter roads, and power transmission lines) and polygon features (e.g., mines, lodges, exploration camps, communities) in a GIS layer. Table 4.2-1 identifies the types of developments and assumptions about the area directly disturbed. The type of previous and existing developments in the boreal caribou NT1 range are illustrated in Figure 4.2-1 and RFDs are illustrated in Figure 4.2-2.

Table 4.2-1: Development Disturbance Types, Features and Known and Assumed Footprints

Development Type	Feature Type	Footprint Radius of Buffer (m)
Airstrip	Polygon	Actual or 50 if unknown
Forestry cutblock	Polygon	Actual
Communications	Polygon	Actual
Community	Polygon	Actual
Quarry	Polygon	Actual
Mine	Polygon	Actual
Oil/Gas	Polygon	Actual
Unknown	Polygon	Actual
Well site	Polygon	Actual
Wildfire	Polygon	Actual
Major road	Line	60
Minor road	Line	44
Pipeline[(a)]	Line	500
Powerline	Line	30
Railway[(a)]	Line	500
Seismic	Line	6
Trail	Line	12
Unknown	Line	12
Winter road	Line	12
Contaminated/remediated site	Point	200
Cabin/lodge	Point	30
Exploration Camp	Point	100
Fuel Storage[(a)]	Point	500
Miscellaneous[(a)]	Point	500

a) Only present in NT1 range for boreal caribou. All feature types for boreal caribou included actual plus a 500 m buffer.

To Table of Contents

For boreal caribou, the ECCC data describing fire and development disturbance through 2010 were used. Fire and development disturbance since 2010 were added using the NWT fire and Inventory of Landscape change datasets. Development disturbance polygon, point and linear features included a 500 m buffer in accordance with Environment Canada (2012).

Habitat types used to support various life processes, such as nesting or foraging, were described for each VC based on information from scientific literature. Based on these habitat descriptions, each of the land cover classes were assigned into one of two categories: moderate to high suitability or low to nil suitability. Land cover classes were assigned to the moderate to high suitability category if they were identified as habitat types supporting critical life stages or life processes (e.g. breeding habitat). All moderate to high suitability land cover classes were broadly defined as suitable habitat. Land cover classes representing habitat that does not directly support life processes, or that were identified as habitat types that are specifically avoided (e.g. grassland birds avoid forest), were included in the low to nil suitability category. All low to nil suitability land cover classes were broadly defined as unsuitable habitat. Habitat mapping for each VC or groups of VCs is described below.

To Table of Contents

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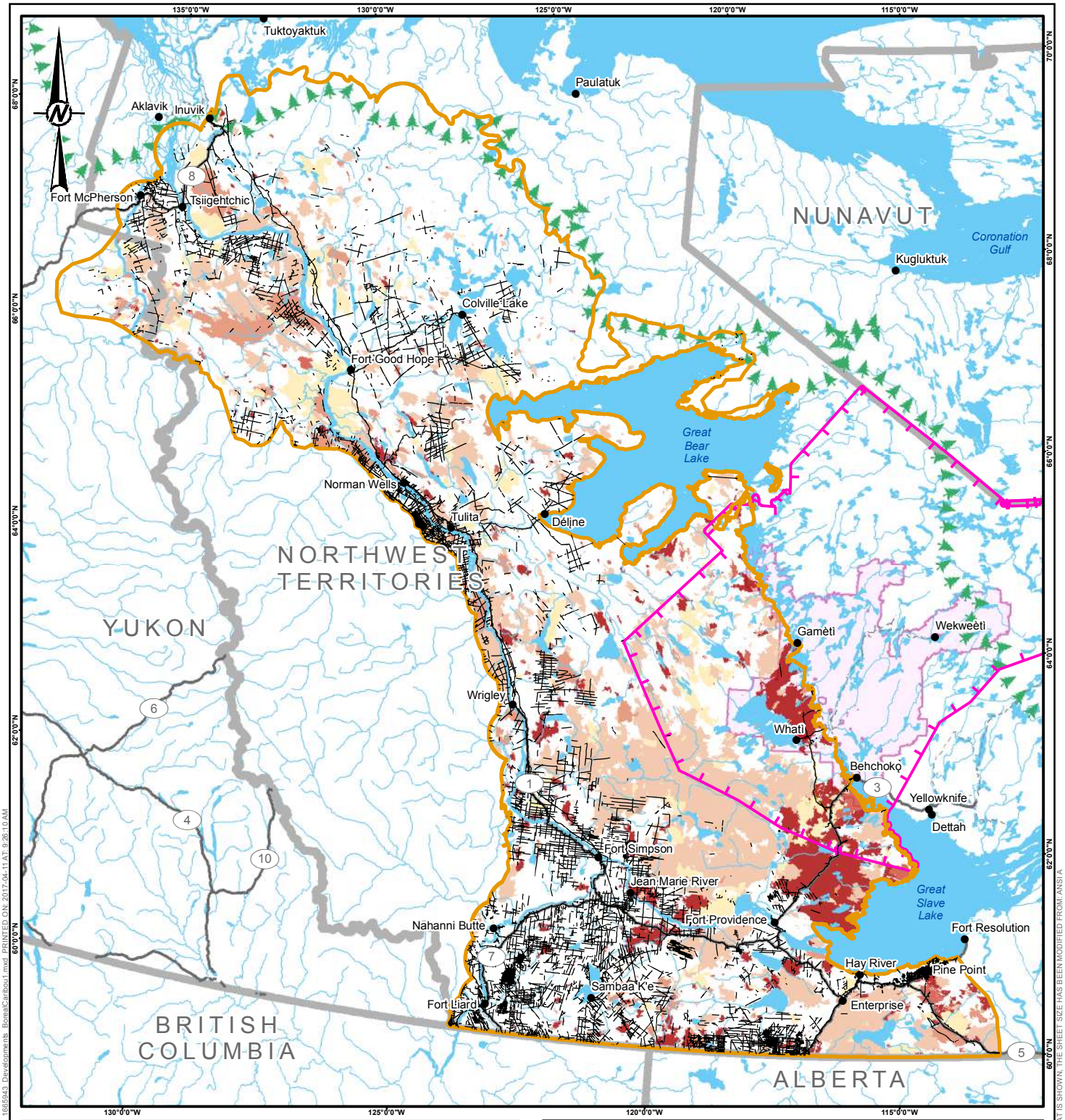

LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- WINTER ROAD
- TREELINE
- WATERCOURSE
- PROVINCIAL/TERRITORIAL BOUNDARY
- TŁĮCHǪ LAND
- WATER BODY
- DEVELOPMENT
- BOREAL CARIBOU RSA
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

FIRE HISTORY

- 0 - 5 YEARS
- 6 - 10 YEARS
- 11 - 20 YEARS
- 21 - 40 YEARS
- >40 YEARS

0 120 240

1:6,000,000 KILOMETRES

REFERENCE(S)

1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. BOREAL CARIBOU RANGE OBTAINED FROM ENVIRONMENT CANADA, 2012.
3. FIRE HISTORY OBTAINED FROM GOVERNMENT OF NWT WITH PERMISSION.
4. CIMP INVENTORY OF LANDSCAPE CHANGE, OBTAINED FROM THE NWT CENTRE FOR GEOMATICS.
4. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: CANADA LAMBERT CONFORMAL CONIC

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
PREVIOUS AND EXISTING DEVELOPMENTS IN THE BOREAL CARIBOU RSA

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-11
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO. 1665943 | REV. 0 | FIGURE 4.2-1

To Table of Contents

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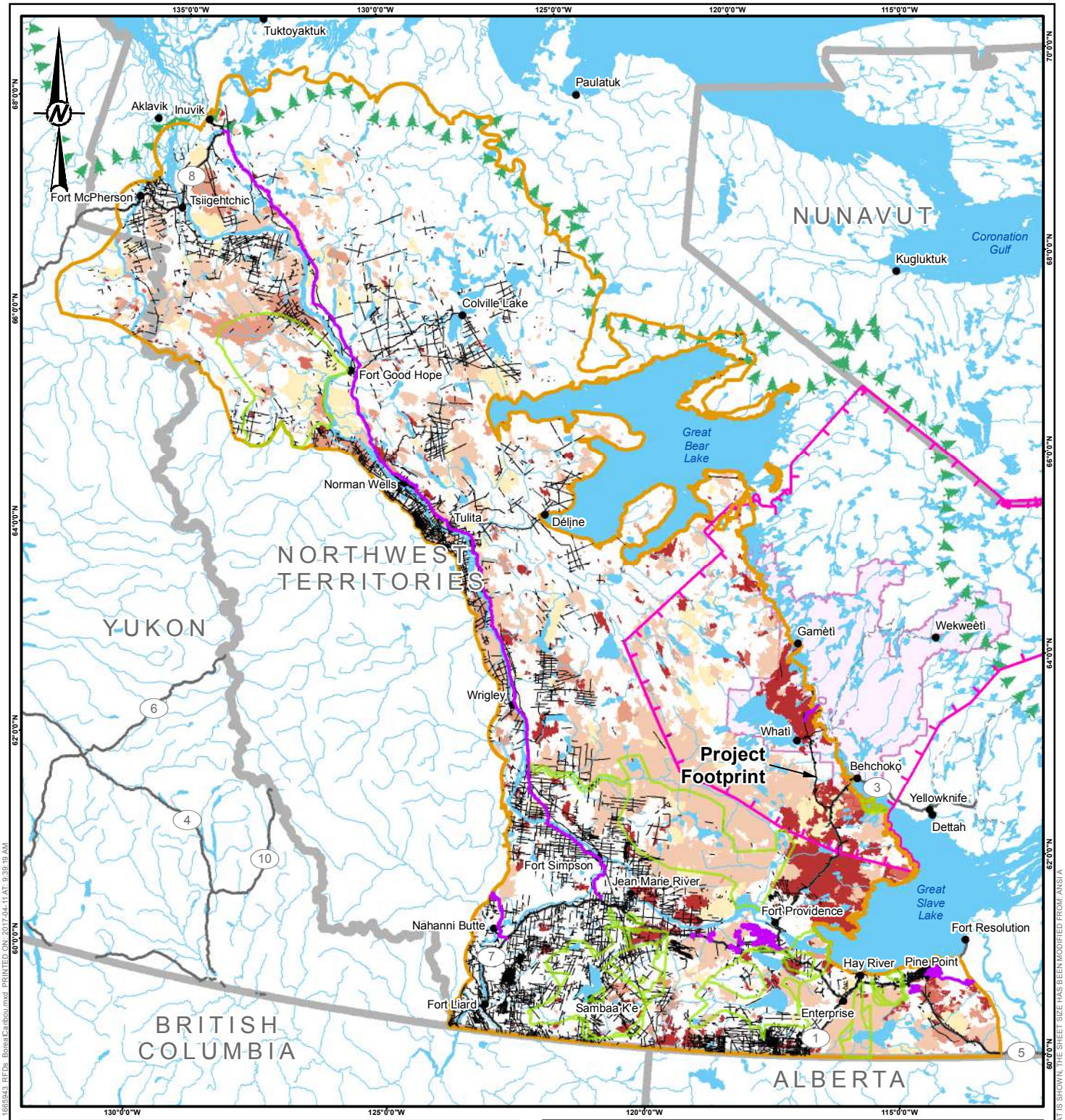

LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- WINTER ROAD
- TREELINE
- WATERCOURSE
- PROVINCIAL/TERRITORIAL BOUNDARY
- TŁĮCHǪ LAND
- WATER BODY
- CANDIDATE PROTECTED AREA
- DEVELOPMENT
- RFD
- BOREAL CARIBOU RSA
- WEK'ÈEZHÌÌ RESOURCE MANAGEMENT AREA

FIRE HISTORY

- 0 - 5 YEARS
- 6 - 10 YEARS
- 11 - 20 YEARS
- 21 - 40 YEARS
- >40 YEARS

0 120 240

1:6,000,000 KILOMETRES

REFERENCE(S)

1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. BOREAL CARIBOU RANGE OBTAINED FROM ENVIRONMENT CANADA, 2012.
3. FIRE HISTORY OBTAINED FROM GOVERNMENT OF NWT WITH PERMISSION
4. CIMP INVENTORY OF LANDSCAPE CHANGE, OBTAINED FROM THE NWT CENTRE FOR GEOMATICS.
5. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: CANADA LAMBERT CONFORMAL CONIC

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
RFDS IN THE BOREAL CARIBOU RSA

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-11
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO. 1665943 | REV. 0 | FIGURE 4.2-2

To Table of Contents

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To Table of Contents

4.2.2.1 Boreal Caribou

Boreal caribou are distributed across the forested regions of Canada, reaching the northern limit of their range in the NWT. Boreal caribou in the NWT range from the Alberta border north to the tundra, west of Great Bear and Great Slave Lakes (Edmonds and Smith 1991, Environment Canada 2010). Boreal caribou do not have definitive calving grounds like barren-ground caribou, although individual females often show fidelity to previous calving sites (Edmonds and Smith 1991; Dzus 2001). Instead pregnant females separate themselves from other caribou for calving.

Both TK and science based studies of boreal caribou in Wek'èezhìı suggest that boreal caribou have used areas along the proposed Project corridor, including some areas identified as traditional harvest sites and important habitat for boreal caribou at Tłįchǫ community workshops held in 2005 (Hillis and Cluff 2005; Cluff and Hillis 2006a, 2006b and 2006c cited in WRRB 2013). Aerial surveys conducted within the Taiga Plains ecoregion portion of the North Slave Region, where the Project is proposed, recorded densities of boreal caribou ranging from 0.17 to 3.44 animals/100 km^2 (Hillis and Cluff 2005). Observations of boreal caribou primarily occurred in spruce lichen forest, jack pine forest and shoreline areas (Hillis and Cluff 2005). The 2015 TK report confirmed that the boreal caribou range includes km 14 to km 65 of the proposed TASR; however, the Elders indicated that the main habitat is to the west of the proposed corridor (PR#28; PR#7).The current population trend in the North Slave Region and Wek'èezhìı region are unknown but areas except in southern NWT are believed to be stable or increasing (SARC 2012).

Boreal caribou prefer mature to old conifer forests since these habitats contain lichen, which is the caribou's primary winter food source (Dzus 2001). Woodland caribou primarily select peatland-dominated landscapes, such as black spruce bogs and black spruce-tamarack fens, while typically avoiding upland areas; however, caribou will use lichen-rich jack pine stands (Stuart-Smith et al. 1997). Boreal caribou tend to calve in low-lying areas, such as muskeg bogs and fens (Dzus 2001).

Wildfire can alter the availability of forage for caribou inhabiting forested environments (i.e., woodland caribou year-round or barren-ground caribou during the winter). Studies from central Alaska suggest that the depletion in lichen abundance after wildfire changes caribou range use and forces caribou to increase their home range size during the winter (Courtois et al. 2007); however, studies in northern Alberta found no change in caribou range size or use after wildfire (Dalerum et al. 2007). Instead, Dalerum et al. (2007) suggest that caribou occupying large home ranges (i.e., caribou in more northern areas) may be able to use alternative areas within their home ranges to forage for lichen, instead of switching to new, previously unused areas. The severity of a fire may affect boreal caribou populations differently depending on the arrangement of burned and unburned patches that are left after the fire (Environment Canada 2008). The differential effects on boreal caribou habitat quality are related to the effects on forage, the post-disturbance trajectory of burned areas, and the numerical response by predators and competitors. Fire disturbance has been negatively associated with caribou recruitment (Environment Canada 2008) and severe fires may negatively impact boreal caribou since caribou avoid young forests (Schaefer and Pruitt 1991; Dunford 2003; Joly et al. 2003; Dalerum et al. 2007). In the NWT, fire and anthropogenic disturbance due to timber harvesting, roads, pipelines and seismic lines have caused habitat change and loss to the boreal woodland caribou habitat and are considered the two most important factors contributing to loss of habitat availability (Environment Canada 2012; SARC 2012).

To Table of Contents

A wide range of forage plants are used by caribou and food habits vary seasonally (Banfield and Jakimchuk 1980). Caribou are not typically browsers and most of the early winter diet consists of lichens (genera *Cladonia and Cladina* spp. preferred) and the green parts of sedges (*Carex* spp.) and horsetails (*Equisetum* spp.) because of their high digestibility and high protein levels (Miller 1976; Case et al. 1996). The consumption of grasses and sedges diminishes over winter, as these plants become less digestible (Kelsall 1968). In late winter, lichens are used extensively, although alder (*Alnus* spp.), birch (*Betula papyrifera*), and willow (*Salix* spp.) may be consumed when other food resources are scarce. Snow characteristics, such as hardness and depth, can influence forage availability and the selection of winter habitat (Case et al. 1996; Dzus 2001). Snow cover, rather than food availability, appears to limit the capacity of winter ranges to support boreal caribou. In spring, lichen uplands are the first areas to become snow free, and shrubby lichens become important until new plant growth emerges. Unique habitat features sought out by caribou include mineral licks of frost boils or mud boils, which are primarily mounds of silt and clay (Pruitt 1960).

Lichen provides a good source of energy but it is not rich in protein (Miller 1992). Therefore, in spring and summer, caribou tend to select new plant growth and flowers, which are rich in minerals and protein (Thompson and McCourt 1981; Miller 1992). During the calving season, willow, dwarf birch (*Betula glandulosa*), green alder (*Alnus crispa*), and cotton grass (*Eriophorum* spp.) are consumed as new growth emerges (Fleck and Gunn 1982). Following calving, caribou will move to areas where new vascular plants are more abundant. Willow, forbs, grasses, and sedges become important forage species in summer (Case et al. 1996; Demarais and Krebs 2000). By late summer, the leaves of deciduous shrubs, such as willow, dwarf birch, and bearberry (*Arctostaphylos* spp.), form much of the diet (Skoog 1986). In the fall, grasses, sedges, mushrooms, birch, and willow leaves remain important because of the protein content (Miller 1992).

Suitable habitat for boreal caribou include the biophysical seasonal habitat attributes for the Taiga Plains ecozone from the Federal Woodland Caribou Recovery Strategy (Environment Canada 2012), which were presented in Table 6-9 of the PDR (PR#7). Boreal caribou habitat was mapped in accordance with methods and data described by the Federal Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population in Canada (Environment Canada 2012). This included applying a 500 m buffer around developments and no buffer was applied to natural disturbance (i.e., fire) footprint. In addition to quantifying disturbed and undisturbed habitat at the NT1 range, a similar assessment was completed for the Wek'èezhìı portion of the NT1 range.

4.2.2.2 Barren-ground Caribou

Habitat selection and barren-ground caribou behaviour are frequently the result of their response to environmental conditions; therefore, caribou can be found in a variety of habitat types at any one time (Case et al. 1996). The selection of habitat appears to be related to food availability, ease of travel, relief from insects, and predation (Curatolo 1975). Barren-ground caribou in the NWT exhibit an annual movement cycle between wintering areas in the southern and calving areas in the northern extent of their annual range.

During winter, barren-ground caribou will select habitats that have an abundance of lichen (Sharma et al. 2009, Barrier and Johnson 2012). The calving season will often find barren-ground caribou in areas of high elevation with sparse vegetation, which likely reduces predation rates (Sharma et al. 2009). During the post-calving season, areas with high quality forage (Sharma et al. 2009) and low insect density (Toupin et al. 1996) are selected. Cows with calves play an important role in influencing caribou behaviour because they direct the overall movements of the herd and pass on traditional movement patterns (Curatolo 1975).

To Table of Contents

In the NWT, barren-ground caribou wintering areas overlap the boreal forest (Nagy et al. 2005; Anderson and Johnson 2014; Golder 2016). Caribou may select coniferous stands for access to arboreal lichens as an important winter food resource (Chowns and Gates 2004; Bergerud et al. 2008; Barrier and Johnson 2012). Caribou may avoid recent fires (within 55 years of being burned; Thomas et al. 1998, Joly et al. 2007) because lichen cover may be reduced to 5%, even after 20 to 35 years of regeneration (Jandt et al. 2008).

Although the Project likely occurs outside of the core seasonal range boundaries described by barren-ground collared caribou cows (Nagy et al. 2005; Anderson and Johnson 2014; Golder 2016; Appendix G) and regular interaction with the Project is not expected. TK indicates that barren-ground caribou have occurred in areas near the north end of the Project during winter (PR#28), likely during periods of high abundance. Because the Project is located in the boreal forest, suitable boreal habitats for barren-ground caribou during winter are provided in Table 4.2-2.

Table 4.2-2: Land Cover Types Identified as Suitable Habitat for Barren-ground Caribou in the RSA

Land Cover Code[a]	Land Cover Name	Land Cover Description
1	Evergreen Conifer Forest (high density)	≥20% needle-leaved tree cover and <2.5% broad-leaved tree cover
2	Evergreen Conifer Forest (medium density)	<20% and ≥12.5% needle-leaved tree cover, and <2.5% broad-leaved tree cover
11	Bryoid	≥60% lichens and mosses
13	Sparse Conifer Lichen	≥40% lichens and mosses, and ≥30% trees
21	Burns >40 years old	Forest fires >40 years old

a) Grid code of SPOT 20 m land cover data and assigned for wildfire burn ages.

4.2.2.3 Moose

Historically, moose have been distributed across forested regions of Canada; however, moose have recently expanded their range to include prairie and tundra ecosystems. Although considered a generalist species, moose have been shown to prefer deciduous aspen, shrubland, and wetlands interspersed with trees and shrubs. Optimal moose habitat consists of deciduous shrub and ground layers within deciduous, mixed, and conifer forests that offer edge or disturbed areas of early successional vegetation (Poole and Stuart-Smith 2003; Courtois et al. 2002; Osko et al. 2004; Nelson et al. 2008).

In general, it is thought that moose respond more to food availability than cover (Stewart et al. 2010); however, in the winter, moose will adjust their behaviour and move to avoid areas of deep snow (e.g., greater than 90 cm; Peek et al. 1982) and use mature coniferous stands, which intercept snowfall (Courtois et al. 2002). Preferred fall and winter browse includes red-osier dogwood (*Cornus sericea*), willow species (*Salix* spp.), trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), dwarf birch (*Betula occidentalis*), alder (*Alnus* spp.), and beaked hazelnut (*Corylus cornuta*), among others (Stelfox 1993). To access this forage, habitats with high cover of shrub species, such as shrubby fens and bogs and riparian habitats with open canopies, are usually preferred, particularly in late winter. Shrub height is important during winter conditions, as forage shrub species must be higher than the snowpack to be accessed by moose. It has been proposed that, in some landscapes, primary habitat (i.e., high quality forage habitat such as shrubland) can provide all of the necessary winter resources for moose (Stewart et al. 2010). The majority of food resources and cover can be contained in shrubland and, potentially, in deciduous forest (Cairns and Telfer 1980; Dussault et al. 2006a; Stewart et al. 2010).

To Table of Contents

Table 4.2-14: Land Cover Types Identified as Suitable Habitat for Short-eared Owl in the RSA

Land Cover Code[a]	Land Cover Name	Land Cover Description
9	Herb-shrub	≥ 40% herbaceous cover, and ≥30% shrub cover (40% – 60% closure)
10	Herbaceous	≥ 60% herbaceous cover
14	Herbaceous wetland	≥ 60% natural and semi-natural aquatic vegetation cover

a) Grid code of SPOT 20 m land cover data.

4.2.3 Results

4.2.3.1 Boreal Caribou

Habitat Availability

The NT1 range for boreal caribou is 41,718,698 ha in the NWT. At Base Case, existing disturbances in the NT1 range include forestry, fire, linear infrastructure (e.g., roads, seismic lines and rail lines), and urban development. Fire disturbance has altered 10,159,286 ha (24.4%) of the NT1 range (Table 4.2-15). Buffered developments have removed 3,697,637 ha (8.9%) of boreal caribou habitat in the NT1 range. Caribou may respond negatively to anthropogenic disturbance by avoiding areas of otherwise suitable habitat because of its proximity to disturbance (Weclaw and Hudson 2004), which therefore reduces the amount of functional habitat available within the range. Avoidance may vary by type and intensity of disturbance, by season (e.g., Dyer et al. 2001, 2002; Eftestøl et al. 2016; Polfus et al. 2011) and can occur at multiple spatial scales (e.g., Apps et al. 2006; Leblond et al. 2011; Rettie and Messier 2001). In a literature review, Vistnes and Nellemann (2008) found that caribou and reindeer reduced their use of areas within 5 km of disturbances by 50% to 95%. Some studies suggest that caribou avoid areas of high disturbance density. In particular, caribou are thought to avoid areas of high road density (Apps et al. 2006; Faille et al. 2010; Nellemann and Cameron 1998; Pinard et al. 2012). However, development disturbance represents a small proportion of the NT1 range landscape. Overall, 66.8% of the NT1 range is undisturbed boreal caribou habitat, which exceeds the 65% minimum threshold for undisturbed habitat predicted necessary to support a self-sustaining boreal caribou population (Environment Canada 2012). At Base Case, boreal caribou are predicted to be self-sustaining and ecologically effective with a low risk, but are near their resilience limits.

Table 4.2-15: Boreal Caribou Habitat Availability in the NT1 Range, Base Case

Habitat Suitability	Area (ha)	Percent (%)
Fire disturbance	10,159,286	24.4
Buffered development	3,697,637	8.9
Undisturbed habitat	27,861,774	66.8

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values. Areas were calculated using Canada Lambert Conformal Conic projection and may not match data presented elsewhere using different projections. ENR typically uses Canada Albers Equal Area Conic projection for calculating boreal caribou habitat, resulting in slightly different results for boreal caribou habitat availability.

To Table of Contents

The Wek'èezhìı portion of NT1 range for boreal caribou is 4,632,765 ha (11.1%). Fire disturbance has altered 1,813,041 ha (39.1%) in the Wek'èezhìı portion of the NT1 range (Table 4.2-16). Buffered developments cover 40,840 ha (0.9%) in the Wek'èezhìı portion of the NT1 range. Approximately 60% of the Wek'èezhìı portion of NT1 range is undisturbed boreal caribou habitat. While the Wek'èezhìı portion of NT1 range includes total disturbance above the 65% minimum threshold for self-sustaining populations (Environment Canada 2012), it is important to note the disturbance thresholds identified by ECCC at the NT1 range scale are not necessarily applicable at different spatial scales. This is because patterns of habitat selection are scale-dependent due to varying availability of different habitats across space and time (Johnson 1980; Rettie and Messier 2000; Mayor et al. 2009). For boreal forest caribou, trends in habitat selection at the regional or seasonal range scale are typically driven by an avoidance of deciduous and early succession forest stands that support high densities of moose and deer (Bergerud et al. 1984; reviewed in Dzus 2001; and in Chowns and Gates 2004) neither of which occur (i.e., high densities of moose and deer) in the Wek'èezhìı portion of NT1 range but are present and inherent in the results of southern jurisdictions reflected in the 65% threshold. Thus, boreal caribou in the Wek'èezhìı area may not require as much undisturbed habitat in order to meet their life history requirements and avoid predation.

Table 4.2-16: Boreal Caribou Habitat Availability in the Wek'èezhìı Portion of NT1 Range, Base Case

Habitat Suitability	Area ha)	Percent (%)
Fire disturbance	1,813,041	39.1
Buffered development	40,840	0.9
Undisturbed habitat	2,778,883	60.0

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values. Areas were calculated using Canada Lambert Conformal Conic projection and may not match data presented elsewhere using different projections. ENR typically uses Canada Albers Equal Area Conic projection for calculating boreal caribou habitat, resulting in slightly different results for boreal caribou habitat availability.

Habitat Distribution

As described in the PDR (PR#7), the distribution range of the NWT boreal caribou population mainly corresponds to the extent of the Taiga Plains ecozone in the NWT. It extends from the NWT-Alberta border north to the Arctic coast towards Inuvik and is bounded by the Taiga Cordillera ecozone to the west and the Taiga Shield ecozone to the east. The TASR is located in the eastern part of the NT1 range near Whatì.

Boreal caribou are not migratory and remain in forested habitats year round (Dzus 2001). The woodland caribou rut occurs in early- to mid-October (Edmonds and Bloomfield 1984). In November, boreal caribou disperse into smaller groups throughout their annual home range (Dzus 2001). When snow depth increases, caribou tend to move into areas of higher tree cover since movement and feeding are easier in these areas (Fuller and Keith 1981).

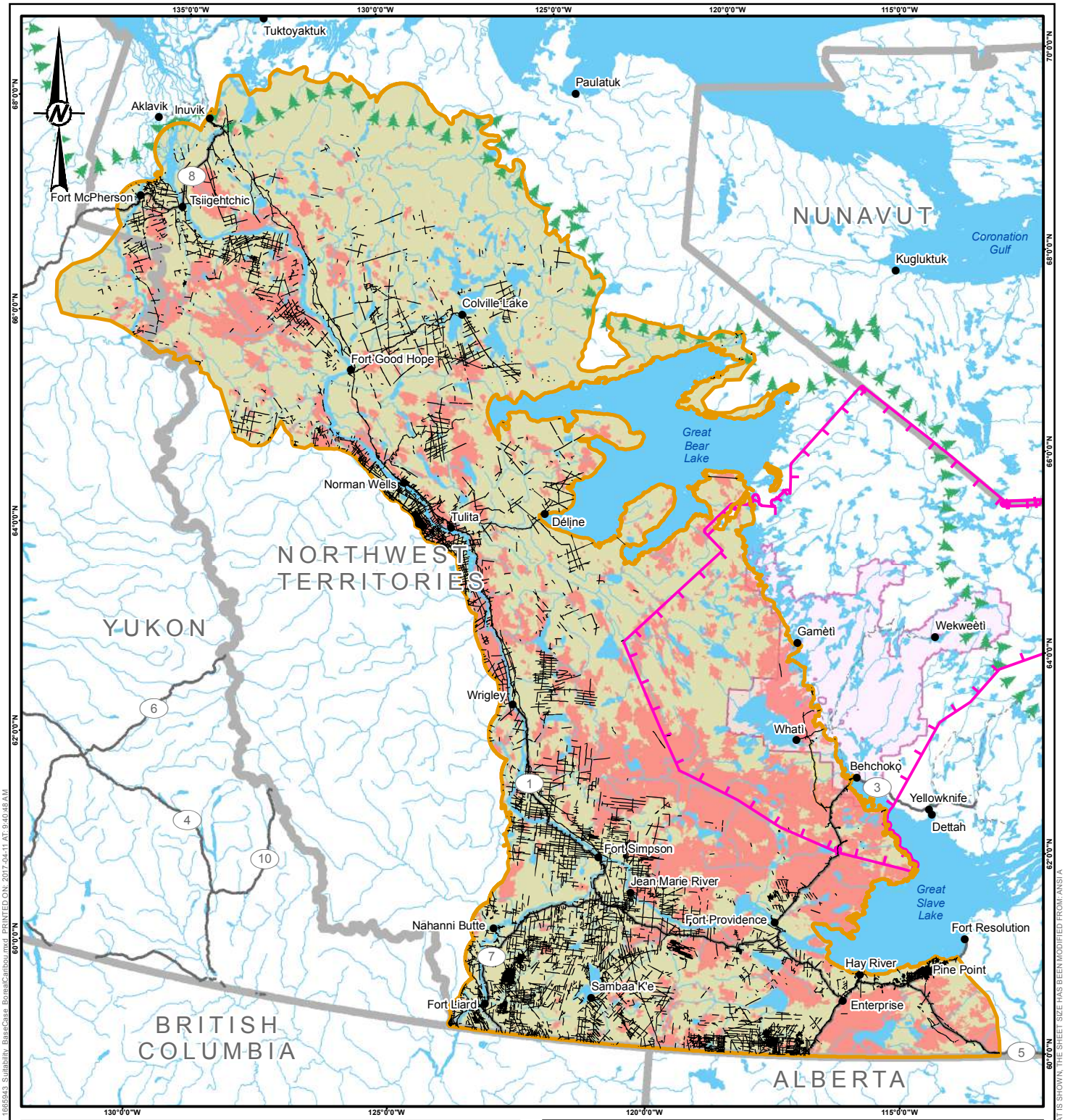
Boreal caribou have also been reported to avoid burned and anthropogenic disturbance areas. Boreal caribou in Newfoundland exhibited avoidance of 4 km surrounding an active mine site (Weir et al. 2007) and 9 km around active logging operations (Schaefer and Mahoney 2007). Burned areas are also avoided, either because of lack of food (i.e., lichen) (Schaefer and Pruitt 1991; Joly et al. 2003) or increased abundance of other ungulates and therefore predators (Environment Canada 2008). Linear corridors, such as roads, are also generally avoided (Dyer et al. 2002); possibly because of increased predator or human presence in these areas (James and Stuart-Smith 2000).

To Table of Contents

For wide ranging species such as caribou, movement is crucial to facilitate access to resources across space and time (Johnson et al. 1992; Nathan et al. 2008; Taylor et al. 1993). Restricted movement can reduce home range size (Andreassen and Ims 1998; Beauchesne et al. 2014; Muhly et al. 2015) and reduce access to resources required for survival such as predator-free space (Muhly et al. 2015). For example, Leclerc et al. (2014) found that boreal caribou reduce selection of areas as road density increases. Dyer et al. (2002) found that roads act as semi-permeable barriers to movement by reducing the frequency of crossing events as compared to simulated road networks. The magnitude of this effect may vary across seasons. During late winter, caribou road crossing rates were six times lower than the rates calculated using hypothetical road networks (Dyer et al. 2002). Similarly, Wilson et al. (2016) found that some individuals cross roads more slowly, which can delay arrival of caribou at seasonal ranges (Mahoney and Schaefer 2002; Wilson et al. 2016).

Features that act as semi-permeable barrier may exacerbate indirect habitat loss caused by avoidance of disturbance features (Dyer et al. 2002). Beauchesne et al. (2014) suggested that over a certain disturbance threshold it is likely that individuals cannot avoid using unsuitable habitats anymore, leading to decreased movement rates and increased use of suboptimal habitats as movement becomes increasingly risky (Smith et al. 2000; Hebblewhite 2008). Reduced movement rates and restricted home ranges increases the amount of time spent in lower suitability habitats and therefore increases vulnerability of caribou to predation (Beauchesne et al. 2014; Morales et al. 2010; Muhly et al. 2015; Rettie and Messier 2000). Caribou confined to smaller home ranges could be forced into less suitable habitat and be more easily detected by predators (Beauchesne et al. 2014).

At Base Case, undisturbed boreal caribou habitat has a patchy distribution throughout the NT1 range, (Figure 4.2-3). Fire disturbance also occurs in large patches throughout the NT1 Range. The NT1 range has existing linear disturbance, in the form of roads, trails, power transmission lines and seismic lines, particularly in the southern part of the NT1 range. Large but less common patches of undisturbed habitat are also present in the northwestern part of Wek'èezhìı Portion of NT1 Range. Development in the WRMA includes two communities, communication towers, a highway with gravel quarries and existing trails, including the Old Airport Road route to the community of Whatì.



LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- WINTER ROAD
- TREELINE
- WATERCOURSE
- PROVINCIAL/TERRITORIAL BOUNDARY
- TŁĮCHǪ LAND
- WATER BODY
- DEVELOPMENT
- FIRE HISTORY (LESS THAN 40 YEARS OLD)
- UNDISTURBED HABITAT
- BOREAL CARIBOU RSA
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

0 120 240

1:6,000,000 KILOMETRES

REFERENCE(S)

1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. BOREAL CARIBOU RANGE OBTAINED FROM ENVIRONMENT CANADA, 2012.
3. CIMP INVENTORY OF LANDSCAPE CHANGE, OBTAINED FROM THE NWT CENTRE FOR GEOMATICS.
4. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: CANADA LAMBERT CONFORMAL CONIC

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
DISTRIBUTION OF BOREAL CARIBOU HABITAT AT BASE CASE

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-11
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO. 1665943 | REV. 0 | FIGURE 4.2-3

To Table of Contents

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To Table of Contents

Survival and Reproduction

Most woodland caribou populations have declined across Canada (GNWT-ENR 2009a). The boreal ecotype of woodland caribou is listed as threatened in the NWT (GNWT-ENR 2017) and by COSEWIC (2017) and SARA (2017). Woodland caribou populations occur at low densities (0.03 to 0.12 caribou/km^2) throughout the mid-continent (Stuart-Smith et al. 1997); however, population numbers and trends for woodland caribou in Canada are poorly known. Low densities, large land area, and multiple jurisdictions limit accurate population estimates. The population estimate of woodland caribou in the NWT was between 6,000 and 7,000 in 2011, and likely less than 10,000 (SARC 2012, PR#7). The most recent population status of the NT1 range was completed in 2012 and indicted boreal caribou are likely a self-sustaining population (Environment Canada 2012; PR#79). The result is based on the proportion of undisturbed habitat exceeding 65% in the NT1 range, which Figure 4.2-3 reflects.

Caribou survival and reproduction are related to the availability of suitable habitats that support life history processes. For example, the reproductive success of females and survival of calves are negatively affected if calving and post-calving habitats are unavailable, inadequate or degraded (Environment Canada 2012; McCarthy et al. 2011; Pinard et al. 2012; Thomas and Gray 2002). Habitat suitability is heavily influenced by the habitat's capacity to provide refuge from predation (Bergerud 1974; Environment Canada 2012; Hornseth and Rempel 2015; Racey and Arsenault 2007; Rettie and Messier 2000). Caribou spatially separate themselves from predators and alternate prey (e.g., moose and white tailed deer [*Odocoileus virginianus*]) as an anti-predator strategy, and maintain low population densities across their range (Bergerud 1988, 1996; Environment Canada 2008, 2012; Johnson et al. 2001). Large continuous tracts of undisturbed habitat are therefore important to maintaining self-sustaining caribou populations. Nagy (2011) found a positive correlation between population growth rates and access to secure unburned habitat, particularly where most of the habitat was in patches greater than 500 km^2.

Predation, primarily by wolves, is considered to be the main factor limiting caribou populations (Bergerud 1988; James 1999; James and Stuart Smith 2000; Seip 1992; Stuart Smith et al. 1997), and increased predation by wolves and possibly other predators is facilitated by underlying landscape changes through apparent competition (Holt 1977). In the case of caribou, apparent competition is manifested when a growing number of prey such as moose and white tailed deer causes an increase in the number of predators, such as wolves, thereby increasing predation pressure. Although the proximate cause of caribou decline is predation, the ultimate cause of caribou decline is linked to a change in habitat (Boutin et al. 2012) because landscape alterations caused by natural and anthropogenic disturbances create early seral habitats suitable for moose and white tailed deer (Latham 2009; Latham et al. 2011; Serrouya et al. 2011). Seral stage is the point along an ecological succession in an ecosystem advancing towards its climax community. However, white tailed deer are uncommon in the NWT.

Caribou are sensitive to changes in predation rate because they have a low reproductive output relative to other ungulates (Environment Canada 2012). Females typically do not reproduce until three years of age and give birth to one calf per year (Bergerud 2000). Calf mortality due to predation can be especially high, particularly within the first 30 days after birth (Bergerud and Elliot 1986; Gustine et al. 2006). In many caribou populations, the proportion of calves that survive to one year of age is usually low and insufficient to compensate for annual adult mortality in declining populations (Bergerud 1974; Stuart Smith et al. 1997; DeMars et al. 2011). Bergerud and Elliot (1986) suggested that caribou populations cannot remain stable when moose densities are sufficient to support more than 6.5 wolves per 1,000 km^2. Moose densities of approximately 0.11 moose per km^2 are likely to support such wolf densities (Bergerud and Elliot 1986). Moose densities in northern environments are low (0.05 to 0.15 moose per km^2 [GNWT-ENR 2016a]) compared to southern boreal forest regions (Sly et al. 2001).

To Table of Contents

Surveys completed in the boreal forest of the North Slave Region, north of Great Slave Lake, found lower density rates ranging from 0.02 to 0.04 moose per km² in the Taiga Shield and Plains (Cluff 2005) and are less than half the density of moose required to support more than 6.5 wolves per 1,000 km² (Section 4.2.3.3).

Local and landscape scale disturbance patterns can influence caribou survival and reproductive success. Linear features (e.g., roads, pipelines, transmission lines, trails) may adversely affect caribou survival (DeCesare et al. 2012; James and Stuart Smith 2000; Whittington et al. 2011). Linear features have been associated with increased predator mobility, leading to a greater risk of predation for caribou when on or near these features (James 1999; Whittington et al. 2011). Leclerc et al. (2014) found that the probability of calf loss was related to the avoidance of areas with increasing density of roads; females whose calves survived demonstrated stronger avoidance of these areas than did females who lost their calves to predation.

Courtois et al. (2007) suggested that mortality increased with the extent of disturbed landscape within caribou home ranges because animals were vulnerable to predation. As the proportion of disturbance increases, it becomes more difficult for caribou to avoid predators and alternate prey. In Alberta and British Columbia, Peters et al. (2013) found a positive relationship between the amount of human induced disturbance and the degree of spatial overlap of caribou and moose. Caribou mortalities were located in areas of high resource use by moose in summer (Peters et al. 2013). Using data from caribou populations across Canada, Environment Canada (2008, 2011) conducted a meta-analysis that quantified a negative relation between recruitment (i.e., calf to cow ratios) and total disturbance (including natural and anthropogenic) within a range. Furthermore, Environment Canada (2011) indicated that the probability of a population remaining stable or undergoing growth is directly influenced by the amount of disturbance within that range, meaning that the likelihood of population persistence decreases as the amount of disturbance increases.

Fragmentation effects that restrict caribou movement can also negatively influence the survival and reproduction of caribou. For wide ranging species that need broad areas for their life history requirements, such as caribou, restricted movement and therefore restricted access to resources within a range can increase extinction probability and reduce lifetime reproductive success (McLoughlin et al. 2007; Revilla et al. 2008). Similarly, in many caribou subpopulations, reduced movements have been associated with fragmented populations and subsequent genetic drift (Serrouya et al. 2012).

Sensory disturbance may affect caribou through physiological stress; however, these effects are difficult to quantify (Dantzer et al. 2014). In general, sensory disturbance is most detrimental at key times of the year, such as late winter periods, when animals tend to be in poor physical condition, and during the reproductive season (spring/early summer) when caribou are raising young (Eftestøl et al. 2016; Kuck et al. 1985; Wolfe et al. 2000; Yarmoloy et al. 1988). Using simulated seismic exploration noise in northeast Alberta (i.e., propane cannons fired every 1 to 2 minutes for one hour with a magnitude of 90 to 110 dB), Bradshaw et al. (1997) found that disturbed caribou moved notably faster and crossed habitat boundaries (i.e., habitat patches) substantially more often than undisturbed caribou. Similarly, Murphy and Curatolo (1987) determined that caribou near oilfield infrastructure (pipelines and roads) in Alaska spent less time lying down, more time running and had higher movement rates than caribou located away from these disturbances. Although these effects may seem minor, displacement and increased wariness may affect energetic expenditures and survival, particularly for young calves.

The TK study report by the Tłı̨chǫ Government (PR#28) indicates that boreal caribou in the WRMA have been harvested in areas along and surrounding the TASR route through a network of trails and routes (Section 5.2.10). Non-aboriginal harvest of woodland caribou is regulated by GNWT-ENR. Hunting regulations for woodland caribou

allow residents to harvest one boreal or mountain woodland caribou per year and non-residents can only hunt woodland caribou in the Mackenzie Mountains (GNWT-ENR 2016b). The resident hunting season for woodland caribou is from July 15 to January 31, while the non-resident season is from July 25 to October 31. As with barren-ground hunts, non-residents must obtain the services of a licensed outfitter.

Considering cumulative changes to caribou habitat quantity and quality (including proportion of disturbance in the NT1 range), habitat connectivity and arrangement, caribou abundance, and densities of predators and alternate prey, boreal caribou in the NT1 range appear to be within the limits of adaptive capacity and resilience at Base Case.

4.2.3.2 Barren-ground Caribou

Habitat Availability

The barren-ground study area is 1,001,520 ha. There is 117,677 ha (11.7%) or a small amount of moderate to high suitability habitat in the RSA at Base Case (Table 4.2-17). Previous and existing development in the RSA is primarily linear in the form of winter roads and trails and Highway 3. Other developments include communication towers, gravel quarries and the community of Whatì.

Traditional Knowledge indicates that barren-ground caribou have not been common near the Project area since the late 1990s (PR#28). Barren-ground caribou herds with potential to be present during winter include the Bluenose-East (BNE) and Bathurst caribou herds, which are identified as separate herds based on their traditional calving grounds. However, locations of collared cows in these herds indicate the RSA is outside of both Bathurst and BNE core ranges (Nagy et al. 2005; Anderson and Johnson 2014; Golder 2016; Appendix G), so regular interaction with the Project is not expected.

The BNE herd typically calves in the Rae and Richardson rivers' area, west of Kugluktuk and moves south and east past Great Bear Lake in late summer (ACCWM 2011). This herd is most likely to overlap with the proposed TASR during winter. Data collected from collared individuals show that they primarily range between Great Bear Lake to the north and to the south around Grandin Lake; however, some satellite collared cows have been recorded as far south as Behchokǫ̀ (ACCWM 2011) and uncollared barren-ground caribou believed to be part of the BNE herd have been found south of Grandin Lake to Lac La Martre.

The Bathurst caribou typically calve in the Bathurst Inlet area and move south and west into the proposed Project route in the fall, following calving (ACCWM 2011). The Bathurst herd usually winters southeast of Great Bear Lake towards Great Slave Lake, close to the communities of Wekweètì, Whatì, and Gamètì. In the past when population numbers were high, Bathurst herd caribou have been found further south into areas near Yellowknife and Łutsel K'e ; and even as far west as Blackwater and Keller lakes and as far south as northern Saskatchewan (ACCWM 2011). Recent estimates of Bathurst herd's winter range from collared caribou cows indicate no overlap with the Project route (Anderson and Johnson 2014; Golder 2016). While uncollared caribou from the Bathurst herd may use areas outside of the delineated range, they have not been detected within the proposed corridor in recent years during a period of population decline. Barren-ground caribou are expected to have the capacity to adapt and be resilient to existing natural and human-related disturbances and associated variations in habitat availability, which at Base Case are not limiting.

To Table of Contents

Table 4.2-17: Barren-ground Caribou Winter Habitat Availability in the RSA, Base Case

Habitat Suitability[a]	Area (ha)	Percent (%)
Moderate to High	117,677	11.7
Low to Nil	883,843	88.3
Total	**1,001,520**	**100**

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
[a] - Refer to Section 4.2.2 for descriptions of each habitat suitability category and and Table 4.2-2 for relevant land cover classes.

Habitat Distribution

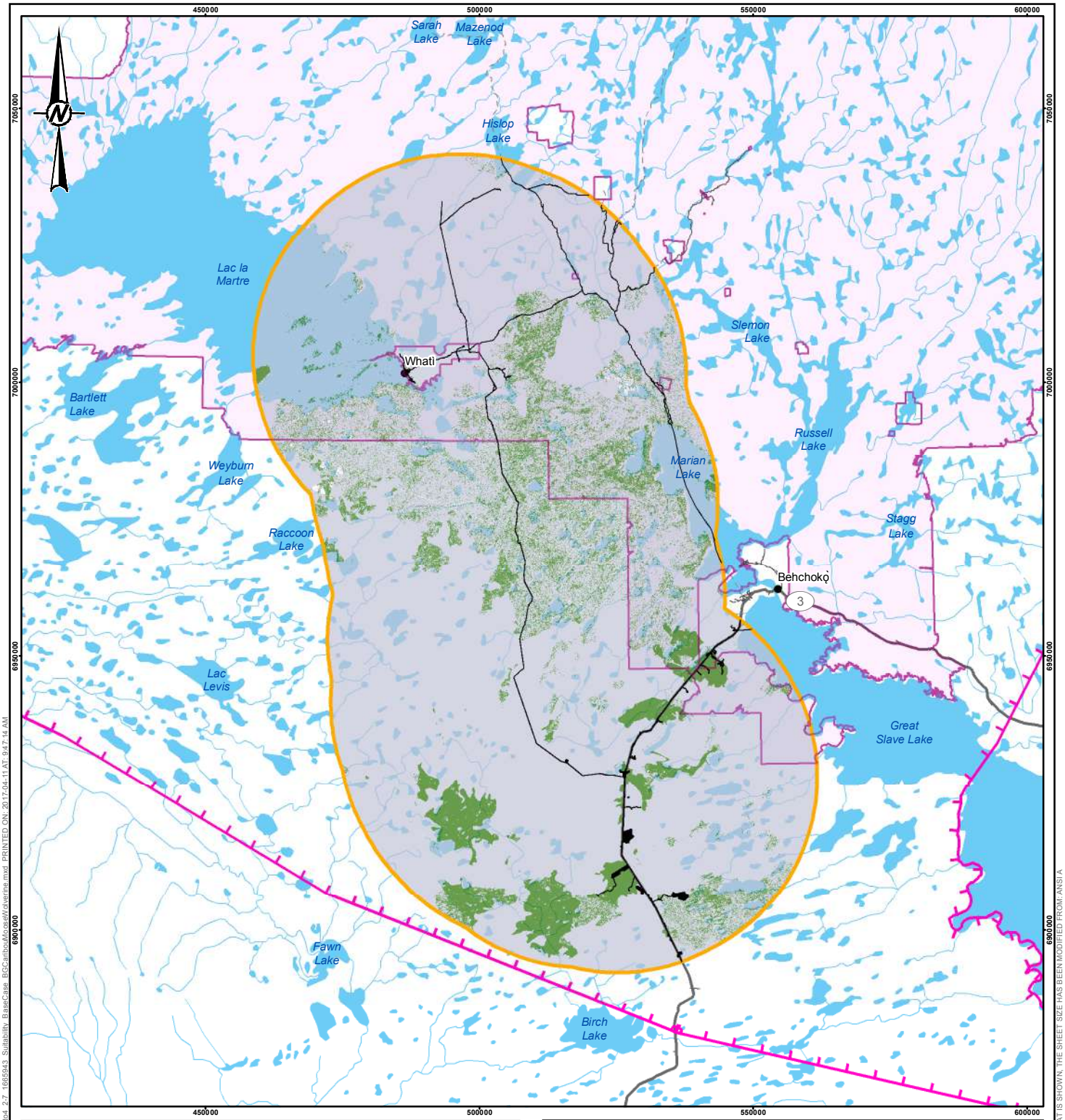
Similar to boreal caribou, barren-ground caribou avoid active developments (Boulanger et al. 2012; Johnson and Russell 2014). In boreal areas of the winter range, burned areas are also avoided, either because of lack of food (i.e., lichen) (Thomas et al. 1998; Barrier and Johnson 2012) or possibly from increased abundance of other ungulates and therefore predators (Environment Canada 2008). Linear features, such as roads, are also generally avoided (Curatolo and Murphy 1987; Johnson and Russell 2014).

For wide ranging species such as caribou, movement is crucial to facilitate access to resources across space and time (Johnson et al. 1992; Nathan et al. 2008; Taylor et al. 1993). Restricted movement can reduce home range size (Andreassen and Ims 1998; Beauchesne et al. 2014; Muhly et al. 2015) and reduce access to resources required for survival such as predator-free space (Muhly et al. 2015). For example, Nellemann and Cameron (1998) found that barren-ground caribou density at calving grounds were inversely related to road density. Specifically, caribou density declined by 63% at road densities between 0.0 and 0.3 km/km^2 and by 86% between 0.6 and 0.9 km/km^2 compared to pre-development conditions. Similarly, Wilson et al. (2016) found that some individuals cross roads more slowly, which can delay arrival of caribou at seasonal ranges (Mahoney and Schaefer 2002; Wilson et al. 2016).

Features that act as semi-permeable barrier effects may exacerbate indirect habitat loss caused by avoidance of disturbance features (Dyer et al. 2002). Beauchesne et al. (2014) suggested that over a certain disturbance threshold it is likely that individuals cannot avoid using unsuitable habitats anymore, leading to decreased movement rates and increased use of suboptimal habitats as movement becomes increasingly risky (Smith et al., 2000; Hebblewhite 2008). Reduced movement rates and restricted home ranges increases the amount of time spent in lower suitability habitats and therefore increase vulnerability to predation (Beauchesne et al. 2014; Morales et al. 2010; Muhly et al. 2015; Rettie and Messier 2000). Caribou confined to smaller home ranges could be forced into less suitable habitat and be more easily detected by predators (Beauchesne et al. 2014).

Traditional Knowledge reports that the frequency and intensity of fire can influence caribou numbers and seasonal ranges (Kendrick et al. 2005). However, recent analysis of collared Bathurst caribou cows indicates that this herd prefers winter on the barren-ground areas north of boreal forest (Golder 2016). Preference for barren-ground wintering areas suggests the Bathurst herd may be less sensitive to loss of habitat from wildfire than previously believed. The BNE winter range occurs almost entirely in boreal forest (ACCWM 2011).

At Base Case, suitable barren-ground caribou winter habitat has a patchy distribution, with small patches dominating the central RSA (Figure 4.2-4). Larger contiguous patches are located at the southern end of the RSA near Highway 3 but these have a low likelihood of use given the winter distributions of BNE and Bathurst caribou herds (Nagy et al. 2005; Anderson and Johnson 2014; Golder 2016: Appendix G). Similarly, barren-ground caribou are expected to be resilient to fragmentation effect and changes to connectivity from previous and existing development and fire disturbance in the RSA at Base Case due to low degree of interaction with the RSA.



LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- LOCAL ROAD
- WINTER ROAD
- WATERCOURSE
- TŁĮCHǪ LAND
- WATER BODY
- DEVELOPMENT
- BARREN-GROUND CARIBOU, MOOSE, AND WOLVERINE RSA
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

HABITAT SUITABILITY

- MODERATE TO HIGH
- NIL TO LOW

0 20 40

1:1,000,000 KILOMETRES

REFERENCE(S)

1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. CIMP INVENTORY OF LANDSCAPE CHANGE, OBTAINED FROM THE NWT CENTRE FOR GEOMATICS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
DISTRIBUTION OF SUITABLE BARREN-GROUND CARIBOU HABITAT AT BASE CASE

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-11
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO. 1665943 | REV. 0 | FIGURE 4.2-4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25mm

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PATH: I:\2016\1665943\Mapping\MXD\Wildlife\10_2_ DO_NOT_OPEN_WITH_10_4\FIG4_2-4to4_2-7_1665943_SuitabilityBaseCase_BGCaribouMooseWolverine.mxd PRINTED ON: 2017-04-11 AT 9:47:14 AM

To Table of Contents

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To Table of Contents

Survival and Reproduction

All herds of barren-ground caribou present in the NWT have declined over the past 10 years (Adamczewski et al. 2009), and 34 of the 43 major herds world-wide are in decline (Vors and Boyce 2009). As a result, all herds of barren-ground caribou in the NWT (with the exception of Peary caribou) are ranked as sensitive in the NWT (GNWT-ENR 2010a). Barren-ground have been assessed as "Threatened" by COSEWIC and are being considered for listing under SARA (SARC 2017a). The number of animals in barren-ground caribou herds increase and decrease at relatively regular intervals, approximately every 30 to 60 years (Case et al. 1996; Boulanger and Gunn 2007; Zalatan et al. 2006; Adamczewski et al. 2009). Although these natural fluctuations in herd size appear to be linked to changes in climatic patterns and winter range quality (Ferguson and Messier 2000; Weladji and Holand 2003; Gunn 2009; Vors and Boyce 2009), the exact mechanisms responsible for generating these population cycles are unknown.

Both the BNE and the Bathurst herds have shown a decline in population numbers. The GNWT-ENR calving ground photo survey results showed that the BNE herd declined from more than 100,000 in 2010 to around 38,600 animals in 2014 (GNWT-ENR 2016c).The Bathurst herd has been in decline since a high of over 350,000 in the mid-1990s. Although it was considered stable at low numbers from 2009-2012 at around 32,000 to 35,000, the photographic survey of the Bathurst calving grounds conducted in June 2015 suggests that the Bathurst herd has further declined to between 16,000 to 22,000 since 2012 (GNWT-ENR 2016d).

Using modelling techniques and data collected from 1996 to 2003, estimated annual survival rates of caribou: female adult = 0.71 to 0.84, female yearlings (age 1) = 0.842, and female calves (i.e., young-of-the-year) = 0.259 (Boulanger and Gunn 2007; GNWT-ENR 2016c,d). Male adult survival was estimated to be from 0.58 to 0.730. Estimates of survival rates for male yearlings and calves were not presented in Boulanger and Gunn (2007) or GNWT-ENR (2016d). Fecundity, defined as the average number of calves produced for each sex and a function of adult survival, was 0.45. Modelling also showed that survival rates of adult females were relatively constant from 1986 to 2006, but that fecundity and calf survival declined during this period. Adult cow survival has been below the 0.83 deemed necessary for herd stability since 2006 in both Bathurst and BNE herds (GNWT-ENR 2016c,d). Furthermore, during surveys on the calving grounds of the Beverly and Qamanirjuaq herds, for every 100 cows there was estimated to be 15 and 20 calves, respectively, which is well below the usual 80 calves per 100 cows.

Natural factors, such as insect pest outbreaks and climate change may also have an important role in population dynamics, and their interacting effects with habitat requirements may confound any perceived relationships with human activity (e.g., Tews et al. 2007). Caribou that experience high levels of insect harassment generally have poor body condition (Weladji and Holland 2003) because they spend less time foraging and more time being active (Toupin et al. 1996; Łutsel K'e Dene Elders and Land-Users et al. 2005). Climate warming is expected to increase the duration and intensity of insect harassment on caribou because of earlier insect emergence, greater insect abundance, and increased insect distribution (Weladji and Holland 2003; Vors and Boyce 2009). Climate change is also expected to increase the frequency and intensity of wildfire and enable plants to expand their ranges northward. As fires increase and plants move north, moose and wolves may also increase their northern distribution, which may negatively impact caribou populations and distributions (Sharma et al. 2009). Climate change is also likely to lead to earlier plant emergence. As plants are most nutritious soon after emergence, it is important for caribou to access these resources as close to plant emergence as possible; however, caribou migrations are mainly cued by day length. For example, the time of year when wintering Bathurst cows

To Table of Contents

begin their annual northward migration to calving areas is highly predictable to occur at mid-April (Gunn et al. 2002). Therefore, as the climate becomes warmer, caribou migrations may become out of sync with plant emergence, which may lead to a decline in reproductive success, as has been shown in Greenland (Post and Forchhammer 2008).

Other possible causes of reductions in herd size include commercial and subsistence hunting (Boulanger and Gunn 2007). Case et al. (1996) estimated that between 14,500 and 18,500 Bathurst caribou were harvested annually from 1982 to 1995. Based on the Dogrib Harvest Study, Boulanger and Gunn (2007) estimated that, on average 6.7% of bulls (range = 3.0 to 9.2%) and 4.1% of cows (range = 1.4 to 7.0%) were harvested annually from 1988 to 1993 (based on estimated population size); however, demographic models suggest that reduced levels of hunting generated only a slight increase in adult survival (3%), which was not enough to produce positive population growth (Boulanger and Gunn 2007).

In addition to the above-mentioned environmental and anthropogenic external factors, density dependence may be an important factor in the population dynamics of barren-ground caribou (Tews et al. 2007). Density dependence occurs when the growth rate of a population decreases as its density increases. In some cases, growth rates decrease because of declining forage resources that cause decreases in survival and/or reproduction. This mechanism can lead to cyclical trends in abundance starting when foraging levels surpass a critical level for maintenance of population size, resulting in either gradual reductions in population growth or abrupt population declines. There is both TK (Zalatan et al. 2006) and scientific evidence (Case et al. 1996; Boulanger and Gunn 2007; Adamczyewski et al. 2009; Festa-Banchet et al. 2011) that describe cyclical patterns in abundance in barren-ground caribou.

Winter represents a time of thermoregulatory and nutritional stress for barren-ground caribou because temperatures are below freezing and forage may be less accessible due to snow and ice resulting in higher energetic costs (Fancy and White 1985; Collins and Smith 1991; Brotton and Wall 1997). The energetic cost for travel in snow is also higher than during non-winter periods but the difference in magnitude depends on snow conditions (Boertje 1985; Fancy and White 1985). Winter is when pregnant cows are typically losing weight (Bergerud 1996) and weight loss decreases the probability of calving the following June (Cameron and Ver Heof 1994). Although there is uncertainty about whether barren-ground caribou populations are regulated by the availability of lichens on their winter range (Bergerud 1996), the body condition of females at the end of winter has important implications to the fecundity rates and trajectory of the population.

A TK study report by the Tłı̨chǫ Government indicates that barren-ground caribou in the WRMA have been harvested in areas along the north end of the proposed TASR route through a network of trails and routes during winter and would include harvest from either BNE or Bathurst herds (PR#28; Section 5.2.10). In addition to existing trails, hunters could access wintering barren-ground caribou beyond the northern end of the TASR by snowmobile in winter using winter road routes before they are open and by truck or snowmobile after winter roads are opened. Harvest restrictions on Bathurst caribou as recommended by the RRB) were in effect for the 2010 to 2014 harvest seasons. This restriction included 150 hunting tags for the Tłı̨chǫ people and 150 for the Yellowknives Dene First Nation (Tłı̨chǫ Government-ENR 2010). A no-hunting mobile conservation zone was implemented by GNWT-ENR in 2015 for the Bathurst herd. The number of tags was further reduced to 15 in 2015 and zero from 2016 until 2019 (WRRB 2016). Harvest allowance for aboriginal hunters for the BNE caribou is 750 bulls from 2016 to 2019. Non-aboriginal harvest of barren-ground caribou is regulated by GNWT-ENR. Hunting regulations for barren-ground caribou allow residents to harvest one or two male barren-ground caribou per year and non-residents cannot

harvest barren-ground caribou in the NWT (GNWT-ENR 2017). The resident hunting season for barren-ground caribou is from August 15 to April 30. Beginning January 1, 2010, barren-ground caribou commercial/meat tag, resident, and non-resident harvesting was closed in the North Slave and South Slave regions, and all hunting was closed in a new no-hunting conservation zone established north of Yellowknife where the Bathurst herd winters. Due to the current low abundance and harvest restrictions of Bathurst caribou and BNE, barren-ground caribou are considered unlikely to be self-sustaining and ecologically effective at Base Case.

4.2.3.3 Moose

Habitat Availability

There is large amount of suitable habitat for moose in the RSA at Base Case. Approximately 322,377 ha (32.2%) of the RSA represents suitable habitat for moose (Table 4.2-18). Moose are expected to have the capacity to adapt and be resilient to existing natural and human-related disturbances and associated variations in habitat availability. Moose are also highly mobile, have large home ranges, and can use many different habitat types.

Table 4.2-18: Moose Habitat Availability in the RSA, Base Case

Habitat Suitability [a]	Area (ha)	Percent (%)
Moderate to High	322,377	32.2
Low to Nil	679,143	67.8
Total	**1,001,520**	**100**

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.
[a] - Refer to Section 4.2.2 for descriptions of each habitat suitability category and Table 4.2-3 for relevant land cover classes.

Habitat Distribution

Moose are highly mobile and have large annual home ranges that often encompass thousands of hectares (Murray et al. 2012; Street et al. 2015). Reported dispersal distances range from a few kilometres to extreme cases of greater than 1,000 km (Hoffman et al. 2006). Juvenile moose disperse short distances after being abandoned by cows, typically after their first year (Hoffman et al. 2006). Causes of dispersal include resource competition, resource depletion, predation pressure, and acquiring mates. Hoffman et al. (2006) suggest that high mobility allows moose to exploit suitable habitat patches in heterogeneous landscapes. Evidence to support this includes that moose are at harvestable population levels in the Canadian prairies where patches of wetlands and trees are highly isolated by secondary roads and agriculture. Suitable habitat for moose is widely distributed and connected throughout the central portion of the RSA at Base Case (Figure 4.2-5). Habitat availability is limited and not well connected at the north and southern ends of the RSA.

Traditional moose range encompasses suitable habitat south of the treeline throughout the NWT; however, since the early 1900s, moose have been seen at numerous locations on the tundra where adequate forage is available (GNWT-ENR 2016a). Moose densities in northern environments are low (5 to 15 moose per 100 km^2 [GNWT-ENR 2016a]) compared to southern boreal forest regions (Sly et al. 2001). Surveys completed in the boreal forest of the North Slave Region, north of Great Slave Lake, found lower density rates ranging from 2.0 to 3.5 moose per 100 km^2 (Cluff 2005). The estimated number of moose in the NWT is approximately 20,000 individuals (GNWT-ENR 2016a).

To Table of Contents

Survival and Reproduction

The short-eared owl has not been assessed by the SARC (2016a), but is listed federally as Special Concern by COSEWIC (2016) and as Special Concern on Schedule 1 of the SARA (2002).

Short-eared owl likely arrives in the NWT to breed in the spring (April to May) (GNWT 2013). Short-eared owl builds a nest on the ground, consisting of a scrape in the ground lined with grasses and feathers. Eggs are laid by mid-June and owlets hatch in early July (COSEWIC 2008). The owls leave their breeding ground in the fall, and are generally gone by late October (GNWT 2013). Short-eared owls typically prefer to nest in areas that are not prone to human disturbance as the female will often desert the nest if disturbed during the critical laying or incubation stages (COSEWIC 2008). However, this species has been known to nest in close proximity to agricultural activities, including haying, mowing or livestock grazing (COSEWIC 2008).

Data suggests that short-eared owl populations in Canada have decreased approximately 27% between 1998 and 2008 (COSEWIC 2008). Roadside surveys in the Taiga Plains Ecoregion have detected a decrease in short-eared owl populations of an average of 4.12% per year from 1966 to 1994 (Kirk and Hyslop 1998). Information on the current population status and trends of short-eared owls in the NWT is not known. Determining population trends of short-eared owls is difficult because they are nomadic and densities fluctuate in relation to vole populations (COSEWIC 2008).

Nationwide, COSEWIC (2008) identifies habitat loss and degradation on winter range as a primary cause of owl decline. On the breeding range, low or unpredictable levels of prey availability and increased predation are believed to be one of the key factors affecting reproductive success and indirectly, population-level declines (Environment Canada 2016a). Mortality due to vehicle collisions has also been documented, but the significance of this factor on overall population decline is unknown (Environment Canada 2016a).

4.3 Pathway Analysis

4.3.1 Methods

Pathway analysis identifies and assesses the linkages (or interactions) between the Project components and activities and the predicted changes to the environment that may affect wildlife VCs. A pathway analysis was used to refine the understanding of how the Project may affect VCs, identify appropriate mitigation, and to help focus the assessment on key interactions between the Project and the environment. Methods for the pathways analysis are provided in Section 2.0.

4.3.2 Results

Project components and activities, effects pathways, and environmental design features and mitigation are summarized in Table 4.3-1. Classification of effects pathways (i.e., no linkage, secondary, and primary) to wildlife VCs are also summarized in Table 4.3-1 and detailed descriptions are provided in the subsequent sections.

To Table of Contents

Table 4.3-1: Pathways Assessment for Wildlife VCs

Tłı̨chǫ Road Project Component/Activity	Effect Pathways	Mitigation	Pathway Assessment
Construction of Project footprint (e.g., road right-of-way, borrow pits, laydown areas and construction camps)	Site preparation, construction and operation activities can result in the loss or alteration of vegetation and topography that may change habitat availability, use, and connectivity and influence wildlife abundance and distribution	■ The current layout of the Project footprint will minimize the amount of new disturbance by primarily following the existing Old Airport Road route to Whatì and intersecting areas previously burned. ■ Habitat loss will be minimized by limiting the proposed TASR corridor to 60 m wide not including the borrow sites and access corridors. ■ Habitat loss by the Project will be minimized by locating construction camps and laydown areas within borrow sites or the ROW. ■ Disturbance of significant wildlife features, such as nests and dens will be avoided using pre-construction monitoring and set-back distances described in the Wildlife Management and Monitoring Plan. ■ The mitigation strategies recommended by Lands' *Northern Land Use Guidelines* will be considered, which includes best practices for avoiding, minimizing and rehabilitation of impacts to vegetation and topography.	Primary
	Site preparation and construction may result in the destruction of roosting or hibernating bats (incidental take)	■ Destruction of bat roosts will be avoided by managing, to the extent possible, the incremental removal of vegetation so that it occurs outside of spring through fall. If vegetation clearing is required within this time, pre-clearing surveys and no-work zones for identified active maternity roost sites will be conducted to avoid disturbance. ■ Avoid disturbance of hibernating bats by surveying for sites of hibernacula potential (i.e., abandoned buildings and mines and caves) within 200 m of ROW for bat use prior to construction.	
	Site preparation and construction may result in the destruction of nests, eggs, and individuals of migratory birds (incidental take)	■ Avoid disturbance to migratory birds by clearing land outside of the bird nesting and fledging season (May to mid-August); however, if vegetation clearing is required within this time, pre-clearing nest surveys will be completed and no-work zones for identified active nesting sites will be used to minimize disturbance.	

To Table of Contents

Table 4.3-1: Pathways Assessment for Wildlife VCs (continued)

Tłı̨chǫ Road Project Component/Activity	Effect Pathways	Mitigation	Pathway Assessment
Construction of Project footprint (e.g., road right-of-way, borrow pits, laydown areas and construction camps)	Dust and air emissions, and subsequent deposition can change soil quality and vegetation, which can affect wildlife habitat availability and distribution	■ Reduced speed limits will assist in minimizing dust production. ■ Construction and maintenance equipment will be equipped with industry-standard emission control systems to minimize air emissions. ■ Dust suppression techniques (as per the GNWT Guideline for Dust Suppression and GNWT-DOT's Erosion and Sediment Control Manual) will be utilized to reduce dust emissions onto vegetation outside of the ROW. ■ Power sources provided at construction camps will minimize unneccesary idling in the winter.	Secondary
	Surface water runoff from the Project area can alter surface water, soil, vegetation, which can change the availability and distribution of wildlife habitat	■ Hazardous materials and fuel will be stored according to regulatory requirements to avoid contamination to the environment and workers (i.e., Hazardous Substances Management Plan). ■ Individuals working on-site and handling hazardous materials will be trained in the Transportation of Dangerous Goods to avoid accidental spills. ■ An approved Spill Contingency Plan will be followed by Project staff to prevent spills and if they were to occur as a result of an accident, that they will be controlled to minimize the area impacted. ■ Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred during construction to minimize effects to vegetation and wildlife habitat. ■ Construction and maintenance vehicles will be equipped with spill kits and fuelled 30 m away from water bodies, to avoid effects to water and minimize effects to vegetation and wildlife habitat. ■ Spill response and containment will be completed expeditiously in accordance with the approved site-specific Spill Contingency Plan to reduce the area impacted. ■ Construction equipment, machinery, and vehicles will be regularly maintained to avoid accidental spills. ■ GNWT-DOT's Erosion and Sediment Control Manual, in conjunction with a suitable road design, will be utilized for erosion and sediment control and slope stabilization, which should minimize damage to riparian, stream, wetland and lake habitat from altered hydrology.	
Construction of Project footprint (e.g., road right-of-way, borrow pits, laydown areas and construction camps)	Changes to hydrology may alter drainage patterns and increase/decrease drainage flows and surface water levels that can cause changes to soils and vegetation, which can affect wildlife habitat availability and distribution	■ GNWT-DOT's Erosion and Sediment Control Manual, in conjunction with a suitable road design, will be utilized for erosion and sediment control and slope stabilization, which should minimize damage to riparian, stream, wetland and lake habitat from altered hydrology. ■ The mitigation strategies recommended by Lands' *Northern Land Use Guidelines* will be employed, which includes best practices for avoiding, minimizing and rehabilitation of impactions to vegetation and topography. ■ Use of culverts and other design features will minimize changes to local flows and drainage patterns and drainage areas. Regular maintenance will occur along the TASR to ensure culverts are clear of debris (including ice during spring thaw).	Secondary

To Table of Contents

Table 4.3-1: Pathways Assessment for Wildlife VCs (continued)

Tłı̨chǫ Road Project Component/Activity	Effect Pathways	Mitigation	Pathway Assessment
Construction of Project footprint (e.g., road right-of-way, borrow pits, laydown areas and construction camps)	Sensory disturbance (lights, smells, noise, dust, human activity, viewscape) can change wildlife habitat availability, use and connectivity (movement and behaviour), which can lead to changes in wildlife abundance and distribution	■ Construction activities will be limited during sensitive periods to minimize effects on wildlife. For example, surface blasting will be suspended when caribou are identified within a 'danger zone' and the period for no harm or disturbance to migratory birds and their nesting habitat will be observed. Further details pertaining to wildlife and blasting can be found in the Wildlife Management and Monitoring Plan and Quarry Operations Plan, respectively. ■ Lights will be positioned to shine downwards and/or will be fixed with shielding to minimize the distribution of peripheral light and shut off when not in use. ■ Wildlife will have the right-of-way to minimize sensory disturbance during construction. ■ Recommended setback distances for dens and nests will be followed as per an approved land use permit and Wildlife Management and Monitoring Plan, which will avoid or minimize disturbance. ■ In the event that an active den or nest is identified during construction, GNWT-ENR will be consulted to determine an appropriate strategy to avoid or minimize disturbance. ■ Project staff will communicate the presence of wildlife to other drivers via radio. ■ Observations of caribou and species at risk will be reported to Environmental Monitors. Any next steps will be actioned as per the directions outlined in the WMMP. ■ Harassment and feeding of wildlife by Project staff will be prohibited. ■ Project staff will be provided with environmental awareness training.	Primary
	Physical hazards on the Project site, and collisions with construction vehicles can cause injury or mortality to individual wildlife, leading to decreases in survival and reproduction	■ Speed limits will be established and posted to minimize the risk of wildlife injury and mortality. ■ The presence of caribou and wildlife will be communicated to construction personnel, which will minimize risks of physical hazards through site-wide awareness. ■ All employees will be provided with environmental awareness training, which will minimize risks of physical hazards through site-wide awareness. ■ Environmental Monitors will be on site to document wildlife and manage and minimize risks to wildlife and workers.	Secondary

To Table of Contents

Table 4.3-1: Pathways Assessment for Wildlife VCs (continued)

Tłı̨chǫ Road Project Component/Activity	Effect Pathways	Mitigation	Pathway Assessment
Construction of Project footprint (e.g., road right-of-way, borrow pits, laydown areas and construction camps)	Spills on the Project site can alter surface water quality, soils, vegetation, which can change the availability and distribution of wildlife habitat	■ Hazardous materials and fuel will be stored according to regulatory requirements to avoid contamination to the environment and workers (i.e., Waste Management Plan). ■ Domestic and recyclable waste and dangerous goods will be stored on-site in appropriate containers to avoid exposure until they are shipped off-site to an approved facility. ■ Individuals working on-site and handling hazardous materials will be trained in the Transportation of Dangerous Goods to avoid accidental spills. ■ An approved Spill Contingency Plan will be followed by Project staff to prevent spills. If they were to occur as a result of an accident, they will be controlled to minimize the area impacted. ■ Emergency spill kits will be available wherever toxic materials or fuel are stored and transferred during construction to minimize effects to vegetation and wildlife habitat. ■ Construction and maintenance vehicles will be equipped with spill kits and fuelled 30 m away from water bodies, to avoid effects to water and minimize effects to vegetation and wildlife habitat. ■ To avoid effects to water and minimize effects to vegetation and wildlife habitat, fuel storage areas will be equipped with spill kits, will be located at least 30 m away from water bodies and large fuel storage tanks (2,000 to 50,000 L) will be double walled. ■ Spill response and containment will be completed expeditiously in accordance with the approved site-specific Spill Contingency Plan to reduce the area impacted. ■ Exposure of wildlife to contaminants will be avoided by use of appropriate deterrents (e.g., temporary fencing, noise makers) to discourage wildlife from entering an affected area. ■ Construction equipment, machinery, and vehicles will be regularly maintained to avoid accidental spills.	No Linkage
	Increase in public access could affect wildlife survival and reproduction through vehicle strikes, and/or legal and illegal hunting	■ Speed limits will be established, posted and enforced to reduce the risk of vehicle-wildlife collisions. ■ To avoid wildlife harvest, firearms will not be allowed on-site during construction except for firearms in the possession and control of authorized Environmental Monitors. ■ No hunting or fishing by Project staff will be permitted to avoid wildlife harvest. ■ Access roads to borrow sites will be blocked when no longer active to minimize future access.	Primary

To Table of Contents

Table 4.3-1: Pathways Assessment for Wildlife VCs (continued)

Tłı̨chǫ Road Project Component/Activity	Effect Pathways	Mitigation	Pathway Assessment
Construction of Project footprint (e.g., road right-of-way, borrow pits, laydown areas and construction camps)	Use of linear corridors and converted habitat (i.e., younger, more productive forest) by prey and predators leading to decreases in survival and reproduction of prey	■ The current layout of the Project footprint will primarily follow an existing trail to minimize the amount of new linear disturbance.	Secondary
	Use of linear corridors by bison may lead to range expansion and affect moose and caribou habitat	■ None proposed.	Primary
	Loss of functional habitat due to competition with other wildlife species (in particular bison)	■ None proposed.	Primary
Tłı̨chǫ Road Project Component/Activity	**Effect Pathways**	**Mitigation**	**Pathway Assessment**
Construction of Project footprint (e.g., road right-of-way, borrow pits, laydown areas and construction camps)	Altered movement patterns, including any changes to interactions with other caribou herds	■ Construction activities will be limited during sensitive periods to minimize effects on wildlife. For example surface blasting will be suspended when caribou are identified within a ‘danger zone’ and the period for no harm or disturbance to migratory birds and their nesting habitat will be observed. Further details pertaining to wildlife and blasting can be found in the Wildlife Management and Monitoring Plan and Quarry Operations Plan, respectively. ■ Wildlife will have the right-of-way to minimize sensory disturbance. ■ Observations of species at risk by Project staff will be reported to GNWT-ENR and trigger mitigation to avoid or minimize impacts. ■ Construction will be temporarily suspended when species at risk, moose and barren-ground caribou are known to be within construction activities to minimize sensory disturbance. Environmental Monitors will be used to help identify the presence of wildlife. ■ Recommended setback distances for dens and nests will be followed to avoid disturbance as per an approved land use permit and Wildlife Management and Monitoring Plan. ■ In the event that an active den or nest is identified during construction, GNWT-ENR will be consulted to determine an appropriate strategy to avoid or minimize disturbance. ■ The TASR route will overlap the existing Old Airport Road route and reduce the amount new sensory disturbance. ■ Surface blasting will be temporarily suspended if wildlife are observed within the danger zone identified by the blast supervisor. ■ All employees will be provided with environmental awareness training, which will minimize risks of physical hazards through site-wide awareness.	Primary

To Table of Contents

Table 4.3-1: Pathways Assessment for Wildlife VCs (continued)

Tłı̨chǫ Road Project Component/Activity	Effect Pathways	Mitigation	Pathway Assessment
Construction of Project footprint (e.g., road right-of-way, borrow pits, laydown areas and construction camps)	Reduced habitat availability and distribution due to any increases in fires resulting from use of the road.	■ Camping areas are not included in the road design, minimizing areas where campfires could be used. ■ Signs indicating the daily wildfire risk will be posted at the TASR junctions at Highway 3 and the existing Whatì community access road to minimize the risk of accidental fires.	Secondary
	Attraction of wildlife to the Project (e.g., food waste, petroleum based products, salt) during construction may increase human wildlife interactions and change predator-prey relationships, which can affect wildlife survival and reproduction	■ Development and implementation of a Waste Management Plan to avoid access to food waste by wildlife ■ Food wastes will be collected in suitable receptacles that minimize attraction or impact to wildlife. ■ Waste products will be stored in secured containers and transported to appropriate facilities to avoid access by wildlife. ■ Recyclables and hazardous waste materials will be stored on-site in appropriate containers to avoid wildlife access until shipped off-site to an approved facility. ■ Littering and feeding of wildlife will be prohibited to avoid wildlife attraction to the site. ■ All workers and visitors will be educated on waste management practices for the Project site to avoid wildlife attraction. Waste management practices will be enforced. ■ All employees will be provided with environmental awareness training to avoid attracting wildlife to site. ■ All employees will be provided with training on the risk associated with feeding wildlife and careless disposal of food garbage to avoid attracting wildlife to site.	Secondary
	Introduction and spread of noxious and invasive plant species can affect plant community composition, which can affect wildlife habitat availability and distribution	■ Cleaning and inspection of Project vehicles and equipment prior to entering the NWT to avoid introducing noxious and invasive plants. ■ Re-cleaning Project vehicles and equipment if an area of weed infestation is encountered, prior to advancing to a weed-free area to minimize the spread of noxious and invasive plants. ■ Locating and managing cleaning locations on the Project site to avoid the spread of noxious and invasive plants. ■ Any required reseeding will be done so with an approved local seed to avoid the introduction of noxious and invasive plants. ■ Monitoring of roadsides for invasive species will be conducted each year of construction and invasive vegetation will be controlled immediately to avoid seed production and long-term establishment. This monitoring will be incorporated into operations and maintenance processes for at least two years after construction to account for additional time that may be needed to observe establishment of invasive species.	Secondary

To Table of Contents

4.3.2.1 No Linkage Pathways

A pathway has no linkage if the mitigation or environmental design features result in no measurable environmental change and, therefore, no residual effects to wildlife VCs. The only pathway identified as having no linkage to wildlife was:

- *Spills on the Project site can alter surface water quality, soils, vegetation, which can change the availability and distribution of wildlife habitat.*

Spills have the potential to change water quality, soils and vegetation. Spills that occur in high enough concentrations could cause effects on aquatic organisms, soil organisms, vegetation and wildlife habitat. Chemical spills can also affect wildlife survival and reproduction if animals are directly exposed to the chemical (e.g., ingestion).

Transport and handling of hazardous materials during construction will be carefully managed. Storage facilities for hazardous materials and waste will meet regulatory requirements and will be designed to protect the environment and workers from exposure, as per the Waste Management Plan (PR#7). Emergency spill kits will be available at transfer locations for toxic materials and fuel. Project vehicles will be equipped with spill kits and fuelled 30 m away from water bodies. Construction equipment, machinery, and vehicles will be regularly maintained to limit leaks. Construction workers will respond to, report, and monitors spills involving hazardous materials as per the Spill Contingency and Waste Management plans (PR#7). Spills will be contained locally and either disposed of through site waste handling systems or removed for disposal in approved facilities. Individuals working on site and handling hazardous materials will be trained in best practices related to the transportation and handling of dangerous goods.

The implementation of the Spills Contingency Plan (PR#7), the Emergency Response Plan (PR#7) and training of personnel in safe handling of chemicals and hazardous materials are anticipated to avoid and minimize the frequency, spatial extent, and severity of spills to the environment.

During operations, speed limits will be posted and enforced. Transport Canada enforces the *Transportation of Dangerous Goods Act/Regulations*. Other commercial operators using the road would also have their own spill contingency plans in place.

Mitigation designs for the Project will help regulate how chemicals and hazardous wastes are stored and where they are used and how they are transported to limit the risk of accidental spills. Additional mitigation will be in place if an accidental spill occurs that will allow spills to be controlled and remediated in a timely manner. The implementation of the Spills Contingency Plan (PR#7), the Emergency Response Plan (PR#7) and training of personnel in safe handling of chemicals and hazardous materials are anticipated to avoid and minimize the frequency, spatial extent, and severity of spills during construction. Therefore, spills on the Project are expected to result in no measurable changes to wildlife habitat or to survival and reproduction.

To Table of Contents

4.3.2.2 Secondary Pathways

In some cases, both a source and a pathway exist, but the change caused by the Project is anticipated to be minor and have a negligible residual effect on wildlife VCs. The pathways described in the following bullets are anticipated to be secondary for wildlife and were not carried forward to the residual effects assessment.

- *Changes to hydrology may alter drainage patterns and increase/decrease drainage flows and surface water levels that can cause changes to soils and vegetation, which can affect wildlife habitat availability and distribution.*

Changes in drainage patterns and increases/decreases in drainage flows and surface water levels beyond the natural range of variation could lead to a loss of soils through increased erosion, affect vegetation, and alter wildlife habitat availability and distribution. A change in local water flows could alter the distribution of wetlands, riparian, and upland areas in relation to the changes in soil moisture (Nilsson and Svedmark 2002; Odland and del Moral 2002; Shafroth et al. 2002; Leyer 2005). As soil moisture levels change because of changes in surface flows and water levels, plant species that thrive in drier soil moisture regimes can out compete riparian species that rely on fluctuations in soil moisture (Shafroth et al. 2002; Leyer 2005).

Mitigation measures have been included in the Project design to limit loss of soils, and include installing culverts or bridges using best management practices and following environmental approval conditions. This includes regular maintenance along the Project to ensure culverts are clear of debris, including ice during spring thaw. Project activities are expected to not influence broad scale drainage patterns. Some measurable changes to localized soil moisture regimes (and erosion) adjacent to smaller drainages are predicted during construction and into operations until vegetation cover is restored in the surrounding area. Overall, minor and local changes in the abundance and distribution of soils and plant communities are predicted relative to Base Case conditions. Therefore, this pathway was determined to have a negligible net effect on the availability and distribution of wildlife habitat.

- *Dust and air emissions, and subsequent deposition can change soil quality and vegetation, which can affect wildlife habitat availability and distribution*

Air and dust emissions, and subsequent deposition can change soil quality and alter vegetation and wetlands, which can adversely influence wildlife habitat availability and distribution. Sulphur dioxide and nitrogen oxides from combustion of fossil fuels and dust deposition can affect soil pH and nutrient content, and soil fauna composition. Changes in soil quality (physical, chemical and biological properties) can affect plant community composition, structure and diversity. Dust that falls directly on plants also can have a physical effect by smothering plant leaves or blocking stomata openings. Plant species have different levels of tolerance to dust deposition, which can result in changes to above ground biomass and species composition. For example, bryophyte and lichens can be sensitive to the chemical effects of dust because they obtain moisture and nutrients from the atmosphere and immediate surroundings, including substances that are trapped or deposited directly on the surface of the bryophyte leaf or lichen thalli. Bryophytes and lichens may experience the largest effects close to roads where the greatest amount of deposition frequently occurs. Rates of dust deposition and accumulation are dependent on the rate of supply from the source, wind speed, precipitation events, topography, and vegetation cover.

To Table of Contents

Accumulation of dust (i.e., total suspended particulate deposition) and concentrations of air emissions produced from the Project may result in a local indirect change on the quality of habitat available. Dust particles of various sizes will be generated by handling of embankment and granular materials in borrow sources and along the proposed Project corridor during construction. Heavy equipment movements, loading and unloading material, crushing, screening, blasting, erosion from stockpiles, vehicle traffic, etc. are expected to contribute to dust generation. Dust control products such as calcium and magnesium chloride that are traditionally used in spot applications each year as part of highways maintenance, can coat granular dust particles and the chemical can become airborne with the dust particle as the dust control application nears the end of its serviceable life (a few months without re-watering). Larger particles (>44 µm diameter) are typically associated with nuisance issues, while smaller particles (<10 µm diameter) can potentially create human health issues at elevated levels in populated areas.

Emissions from diesel engine combustion exhaust during (carbon monoxide, nitrogen oxides, sulphur dioxide and particulate matter) construction and operation will be generated and can negatively impact air quality in the local area around where the equipment is operating at the particular time. Power sources will be included at construction camps to minimize the need to keep a vehicle or equipment running during cold weather.

Daily incineration of combustible waste at camp site locations is not expected to impact air quality as incinerators will be operated and maintained as per manufacturers' expectations and will follow the Project's Waste Management Plan (PR#7). Incinerator use will follow Environment Canada's Guideline for Batch Waste Incineration and meet applicable standards (Canadian Standards Association or Underwriters' Laboratories of Canada).

Vehicles travelling on the all-season and winter roads during operation have the potential to transfer dust from vehicles and loads (e.g., dust deposited on wheels and undercarriage in other communities); however, the relative contribution of these loads to the overall dust accumulation for the Project is considered to be negligible. Similarly, dust generation from vehicles along the Project would occur annually, but would likely be higher during the non-winter period and not continuous (i.e., would occur less frequently during wet and cool conditions).

Dust deposition is expected to result in minor and localized changes to vegetation and wildlife habitat along the ROWs for the Project. For example, Walker and Everett (1987) and Everett (1980) reported that effects were confined to a 50 m buffer on either side of a road in open tundra and less in areas where trees intercept dust fall (Walker and Everette 1987). Moreover, Meininger and Spatt (1988) found that most effects occurred within 5 to 50 m of a road, with less obvious effects observed between 50 m and 500 m from a road. Similarly, annual emissions from up to 40 vehicles on the roads are anticipated to result in no detectable changes to soils and vegetation. Therefore, dust deposition and emissions from vehicles along Project are predicted to result in negligible residual effects to wildlife habitat availability and distribution.

- *Surface water runoff from the Project area can alter surface water, soil, vegetation, which can change the availability and distribution of wildlife habitat*

Contaminated surface water runoff into natural areas can kill vegetation and reduce the availability and distribution of habitat. Mitigation associated with the transport and handling of hazardous materials will be used to manage sources and the spread of contaminants to the environment during construction. Storage facilities for hazardous materials and waste will meet regulatory requirements and will be designed to protect the environment and workers

To Table of Contents

from exposure, as per the Waste Management Plan (PR#7). Emergency spill kits will be available at transfer locations for toxic materials and fuel. Project vehicles will be equipped with spill kits and fuelled 30 m away from water bodies. Construction equipment, machinery, and vehicles will be regularly maintained to limit leaks. Employees will respond to, report, and monitor spills involving hazardous materials as per the Spill Contingency and Waste Management plans (PR#7). Spills will be contained locally and either disposed of through site waste handling systems or removed for disposal in approved facilities. Individuals working on site and handling hazardous materials will be trained in best practices related to the transportation and handling of dangerous goods. The implementation of the Spills Contingency Plan (PR#7), the Emergency Response Plan (PR#7) and training of personnel in safe handling of chemicals and hazardous materials are anticipated to avoid and minimize the frequency, spatial extent, and severity of spills.

During operations, speed limits will be posted and enforced. Transport Canada enforces the *Transportation of Dangerous Goods Act/Regulations*. Other commercial operators using the road would also have their own spill contingency plans in place. Because of mitigation in place for the Project, negligible effects from contaminated surface water runoff on water, soils and vegetation are expected.

- *Physical hazards on the Project site, and collisions with vehicles cause injury or mortality to individual wildlife, leading to decreases in survival and reproduction*

There is potential for an increase in the risk of injury or death to wildlife species through collisions with Project vehicles and equipment or physical hazards, such as blasting activities, associated with the Project. Construction and operation of the TASR will cause an increase in the volume of vehicle traffic. As such, the potential for collisions of vehicles with wildlife may increase (Romin and Bissonette 1996; Hussain et al. 2007). The primary factors that contribute to road-related wildlife deaths are traffic volume and vehicle speed (EBA 2001; Jaarsma et al. 2006; Litvaitis and Tash 2008). These factors directly affect the success of an animal reaching the opposite side of the road. An increase in either factor reduces the probability of an animal crossing safely (Underhill and Angold 2000).

A total of 113 collisions involving animals have been reported in the NWT from 2010 to 2014 (GNWT-DOT 2011, 2012, 2013, 2014, 2015). Approximately 65% of animal collisions during this period were reported to involve bison. Most of these collisions occurred on highways (95%), with a few collisions reported in communities (5%) and none reported in rural areas (GNWT-DOT 2011, 2012, 2013, 2014, 2015). The majority of bison collisions on Highway 3 occur in the Mackenzie Bison Sanctuary where the maximum speed limit is 90 km/h. Traffic flow on the Project is predicted to be primarily between the Tłı̨chǫ communities and Yellowknife, which intersects a very small portion of the Mackenzie Bison Sanctuary.

Surface blasting in aggregate borrow areas will increase the potential for mortality or injury to wildlife as a result of fly rock from the blasting. Fly rock is more likely to impact large mammals or ungulates due to their physical size (i.e., larger target) compared to birds, smaller mammals and insects.

To mitigate the increase in mortality risk due to vehicle-collisions in the Project footprint, several environmental design features will be implemented. All employees will receive environmental awareness training, and the presence of wildlife will be monitored and communicated to site personnel. Speed limits will be posted and enforced on the Project site during construction. During operation, the posted speed limit will be 70 km/h, which is

considered a low highway speed. Lower speeds allow the motorist and animal to avoid a collision by increasing reaction time (van Langevelde et al. 2009).

In addition, the presence of caribou and wildlife will be monitored and communicated to site personnel, and surface blasting will be temporarily suspended if wildlife are observed within the danger zone identified by the blast supervisor. The risk of wildlife from collisions with vehicles, heavy equipment or physical hazards on-site is predicted to be low during construction, and predicted to increase during operations at night. The implementation of mitigation measures is expected to result in minor changes in mortality rate from physical hazards and wildlife-vehicle collisions relative to existing conditions.

- *Use of linear corridors and converted habitat (i.e., younger, more productive forest) by prey and predators leading to decreases in survival and reproduction of prey*

Increased linear density and the associated creation of edge habitat from the Project has the potential to change predator-prey dynamics and decrease the survival and reproduction of prey species. Prey species that are most vulnerable to increased predation due to increases in linear density include ungulates (e.g., caribou; Latham et al. 2013) and hunted/trapped species such as moose and wolverine. Some species of birds, typically forest-breeding birds, may experience reduced reproductive success with increasing linear density due to increased rates of brood parasitism. Other species are more resilient to adverse effects associated with increases in linear density because they are predators (e.g., peregrine falcon and wolverine), because they may use edge habitat (e.g., foraging little brown myotis), or because they are not particularly vulnerable to brood parasitism (e.g., bank swallow [Garrison 1999], barn swallow [Brown and Brown 1999], common nighthawk [Brigham et al. 2011], rusty blackbird [Avery 2013], and olive-sided flycatcher [Altman and Sallabanks 2012]).

To minimize the amount of new linear disturbance, the current layout of the Project footprint will intersect the existing Old Airport Road route and burned habitat. Therefore, increase in the amount of linear disturbance by the Project will be small relative to existing conditions.

With the implementation of design features and mitigation measures, decreases in survival and reproduction of prey due to changes in predator and prey use of linear corridors and converted habitat is expected to have negligible net residual effects.

- *Attraction of wildlife to the Project (e.g., food waste, petroleum based products, salt) during construction may increase human wildlife interactions and change predator-prey relationships, which can affect wildlife survival and reproduction*

Food smells and other aromatic compounds such as petroleum-based chemicals can attract carnivores to human developments (Benn and Herrero 2002; Peirce and Van Daele 2006; Canadian Wildlife Service 2007). In addition, infrastructure, such as buildings at temporary work camps, may also attract carnivores as it can serve as a refuge to escape extreme heat or cold (Canadian Wildlife Service 2007). Corvids (e.g., crows and ravens) and raptors may also be attracted to anthropogenic food sources (Restani et al. 2001; Canadian Wildlife Service 2007; Kristan and Boarman 2007). Attraction of carnivores, raptors, corvids, and gulls can increase predation pressure on prey species (e.g., moose, passerines, and waterfowl) (CWS 2007; Liebezeit et al. 2009). This increase in predation may have the potential to cause local and regional population declines of these prey species (Monda et al. 1994;

CWS 2007; Liebezeit et al. 2009). The attraction of wildlife to the Project also has the potential to increase human-wildlife interactions, which may result in the removal of individuals by mortality or relocation.

Numerous mitigation measures to appropriately manage food and other waste will be implemented. Waste, including food waste, recyclables, and hazardous waste materials will be stored in appropriate, secured containers on site to prevent wildlife attraction and exposure, prior to transport to appropriate facilities. An approved Waste Management Plan (PR#7) will be implemented and enforced for the Project. Littering and feeding of wildlife will be prohibited, and all employees will be provided with environmental awareness training, and training on the risks associated with feeding wildlife and careless disposal of food waste.

Mitigation measures and management plans should limit attractants to the Project and result in a minor increase in wildlife mortality risk from human-wildlife interactions and predation relative to baseline conditions and have a negligible residual effect on the survival and reproduction of wildlife populations.

- *Reduced habitat availability and distribution due to any increases in fires resulting from use of the road.*

Humans cause slightly more than half of all wildfires in Canada, typically in populated forest and grassland areas (NRC 2017). However, in the NWT, approximately 90% of wildfires are due to lightning strikes (GNWT-ENR 2017) with the wildfire season occurring from April to October annually. When winter or summer precipitation is low, unattended campfires and cigarettes that are not extinguished fully have the potential to proliferate and result in wildfire and loss of wildlife habitat. The design of the Project does not include camping areas, which will minimize the places where campfires may be used. Signs indicating the daily wildfire risk will be posted at the junctions of the TASR with Highway 3 and the Whatì community access road to alert drivers of the wildfire risk. The implementation of these design features and mitigation is anticipated to minimize risk of accidental human caused fires, and is predicted to result in negligible residual effects to wildlife habitat availability and distribution.

- *Introduction and spread of noxious and invasive plant species can affect plant community composition, which can affect wildlife habitat availability and distribution.*

The ground disturbance associated with construction and operation of the Project can create the type of habitat favoured by invasive plant species. Newly cleared areas, including roads, provide dispersal avenues for non-native and invasive species, and invasions may be more likely to succeed as a result of stress placed on native species from habitat alteration (Trombulak and Frissell 2000). Vehicles and machinery can serve as dispersal mechanisms for plant seeds and vegetative parts that can get lodged in tires, the undercarriage, or mud on the surface of the vehicle.

The introduction of non-native and invasive plant species can upset the natural balance of established ecosystems (Forman 1995). When non-native or invasive plant species (e.g., Canada thistle) are introduced or invade from an adjacent area, they may compete with native species for resources, degrade habitats, or modify genetic diversity resulting in population declines of native species (Pimentel et al. 2007). Once invasive species are introduced into an area and become established, they are difficult to eradicate (Simberloff 1997). Non-native plant species can negatively affect wildlife habitat quality if non-native species come to dominate native vegetation in certain areas, thereby reducing habitat niches for some wildlife. Construction equipment originating from outside of the NWT will be washed prior to arrival to remove any attached soil and vegetation. If an area of weed infestation is encountered,

construction vehicles will be re-cleaned prior to advancing to a weed-free area to minimize the spread of noxious and invasive plants.

The implementation of mitigation is anticipated to minimize the introduction and spread of noxious and invasive species so that any effect to native vegetation would be localized and minor, and is predicted to result in negligible residual effects to wildlife habitat availability and distribution.

4.3.2.3 Primary Pathways

The following primary pathways were identified from the screening-level assessment after consideration of mitigation.

- *Site preparation, construction and operation activities can result in the loss or alteration of vegetation and topography that may change habitat availability, use, and connectivity and influence wildlife abundance and distribution.*
- *Site preparation and construction may result in the destruction of roosting or hibernating bats (incidental take).*
- *Site preparation and construction may result in the destruction of nests, eggs, and individuals of migratory birds (incidental take).*
- *Sensory disturbance (lights, smells, noise, dust, human activity, viewscape) can change wildlife habitat availability, use and connectivity (movement and behaviour), which can lead to changes in wildlife abundance and distribution.*
- *Altered movement patterns, including any changes to interactions with other caribou herds.*
- *Increase in public access could affect wildlife survival and reproduction through vehicle strikes, and/or legal and illegal hunting.*
- *Use of linear corridors by bison may lead to range expansion and affect moose and caribou habitat.*
- *Loss of functional habitat due to competition with other wildlife species (in particular bison).*

Primary pathways identify potential effects of the Project on wildlife in general, and the potential for each VC to be affected by each primary pathway varies. For example, some wildlife species are highly susceptible to sensory disturbance (Dahlgren and Korschgen 1992; Kempenaers et al. 2010; Kuck et al. 1985; Manci et al. 1988;Yarmoloy et al. 1988), whereas others are unaffected by it, or habituate easily (Borkowski et al. 2006; Hardy 2001; Herrero et al. 2005; Smith et al. 2005). Valued components that are likely to be little affected by the cumulative changes from the Project and previous and existing developments, and have no interaction with RFDs would be predicted to not be significantly influenced by cumulative effects. (Section 4.3.1). The expected strength of the interactions between primary pathways and each VC is identified in Table 4.3-2, which was based on Base Case results, potential to be influenced by RFDs (Figure 4.3-1), and literature on the responses of each VC to the effects from road construction and operations (Section 4.1.2).

To Table of Contents

For those VCs that are predicted to have weak interactions with primary pathways, a quantitative and qualitative analysis of changes to measurement indicators from the Project relative to Base Case conditions, along with a description of potential changes to populations, is provided in Sections 4.3.3 to 4.3.12. However, a formal classification of residual effects and determination of significance was completed only for those VCs that are expected to have strong interactions with Project pathways (Section 4.3.1). Species for which the Project may have strong interactions were barren-ground and boreal caribou, moose, and wolverine (Table 4.3-2).

To Table of Contents

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To Table of Contents

Table 4.3-2: Interaction Strength between Primary Pathways and VCs

Primary Pathway	Barren-ground Caribou	Boreal Caribou	Bison	Moose	Wolverine	Little Brown Myotis	Bank and Barn Swallow	Common Nighthawk	Olive-sided flycatcher	Horned grebe	Yellow rail	Red-necked phalarope	Rusty blackbird	Peregrine falcon	Short-eared owl	Bumble bees
Site preparation, construction and operation activities can result in the loss or alteration of vegetation and topography that may change habitat availability, use, and connectivity and influence wildlife abundance and distribution	+	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-
Site preparation and construction may result in the destruction of roosting or hibernating bats (incidental take)	n/a	n/a	n/a	n/a	n/a	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Site preparation and construction may result in the destruction of nests, eggs, and individuals of migratory birds (incidental take)	n/a	n/a	n/a	n/a	n/a	n/a	-	-	-	-	-	-	-	-	-	n/a
Sensory disturbance (lights, smells, noise, dust, human activity and viewscape can change wildlife habitat availability, use and connectivity (movement and behaviour), which can lead to changes in wildlife abundance and distribution	+	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-
Altered movement patterns, including any changes to interactions with other caribou herds	-	-	-	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increase in public access could affect wildlife survival and reproduction through vehicle strikes, and/or legal and illegal hunting	+	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-
Use of linear corridors by bison may lead to range expansion and affect moose and caribou habitat	-	-	-	-	n//a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of functional habitat due to competition with other wildlife species (in particular bison)	-	-	n/a	-	-	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

+ = strong interaction; - = weak interaction; n/a = not applicable.

To Table of Contents

4.4 Residual Effects Analysis

4.4.1 Approach and Methods

The residual effects analysis is based on pathways determined to be primary in the pathway analysis (Section 4.3.2.3), and on those VCs identified as having strong interactions with the Project (Table 4.3-2). The following primary pathways are analyzed and carried through the residual effects classification and determination of significance for boreal caribou, barren-ground caribou, moose and wolverine:

- *Site preparation, construction and operation activities can result in the loss or alteration of vegetation and topography that may change habitat availability, use, and connectivity and influence wildlife abundance and distribution.*
- *Sensory disturbance (lights, smells, noise, dust, human activity, viewscape) can change wildlife habitat availability, use and connectivity (movement and behaviour), which can lead to changes in wildlife abundance and distribution.*
- *Increase in public access could affect wildlife survival and reproduction through vehicle strikes, and/or legal and illegal hunting.*

As described in Section 2.3, the residual effects analysis is completed for the Application Case and the RFD Case, relative to the Base Case. The Application Case represents predictions of the effects from the Base Case combined with the effects from the Project, and is also used to identify the incremental changes from the Project. The RFD Case represents predictions of the cumulative effects of the Application Case, which includes the Base Case, plus the Project and RFDs. A list of potential RFDs is provided in Section 2.2 and presented on Figures 4.2-2 and 4.3-1. The RFD Case also considers other disturbance factors such as climate change, which can influence VCs beyond the RSAs.

The residual effects analysis for the Application Case is completed by calculating and predicting changes to measurement indicators. Residual effects of the Project are those effects that remain after implementation of all mitigation. Changes in measurement indicators for VCs were estimated relative to the Base Case to describe the following residual effects.

- Changes in habitat availability and animal use were estimated quantitatively by calculating differences in the amount of different types of suitable habitat for each VC, and qualitatively considering potential changes in habitat use (e.g., avoidance due to sensory disturbance).
- Changes in habitat distribution, including the effects on wildlife movement and habitat connectivity, were estimated by qualitatively examining changes to the distribution of habitat patches within the VC-specific RSA, and considering potential barriers to movement.
- Changes in survival and reproduction (abundance) were identified qualitatively and quantitatively using the results from changes in habitat, and knowledge of potential changes in abundance from other Project components and activities. Predictions of change were made using data collected in the RSAs, where possible, and supported by scientific literature.

To Table of Contents

To be conservative, the Project footprint of 2,198.6 ha (which includes all Project components and activities) was buffered by 100 m around the La Martre River crossing and 50 m around the remaining portion of the preferred road route and borrow sites so that direct effects to wildlife VCs would not be underestimated. As a result, the change in habitat from direct disturbance due to the Project is overestimated by about 1,219 ha (56%).

Similar to the Application Case, effects in the RFD Case were predicted using quantitative and qualitative changes in measurement indicators. Where actual footprint size and location were known for RFDs, the analysis of changes in habitat availability was quantitative, otherwise the analysis was qualitative. Potential effects from beyond regional disturbance factors such as climate change were also qualitatively discussed.

4.4.2 Application Case Results

4.4.2.1 Boreal Caribou

Habitat Availability

The Project will increase the area of buffered developments disturbance by 4,504 ha (0.1%) and reduce caribou habitat availability in the NT1 range by removal of 1,780 ha (<0.1%) of habitat that is undisturbed under existing conditions (Table 4.4-1). The buffered Project will overlap more with areas already affected by fire disturbance under existing conditions and these areas account for 2,725 ha (60%) of the Project footprint. At the Application Case, 66.8% of the NT1 range is predicted to remain undisturbed boreal caribou habitat, a number that does not change from existing conditions (Section 4.2.3.1) because of the size of the NT1 range relative to the area of the Project.

Table 4.4-1: Boreal Caribou Habitat Availability in the NT1 Range, Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent (%)
Fire disturbance[a]	10,159,286	10,156,561	-2,725	<-0.0
Buffered developments	3,697,637	3,702,142	4,504	0.1
Undisturbed habitat	27,861,774	27,859,995	-1,780	<-0.1

a) The buffered Project will overlap with areas already affected by fire disturbance and therefore reduce the area classified as fire disturbance in the Application Case

In the Wek'èezhìı portion of the NT1 Range, the Project will remove 0.1% of habitat that is undisturbed under existing conditions (Table 4.4-2). The buffered Project will overlap to a greater extent with areas already affected by fire disturbance under existing conditions, which accounts for 2,725 ha (60%) of the Project footprint. The Project is predicted to increase buffered development by 11.0% relative to Base Case. The proportion of total disturbance will increase from 40.0% at Base Case to 41.1% in the Application Case. The proportion of undisturbed habitat will be 59.9% at the Application Case for the Wek'èezhìı portion of the NT1 Range.

Table 4.4-2: Boreal Caribou Habitat Availability in the Wek'èezhìı Portion of NT1 Range, Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent (%)
Fire disturbance[a]	1,813,041	1,810,316	-2,725	-0.2
Buffered developments	40,840	45,345	4,504	11.0
Undisturbed habitat	2,778,883	2,777,104	-1,780	-0.1

a) The buffered Project will overlap with areas already affected by fire disturbance and therefore reduce the area classified as fire disturbance in the Application Case

To Table of Contents

Habitat Distribution

At the Application Case, there is little change in the distribution of undisturbed boreal caribou habitat in the NT1 range or in the Wek'èezhìı Portion of NT1 Range relative to the Base Case (Figure 4.4-1). Habitat losses, either through direct or indirect effects, can result in changes to the distribution of available habitat (and ultimately caribou within the range) through two processes. The first process being through a reduction in habitat resulting in avoidance of affected areas and localized changes in the distribution of animals. Consistent with the above interpretation of Project-related habitat losses, changes to local distributions of individual caribou are expected to be minor, particularly where the Project ROW intersects burned areas that are less than 40 years old. Direct disturbance of caribou habitat will occur during construction, so effects to local distributions of individual caribou will be temporary. Project effects will also be minimized by timing land clearing primarily during winter to reduce disturbing boreal caribou during sensitive periods, such as calving and post-calving periods. Other construction activities will continue during calving and post-calving periods but effects will likely be limited to the 1,780 ha of undisturbed habitat where boreal caribou may be present during these periods. Traditional Knowledge indicates that key boreal caribou habitat includes areas near Lake Ethletitso and smaller lakes west of Tsigatii (PR#28), which are approximately 5 to 10 km west of the Project. Although some displacement of animals may result from the Project, a contraction in the NT1 range is not expected from localized changes in habitat suitability (given the anticipated scale of disturbance).

Construction activities are likely to alter boreal caribou movement and behaviour around the Project footprint resulting in a temporary, indirect loss of habitat. Indirect habitat loss was measured by applying a 500 m buffer around the Project footprint (Environmental Canada 2012). Habitat effects will be minimized by aligning the Project route to intersect areas burned by forest fire, which caribou avoid under existing conditions. The buffered Project footprint overlaps with the existing Old Airport Road route (i.e., within 500 m), which is associated with vehicular activity, noise and other sensory disturbances under existing conditions (PR#7; PR#28) and therefore, measurable losses in local habitat use from indirect effects from the Project during construction and operation are predicted to be small and confined to 1,780 ha of undisturbed habitat (Table 4.4-1).

The distribution of available habitat can also change where there are impacts to movement corridors or changes that prevent access to key habitats, such as nursery or winter use areas. The location of the TASR is near the eastern boundary of the NT1 range and will not completely isolate a portion of the range. Thus, effects to movement from either fragmentation or avoidance of the TASR during construction or operation will be localized and not likely to be measurable at the NT1 range scale. Caribou appear to be more sensitive to the human activities associated with construction, traffic, and noise, than to the infrastructure per se (Curatolo and Murphy 1986; Murphy and Curatolo 1987; Nellemann and Cameron 1998; Smith et al. 2000; Dyer et al. 2001). Mitigation, such as restricting construction activities when boreal caribou are known to be present. As well, up to 40 vehicles are predicted to use the road daily, which represents approximately 1.7 vehicles per hour on average. Thus, noise or visual stimulus from traffic will be periodic and unlikely to result in permanent reduction of movement potential through the area.

The Project will cause an incremental increase in fragmentation of the RSA by adding a linear disturbance to the landscape, which will alter 1,780 ha of habitat that is undisturbed under existing conditions. However, the change is predicted to be small given that the Project alignment follows an existing linear feature and that may already influence movement under existing conditions from existing human use (PR#7; PR#28) or use by predators. Effects will be minimized by applying mitigation to limit the amount of vegetation disturbance during construction. This includes aligning the Project to intersect caribou habitat that has been previously disturbed by fire within the last 40 years and avoided by caribou and using existing disturbance from the existing Old Airport Road alignment.

To Table of Contents

As well, construction camps and laydown areas will be located within borrow sites or the Project ROW. Fragmentation and linear disturbance effects at the Application Case are predicted to increase but be small relative to the Base Case.

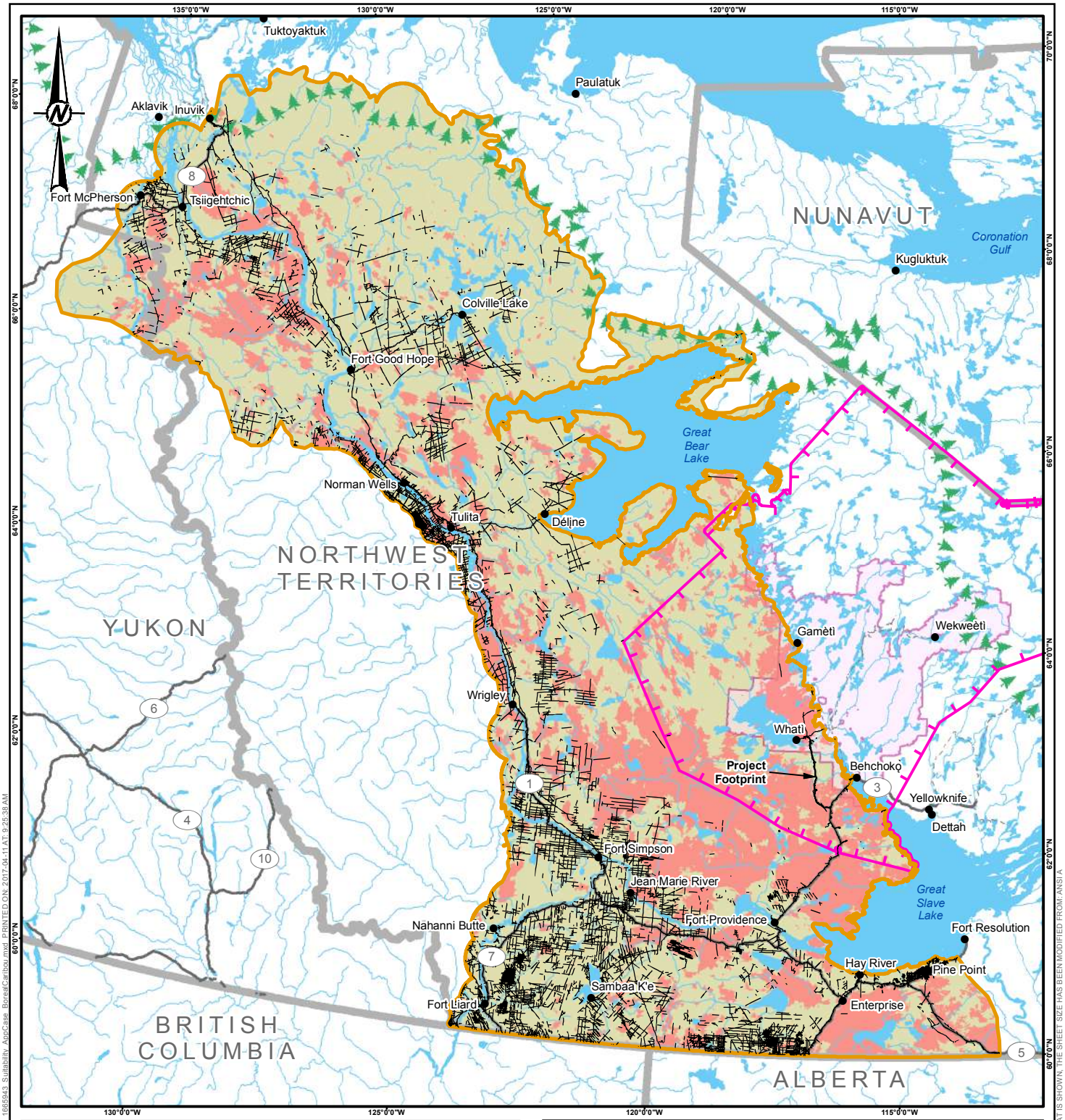
Survival and Reproduction

The Project will affect boreal caribou survival and reproduction through habitat loss (vegetation clearing), sensory disturbances, and increased harvest pressure and injuries and mortalities from vehicle strikes due to greater access. Vegetation clearing along the TASR ROW and for ancillary facilities (e.g., borrow sits and access roads) will create early seral habitat, which is more favourable for moose. Increased moose densities can cause associated increases in wolf densities, which can increase predation pressure on caribou. Habitat loss from Project development is predicted to alter 1,780 ha (<0.1%) of undisturbed habitat (including sensory disturbance) in the NT1 range.

Features that act as semi-permeable barrier effects may exacerbate indirect habitat loss caused by avoidance of disturbance features (Dyer et al. 2002). Reduced movement rates and restricted home ranges increases the amount of time spent in lower suitability habitats and therefore increase vulnerability to predation (Beauchesne et al. 2014; Morales et al. 2010; Muhly et al. 2015; Rettie and Messier 2000). Caribou confined to smaller home ranges could be forced into less suitable habitat and be more easily detected by predators (Beauchesne et al. 2014). The Project will use mitigation that will help minimize avoidance of suitable habitat resulting from sensory disturbance. During construction, the amount of noise and lights will be limited by restricting construction activities when boreal caribou are present and fugitive dust will be reduced by completing land clearing primarily during winter. For summer construction, mitigation such as restricting construction activities when boreal caribou are known to be present will reduce noise and activity during construction. During operation up to 40 vehicles are predicted to use the road daily, which represents approximately 1.7 vehicles per hour on average and a low volume of traffic. Thus, noise or visual stimulus from traffic will be periodic and unlikely to result in continual barrier effects.

Injury or mortality from vehicle collisions and increased harvest pressure facilitated by the development of new access roads may also influence boreal caribou survival and reproduction. Boreal caribou are mobile and can avoid interactions with Project activities that could result in injury or mortality. The Project will include monitors during construction to help detect boreal caribou and other wildlife and protect them from Project activities. Construction activities will be suspended or restricted when caribou are known to be present as described in the Wildlife Management and Monitoring Plan (WMMP; PR#7). The Project also has the potential to increase mortality through collisions with vehicles, especially during operations; however, the likelihood of collision is low given the low speed limit and low predicted traffic volume on the road.

The development of the Project will improve access, which could directly affect boreal caribou survival and reproduction through increased harvest during the construction and operation phase. This effect will be avoided during construction by not allowing construction workers to harvest wildlife and by blocking access roads to borrow sites when no longer active to restrict future access. Improved access could also directly affect boreal caribou survival and reproduction through increased harvest during the operation phase, especially if the Project facilitates greater access for hunters to high suitability caribou habitat. The Project will intersect undisturbed habitat, which is likely to increase harvest potential and harvest during operation. However, a reduction of boreal caribou survival and reproduction as a result of greater access is predicted to be small and not affect the population given that boreal caribou occur in low densities (0.17 to 3.44 animals/100 km^2 [Hillis and Cluff 2005]), use large areas of undisturbed habitat (Nagy et al. 2011) and the Project ROW follows an existing linear feature that is currently used by hunters to harvest caribou and access the WRMA at Base Case (PR#7; PR#28).



LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- WINTER ROAD
- TREELINE
- WATERCOURSE
- PROVINCIAL/TERRITORIAL BOUNDARY
- TŁĮCHǪ LAND
- WATER BODY
- DEVELOPMENT
- FIRE HISTORY (LESS THAN 40 YEARS OLD)
- UNDISTURBED HABITAT
- BOREAL CARIBOU RSA
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

0 120 240

1:6,000,000 KILOMETRES

REFERENCE(S)

1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. BOREAL CARIBOU RANGE OBTAINED FROM ENVIRONMENT CANADA, 2012.
3. CIMP INVENTORY OF LANDSCAPE CHANGE, OBTAINED FROM THE NWT CENTRE FOR GEOMATICS.
4. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: CANADA LAMBERT CONFORMAL CONIC

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
DISTRIBUTION OF BOREAL CARIBOU HABITAT AT APPLICATION CASE

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-11
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO. 1665943 | REV. 0 | FIGURE 4.4-1

PATH: I:\2016\1665943\Mapping\MXD\Wildlife\10_2_DO_NOT_OPEN_WITH_10_4\FIG4_4-1_1665943_Suitability_AppCase_BorealCaribou.mxd PRINTED ON: 2017-04-11 AT 9:25:38 AM

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To Table of Contents

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To Table of Contents

4.4.2.2 Barren-ground Caribou

Habitat Availability

Locations of collared cows in the Bathurst and BNE herds indicate the RSA is outside of core seasonal ranges (Nagy et al. 2005; Anderson and Johnson 2014; Golder 2016; Appendix G) but some caribou may be present when these herds are more abundant (PR#28). The construction of the Project would contribute to a loss of 264 ha (0.2%) of moderate to high suitability winter habitat relative to existing conditions (Table 4.4-3). Project mitigation to minimize the effects to habitat availability includes aligning the Project route to intersect caribou habitat that has been previously disturbed by fire within the last 40 years and avoided by caribou at Base Case. The Project will also occur in areas of existing disturbance from an old linear winter road route minimizing the amount of new disturbance. As well, construction camps and laydown areas will be located within borrow sites or the Project ROW.

Table 4.4-3: Barren-ground Caribou Winter Habitat Availability in the RSA, Application Case

Habitat Suitability	Base Case (ha)	Application Case (ha)	Change in Area (ha)	Percent (%)
Moderate to High	117,677	117,413	-264	-0.2
Nil to Low	883,843	884,107	264	<0.0

In addition to direct habitat loss, indirect loss may occur in the RSA if animals avoid suitable areas due to sensory disturbance. Loud noises, lights, smells, dust and human activity could potentially cause displacement of individuals (Bradshaw et al. 1998; Johnson et al. 2005; Boulanger et al. 2012), loss of foraging and resting habitat, and changes in predator-prey relationships. For example, Bradshaw et al. (1998) found that disturbed caribou in the boreal forest of Alberta move rapidly from the noise source for about 15 minutes. Benítez-López et al. (2010) indicate that the spatial effects of sensory disturbance on large mammals can extend up to 5 km from human developments. Sensory disturbance from the Project is predicted to have a negligible effect on barren-ground caribou populations due to low presence in the area.

Given the small amount of suitable habitat directly altered by the Project and the low likelihood of regular presence in the RSA, it is anticipated that very few individuals will occupy habitats near the Project ROW under existing conditions during winter. Barren-ground caribou can adapt to sensory disturbance (Johnson and Russell 2014) and any caribou using the area around the Project have previous experience with human activity along the existing network of trails surrounding the Project route at Base Case (PR#28). Individual caribou that avoid suitable habitat during construction due to temporary sensory disturbance are expected to reoccupy the habitat once the disturbance is removed. Vehicle traffic during the operation phase may also disturb individual caribou; however, such events will be infrequent, isolated, and short-term in duration and only if barren-ground caribou are present during winter, which may be more common when barren-ground caribou herd sizes are near peak abundance (PR#28).

Changes in habitat availability at the Application Case are predicted to be small relative to the Base Case and are not expected to result in any measurable change in the number of barren-ground caribou present in the RSA.

To Table of Contents

Habitat Distribution

The Project will remove 264 ha (0.2%) of moderate to high suitability winter habitat in the RSA. Similar to habitat availability, a small reduction in the amount of disturbed habitat is unlikely to influence the distribution of regional barren-ground caribou populations because barren-ground caribou are not regularly present in the RSA (Figure 4.4-2). If present, mitigation such as restricting construction activities when barren-ground caribou are known to be present. As well, up to 40 vehicles are predicted to use the road daily, which represents approximately 1.7 vehicles per hour on average. Thus, noise or visual stimulus from traffic will be intermittent and of short duration and unlikely to result in permanent reduction in movement through the area.

Although some barren-ground caribou may avoid areas near the Project, a contraction in the winter range is not expected from localized changes in habitat suitability, given the anticipated small scale of disturbance. Construction activities are not likely to alter barren-ground caribou movement and behaviour around the Project footprint resulting in a temporary, indirect loss of habitat. At the current low barren-ground herd sizes, little interaction during the Project construction phase is expected. Even so, habitat effects will be minimized by aligning the Project route to intersect areas burned by forest fire, which caribou avoid. The Project footprint also overlaps the existing Old Airport Road route, which is associated with human activity, noise and other sensory disturbances at Base Case (PR#7; PR#28). Collar locations from Bathurst or BNE herds indicate that there is a low likelihood of regular interaction of these herds with the Project (Nagy et al. 2011, Anderson and Johnson 2014, Golder 2016), except when these herds are near peak abundance as in the early 1990s (PR#28). Therefore, measurable losses in local habitat use from indirect effects from the Project are not predicted during construction but may be small during operation if caribou interact with the Project when more abundant and burned habitat becomes suitable over time through succession.

Survival and Reproduction

The Project could affect barren-ground caribou survival and reproduction through winter habitat loss (vegetation clearing), sensory disturbances, and increased harvest pressure and injuries and mortalities from vehicle strikes due to improved access. Vegetation clearing along the Project ROW and for ancillary facilities (e.g., borrow sites and access roads) will create early seral habitat, which is more favourable for moose. Increased moose densities can cause associated increases in wolf densities, which can increase predation pressure on caribou. Habitat loss from Project development is predicted to alter 264 ha (<0.2%) of undisturbed habitat (including sensory disturbance) in the RSA.

Features that act as semi-permeable barrier effects may exacerbate indirect habitat loss caused by avoidance of disturbance features (Dyer et al. 2002). Reduced movement rates and restricted home ranges increases the amount of time spent in lower suitability habitats and therefore increase vulnerability to predation (Beauchesne et al. 2014; Morales et al. 2010; Muhly et al. 2015; Rettie and Messier 2000). Caribou confined to smaller winter home ranges could be forced into less suitable habitat and be more easily detected by predators (Beauchesne et al. 2014). Alternatively, semi-permeable barriers may have energetic costs to caribou if their migratory routes are disrupted.

The Project will use mitigation that will help minimize avoidance of suitable habitat resulting from sensory disturbance. During construction, the amount of noise and lights will be limited by restricting construction activities when caribou are known to be present. During operation, up to 40 vehicles are predicted to use the road daily, which represents approximately 1.7 vehicles per hour on average and a low volume of traffic. Barren-ground caribou will only be exposed to the sensory disturbances from the Project during winter when they are present,

To Table of Contents

which is only likely when nearby herds are near peak abundance (PR#28). Recent analysis of collared caribou movements from the Bathurst herd provides some insight into the energetic implications of development (De Beers 2010, DDEC 2014). Analysis of caribou encounters with development in the post-calving to autumn period for the Jay Project estimated a mean of 18.6 encounters with a zone of influence per season, and similar results were found for the Gahcho Kué Project (this modelling was not completed for this Project due to a lack of collar data in the area, confirming that this is not a commonly used area). Even when the effects of disturbance were over-estimated, insect abundance was found to be the greatest driver of caribou energy expenditures (De Beers 2010, DDEC 2014). Similar analysis was completed for the Fortune Minerals NICO Project, incorporating also the energetic costs of walking through snow (Golder 2011). This analysis considered several scenarios including a severe spring (i.e. additional energy expenditure of walking and cratering through deep snow) and disturbance events that elecit a response from caribou. As there is more development in the boreal regions of the NWT, a conservative estimate of 40 encounters with developments was included. The analysis indicated that although human developments during autumn and early winter movements in the winter range of the Bathurst herd may affect the demography of the herd, the effect is relatively small compared to weather-related factors.

While Project is near the Bathurst caribou winter range and insect harassment would not be an issue, it is likely that similar environmental variables such as snow depth, hardness and freezing rain events (Bianci et al. 2007, Adamczewski et al. 1987) would still dominate caribou energy expenditures in the a zone of influence. Bergerud et al. (1984) contend that there is little to no evidence that sensory disturbance activities affect herd productivity. Thus, noise or visual stimulus from traffic will be periodic and unlikely to result in permanent barrier effects that will reduce survival and reproduction.

To Table of Contents

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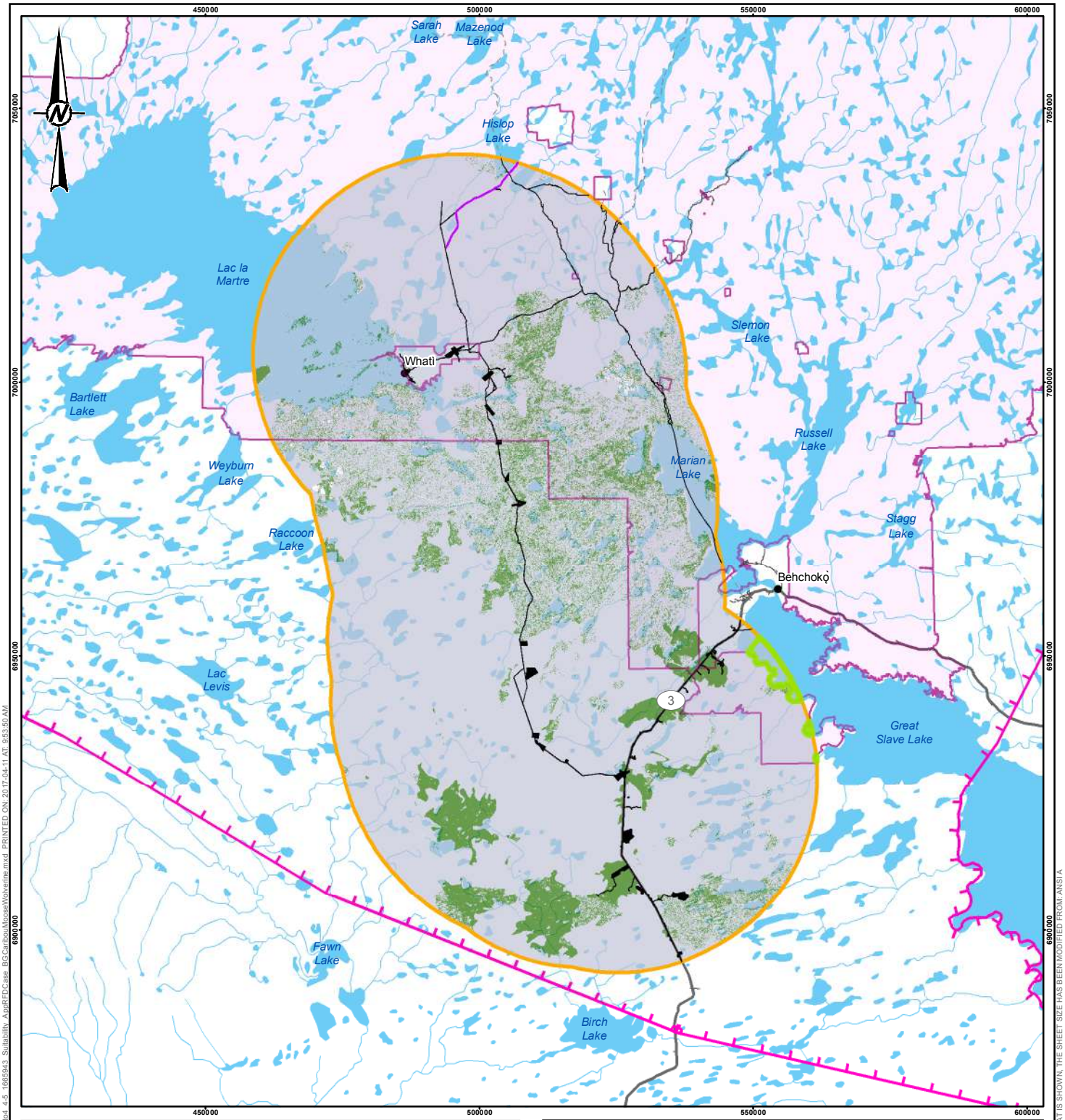

LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- LOCAL ROAD
- WINTER ROAD
- WATERCOURSE
- TŁĮCHǪ LAND
- WATER BODY
- CANDIDATE PROTECTED AREA
- DEVELOPMENT
- RFD
- BARREN-GROUND CARIBOU, MOOSE, AND WOLVERINE RSA
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

HABITAT SUITABILITY

- MODERATE TO HIGH
- NIL TO LOW

0 20 40

1:1,000,000 KILOMETRES

REFERENCE(S)

1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. CIMP INVENTORY OF LANDSCAPE CHANGE, OBTAINED FROM THE NWT CENTRE FOR GEOMATICS.
3. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
DISTRIBUTION OF SUITABLE BARREN-GROUND CARIBOU HABITAT AT APPLICATION CASE AND RFD CASE

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-11
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO.	REV.	FIGURE
1665943	0	4.4-2

To Table of Contents

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To Table of Contents

Injury or mortality from vehicle collisions and increased harvest pressure facilitated by the development of new access roads may also influence barren-ground caribou survival and reproduction. Barren-ground caribou are mobile and can avoid interactions with Project activities that could result in direct mortality. The Project will include monitors during construction to help detect caribou and other wildlife and protect them from Project activities. Construction activities will be suspended or restricted as described in the WMMP (PR#7) when caribou are known to be present. The Project also has the potential to increase mortality through collisions with vehicles, especially during operations; however, the likelihood of collision is low given the low speed limit and low predicted traffic volume on the road.

Highway 3 and one existing all-weather road (Highway 4) provide access to a small amount of area within the barren-ground winter ranges. Access is less limited in the winter because existing winter roads pass through the caribou study area (Figure 4.4-1). The winter roads to Wekweètì and Gamètì are typically open from early February to mid-April (GNWT-DOT 2016). At Base Case, snowmobiles can access the most of the study area and beyond through existing trails, and this is facilitated by the presence of existing winter roads (PR#28). The construction of the Project will provide year-round access by vehicles to the region and is anticipated to result in a 10 to 14 day earlier opening and closing of these winter roads (PR#7), which may allow hunters to use trucks with snowmobile trailers to reach caribou wintering near or beyond these communities. However, construction of winter roads requires at least 10 cm of snow cover for environmental protection and minimum ice thickness to support construction equipment, which is not achieved until January. Historical winter road operational periods are variable for the Wekweètì winter access road and trending toward opening later in the year (Figure 4.4-3), which is consistent with predictions of climate warming and with trends observed for other NWT winter roads (GNWT-DOT 2016). The winter road to Gamètì opening dates have ranged from February 14 in 2011 to March 31 in 2008. Thus, there is uncertainty in how much earlier the winter roads north of Whatì will be open and how long they will be viable if climate warming continues, so earlier access for trucks with snowmobiles may be temporary.

Both the Wekweètì and Gamètì winter access roads historically close mid-April (GNWT-DOT 2016). The BNE begin their migration to northern calving areas in early April (Nagy et al. 2005). While the road may improve access for snowmobilers during winter road shoulder seasons, Bathurst caribou begin their migration to northern calving areas in mid-April (Gunn et al. 2002) so a longer operational period of these winter roads resulting from the Project may not increase harvest because caribou may not be available past mid-April as they migrate north to calving areas. As well, recent winter habitat selection analysis on Bathurst caribou indicates preference for barren-ground areas (Golder 2016), which means only a fraction of this herd may be present below the treeline, near these communities and available for harvest. The GNWT-ENR has also implemented a no-hunting mobile conservation zone for the Bathurst herd with no hunting tags available between 2016 and 2019 (WRRB 2016). While the BNE herd does winter below the treeline, the BNE herd currently has regulated harvest of 750 bulls for aboriginal hunters. The Project will have a no hunting policy in place for construction workers as mitigation to avoid harvest of wintering barren-ground caribou. Access roads to borrow sites will be blocked, which will impede future use of areas required for Project construction. Therefore, Application Case effects to survival and reproduction for barren-ground caribou are predicted to be small relative to the Base Case.

To Table of Contents

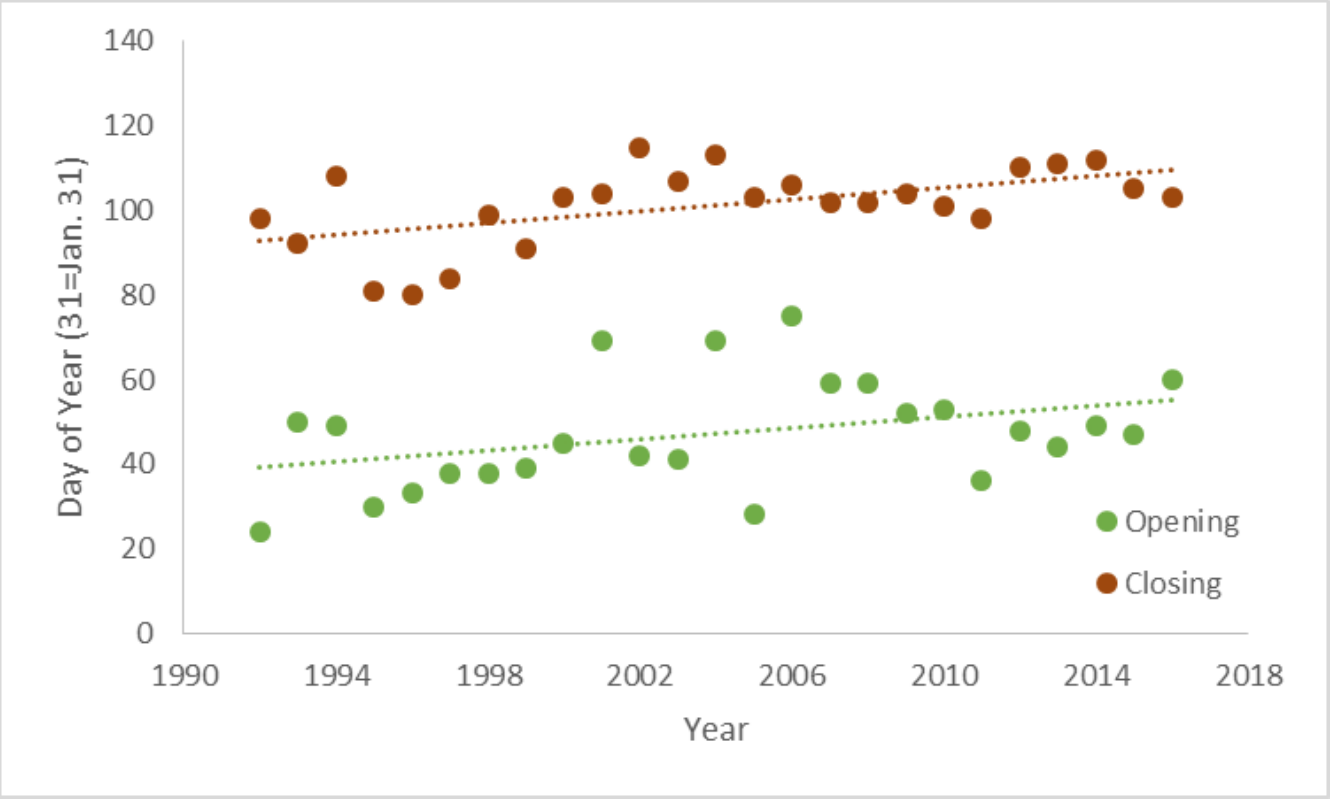

Figure 4.4-3: Opening and Closing Dates of the Wekweètì Winter Access Road, 1992 to 2016

To Table of Contents

4.4.3 Reasonably Foreseeable Development Case Results

4.4.3.1 Boreal Caribou

Habitat Availability

The buffered developments in the RFD Case, including the Project, will reduce boreal caribou habitat availability in the NT1 range by removal of 57,507 ha (0.2%) of undisturbed habitat under existing conditions (Table 4.4-6). Because the NT1 range is larger than the RSA for most other VCs, the RFD Case for boreal caribou considers additional developments, including the Prairie Creek Mine Project and Mackenzie Valley Highway. In the RFD Case, fire disturbance covers 10,141,116 ha (24.3%) of the NT1 range. The buffered developments will overlap with and reduce fire disturbance by 18,170 ha (0.2%) under existing conditions and accounts for 23.5% of the total area of buffered footprints. The total amount of disturbance will increase by 77,456 ha (2.1%) and the proportion from 33.2% at Base Case to 33.4% in the RFD Case. The proportion of undisturbed boreal caribou habitat is predicted to be 66.6% in the NT1 range, which exceeds the minimum threshold of 65% predicted to be necessary for self-sustaining boreal caribou populations (Environment Canada 2012). Regenerating forest post-burn may become available in the near future, although these areas may also be at risk of burning again. Given that RFDs are future developments that are not present on the landscape, there is uncertainty about mitigation detail that will be used to avoid, minimize rehabilitate or off-set effects to boreal caribou habitat availability. Therefore, the assessment assumes that mitigation designs will be similar or similarly effective to those used by the Project. Thus, the reduction in availability of undisturbed habitat for boreal caribou in the RFD Case is predicted to be small relative to the Base Case and near the resilience limits and adaptive capacity of boreal caribou.

Table 4.4-6: Boreal Caribou Habitat Availability in the NT1 Range, RFD Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent (%)
Fire disturbance [a]	10,159,286	10,141,116	-18,170	-0.2
Buffered developments[b]	3,697,637	3,775,093	77,456	2.1
Undisturbed habitat	27,861,774	27,802,488	-57,507	-0.2

a) The buffered Project will overlap with areas already affected by fire disturbance and therefore reduce the area classified as fire disturbance in the Application Case

b) Buffered developments in the RFD Case include Fortune Minerals Ltd. NICO Mine, Nailii Hydroelectric Project, Tłı̨chǫ/Whatì Park Area, Prairie Creek Mine Project and Mackenzie Valley Highway.

In the Wek'èezhìı portion of the NT1 Range, buffered development disturbance in the RFD Case will reduce undisturbed habitat availability by 1,835 ha (0.1%) (Table 4.4-7). The total amount of buffered disturbance will increase by 5,897 (14.4%) and 4,062 ha (68.9%) will overlap with habitat disturbed by fire under existing conditions. The proportion of disturbed habitat from fire and buffered developments will change from 40.0% in the Application Case to 41.1% in the RFD Case, so 59.9% of the Wek'èezhìı portion of the NT1 Range is predicted to be undisturbed habitat

Table 4.4-7: Boreal Caribou Habitat Availability in the Wek'èezhìı Portion of NT1 Range, RFD Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent (%)
Fire disturbance[a]	1,813,041	1,808,979	-4,062	-0.2
Buffered developments[b]	40,840	46,737	5,897	14.4

To Table of Contents

Table 4.4-7: Boreal Caribou Habitat Availability in the Wek'èezhìı Portion of NT1 Range, RFD Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent (%)
Undisturbed habitat	2,778,883	2,777,048	-1,835	-0.1

a) The buffered Project will overlap with areas already affected by fire disturbance and therefore reduce the area classified as fire disturbance in the Application Case

b) Buffered developments in the RFD Case include Fortune Minerals Ltd. NICO Mine, Nailii Hydroelectric Project, and Tłı̨chǫ/Whatì Park Area

Because wildfire is the predominant source of habitat loss in the NT1 range, RFDs may also overlap with burned areas, and not completely remove suitable habitat as with the Project. Climate change is also likely to affect boreal caribou habitat availability for the foreseeable future. The magnitude will depend on how much climate change and fire alter the amount of habitat availability in the NT1 range. There is also uncertainty around the location, geographic extent, and feasibility of the development of RFDs. However, it is expected that RFDs will be required to implement mitigation that will limit cumulative effects on the habitat availability for boreal caribou. Although there is uncertainty in the magnitude of changes to habitat availability, effects are anticipated to be near but not exceed the resilience or adaptability limits of this species in the RFD Case.

Habitat Distribution

RFDs occurring in the NT1 range will result in additional fragmentation of boreal caribou habitat in the NT1 compared to the Base Case (Figure 4.4-6). It is currently unknown how much the proposed Nailii Hydroelectric Project would contribute to cumulative changes to fragmentation of undisturbed habitat in the Wek'èezhìı portion of the NT1 range or NT1 range because its size is unknown but is expected to be small. Overall, the expected landscape level changes in the distribution of suitable boreal caribou habitat in the RSA due to RFDs (including the Project) are small, and the effect is predicted to be permanent because there is currently a poor understanding of the reclamation plans associated with RFDs and because the Project will exist indefinitely.

As with habitat availability, climate change and wildfire may contribute cumulatively to changes in the distribution of boreal caribou habitat. Climate warming is predicted to alter forest landscape composition and the availability of spring snow cover in the northern boreal forest (Weber and Flannigan 1997; IPCC 2007). This may affect habitat connectivity by changing the extent and location of suitable habitats and movement corridors as caribou avoid deep snow (Boertje 1985; Fancy and White 1987). For example, reduced canopy cover in burns leads to higher snow depths, which appear to increase mobility costs and decrease travel rates for caribou and increase predation risk (Boertje 1985; Fancy and White 1987; Thomas et al. 1998). Alternatively, climate change may reduce spring snow cover and increase the areas with more favourable travel conditions and connectivity for caribou. However, the intensity and amount of areas affected by wildfire is predicted to increase, which will remove habitat for boreal caribou and reduce connectivity in the NT1 range and WRMA.

Overall, connectivity among boreal caribou habitat patches is expected to be maintained at the RFD Case despite potential increased fragmentation from natural factors and RFDs. The effect is considered continuous and beyond regional in geographic extent (because of potential changes from climate change). For the purpose of this assessment, the changes to boreal caribou habitat distribution from human developments and natural factors are assumed to be permanent because the Project is expected to operate indefinitely, reclamation plans are not available for RFDs, and climate change will continue over the foreseeable future. This represents a precautionary

approach so effects are not underestimated. However, Project footprint cleanup and reclamation activities, as well as reclamation of RFDs, is likely to reduce effects from habitat fragmentation. Although there is a large amount of uncertainty around the location and feasibility of the development of RFDs, it is expected that future development will be required to implement mitigation that will limit cumulative effects on habitat distribution of boreal caribou. While there is uncertainty in the magnitude of changes to habitat distribution, effects are not expected to exceed the resilience or adaptability limits of boreal caribou in the RFD Case.

Survival and Reproduction

Cumulative effects to survival and reproduction of boreal caribou from RFDs (including the Project) are predicted to be small at the NT1 range and in the WRMA. Future developments occurring in the RSA are assumed to use established mitigation such as giving wildlife the right-of-way and speed restrictions on their leases that will limit wildlife injury and mortality from vehicle collisions. As a conservatism, the traffic volume in the Application Case was assessed assuming up to 40 vehicles daily during operation. As noted in the PDR (PR#7), this amount includes traffic volume associated with the NICO Project. Thus, no additional wildlife-vehicle collisions due to this RFD is predicted. No hunting policies for workers at RFDs are also assumed to be effective to limit cumulative effects to caribou from harvest. Winter or all-season access roads to RFDs, such as the NICO Project, may be used by the public, however, the WRMA is already accessible through a network of existing trails at Base Case (PR#7; PR#28) and will still require use of these trails to reach more suitable caribou habitat a considerable distance beyond the RSA. Therefore, changes in the survival and reproduction of boreal caribou in the RSA due to RFDs, as well as the Project, are predicted to be small and not expected to exceed the resilience or adaptability limits of boreal caribou in the RFD Case.

Climate change may also contribute cumulatively to changes in survival and reproduction of boreal caribou by altering fire change the amount of habitat availability of spring snow cover and the distribution of food resources. A decline in the amount and duration of snowpack may reduce areas of deep snow where caribou are more susceptible to predation by wolves (Boertje 1985; Fancy and White 1987; Thomas et al. 1998). However, reduced canopy cover in burns leads to higher snow depths and loss of lichen stores which negatively affect caribou survival and reproduction (Boertje 1985; Fancy and White 1987; Thomas et al. 1998). A changing climate may also alter the composition of forested ecosystems and result in changes to ungulate distribution and abundance, although changes that negatively affect one species (e.g., caribou) may benefit another (e.g., moose), such as the loss of conifer forest cover. Overall, uncertainty is high regarding the potential effects of climate change on boreal caribou survival and reproduction because the predicted outcomes are variable. It is expected that RFDs will be required to implement mitigation that will limit cumulative effects on the survival and reproduction for boreal caribou. Although there is uncertainty in the magnitude of changes to survival and reproduction, effects are not expected to exceed the resilience or adaptability limits of boreal caribou in the RFD Case.

To Table of Contents

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LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- WINTER ROAD
- TREELINE
- WATERCOURSE
- PROVINCIAL/TERRITORIAL BOUNDARY
- TŁĮCHǪ LAND
- WATER BODY
- CANDIDATE PROTECTED AREA
- DEVELOPMENT
- RFD
- FIRE HISTORY (LESS THAN 40 YEARS OLD)
- UNDISTURBED HABITAT
- BOREAL CARIBOU RSA
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

0 120 240

1:6,000,000 KILOMETRES

REFERENCE(S)

1. ADMINISTRATIVE REGIONS OBTAINED FROM GOVERNMENT OF NORTHWEST TERRITORIES.
2. BOREAL CARIBOU RANGE OBTAINED FROM ENVIRONMENT CANADA, 2012.
3. CIMP INVENTORY OF LANDSCAPE CHANGE, OBTAINED FROM THE NWT CENTRE FOR GEOMATICS.
4. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: CANADA LAMBERT CONFORMAL CONIC

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
DISTRIBUTION OF BOREAL CARIBOU HABITAT AT RFD CASE

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-04-11
DESIGNED	DC
PREPARED	LMS
REVIEWED	DC
APPROVED	JV

PROJECT NO.	REV.	FIGURE
1665943	0	4.4-6

To Table of Contents

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To Table of Contents

4.4.3.2 Barren-ground Caribou

Habitat Availability

Locations of collared cows in the Bathurst and BNE herds indicate the RSA is outside of core ranges (Nagy et al. 2005; Anderson and Johnson 2014; Golder 2016; Appendix G) but some caribou may be present when these herds are more abundant (PR#28). RFDs, including the Project, are predicted to reduce moderate to high suitability barren-ground caribou habitats by 264 ha (0.2%) in the RSA relative to the Base Case (Table 4.4-8). Changes to habitat availability in the RFD Case are the same as the Application Case. This is because the NICO Project all-season road reduced a small amount (72 ha) of recently burned areas (from 2011 and 2016) relative to the Application Case, but recently burned areas do not provide suitable habitat for barren-ground caribou. Thus, while the area of individual habitats types changed, these changes only affected types that were of poor quality. It is currently unknown how much habitat will be removed by the proposed Nailii Hydroelectric Project for barren-ground caribou in the RFD Case compared to the Base Case. However, it is assumed that this run-of-river hydro project will have a relatively small footprint and implement similar mitigation measures that avoid, reduce, or limit effects to habitat availability for barren-ground caribou.

Table 4.4-8: Barren-ground Caribou Winter Habitat Availability in the RSA, RFD Case

Habitat Suitability	Base Case (ha)	RFD Case (ha)	Change in Area (ha)	Percent (%)
Moderate to High	117,677	117,413	-264	-0.2
Nil to Low	883,843	884,107	264	<0.0

In addition to development, natural factors such as climate change and wildfire may contribute cumulatively to influence habitat availability for barren-ground caribou, although the extent of habitat loss from climate change is uncertain. Climate warming is predicted to result in warmer conditions and changes in precipitation patterns in northern boreal forest, which will increase the occurrence and severity of fire and affect the composition of forested ecosystems as some plants expand their ranges northward (Weber and Flannigan 1997). This may result in loss of conifer cover and snow conditions which are important to caribou, but may benefit moose (and wolves) that are likely to increase their northern distribution with changing vegetation patterns (Sharma et al. 2009). Wildfire will reduce the availability of suitable boreal caribou habitat immediately post-disturbance due to the loss of lichens (Barrier and Johnson 2014). Caribou begin to use post-fire areas 40 to 50 years later when lichens are available (Thomas et al. 1998), so habitat loss from fire is temporary and reversible. It is not expected that fire suppression activities will change habitat availability for caribou in the RSA as the majority of the RSA would be considered low priority for suppression given the remoteness of the region and the limited economic value of the forests in the RSA (GNWT-ENR 2017).

Climate change is also likely to affect barren-ground caribou habitat availability for the foreseeable future. The magnitude will depend on how much climate change and fire change, change the amount habitat available in the RSA. There is also uncertainty around the geographic extent and feasibility of the development of RFDs. However, it is expected that RFDs will be required to implement mitigation similar to the Project (e.g., footprints that overlap existing disturbance) which will limit cumulative effects on the habitat availability for this species. Although there is uncertainty in the magnitude of changes to habitat availability, effects are anticipated to not exceed the resilience or adaptability limits of this species in the RFD Case.

To Table of Contents

Habitat Distribution

The two RFDs occurring in the RSA are not predicted to result in additional fragmentation of barren-ground caribou winter habitat since the amount of moderate to high suitability is not predicted to change in the RFD Case compared to the Application Case (Figure 4.4-2). It is currently unknown if the proposed Nailii Hydroelectric Project would contribute to cumulative changes to fragmentation of moderate to high suitability barren-ground caribou habitat in the RSA because the exact location and size is not available. Habitat connectivity may be reduced locally due to the Nailii Hydroelectric Project and NICO Project all-season access road.

Much like the Project, the NICO Project all-season access road will also follow an existing linear disturbance (trail) present at Base Case (Figure 4.4-2). As well, good quality habitat does not appear to be limited in the boreal winter range of barren-ground caribou beyond the RSA (Barrier and Johnson 2014). Overall, landscape level changes in the distribution of suitable barren-ground caribou habitat in the RSA due to RFDs (including the Project) are anticipated to be small, and the effect is predicted to be permanent because there is currently a poor understanding of the reclamation plans associated with RFDs and because the Project will exist indefinitely. It is also assumed that the RFDs will implement mitigation measures that avoid, reduce or limit effects to connectivity.

As with habitat availability, climate change and wildfire may contribute cumulatively to changes in the distribution of barren-ground caribou habitat. Climate warming is predicted to alter forest landscape composition and the availability of spring snow cover in the northern boreal forest (Weber and Flannigan 1997; IPCC 2007). This may affect habitat connectivity by changing the extent and location of suitable habitats and movement corridors as caribou avoid deep snow (Boertje 1985, Fancy and White 1987). For example, reduced canopy cover in burns leads to higher snow depths, which appear to increase mobility costs and slow travel for caribou and increase predation risk (Boertje 1985; Fancy and White 1987; Thomas et al. 1998). Alternatively, climate change may reduce spring snow cover and increase the areas with more favourable travel conditions for caribou.

Overall, connectivity among habitat patches is expected to be maintained at the RFD Case despite potential increased fragmentation from natural factors and RFDs. Regenerating forest post-burn may become available in the near future, although these areas may also be at risk of burning again.

Although there is a large amount of uncertainty around the location and feasibility of the development of RFDs, it is expected that future development will be required to implement mitigation that will limit cumulative effects on habitat distribution of this species. While there is uncertainty in the magnitude of changes to habitat distribution, effects are not expected to exceed the resilience or adaptability limits of barren-ground caribou in the RFD Case.

To Table of Contents

Survival and Reproduction

Cumulative effects to survival and reproduction of barren-ground caribou from RFDs (including the Project) are predicted to be small. Vegetation clearing by the proposed Nailii Hydroelectric Project and all-season access road for the NICO Project are not predicted to affect the amount of quality habitats relative to the Application Case, which represents no change to survival and reproduction. While the exact location and size of the Nailii Hydroelectric Project is unknown, it is a small scale run-of-river design so it is unlikely to remove a large amount of suitable habitat.

While the presence of new roads may delay migratory caribou movement (Wilson et al. 2016), Bathurst caribou are familiar with roads and appear to cross them when encountered at Ekati (ERM Rescan 2014). RFDs occurring in the RSA are assumed to use established mitigation such as giving wildlife the right-of-way and speed restrictions on their leases that will limit wildlife injury and mortality from vehicle collisions. As a conservatism, the traffic volume in the Application Case was assessed assuming up to 40 vehicles daily during operation. As noted in the PDR (PR#7), this amount includes traffic volume associated with the NICO Project. Thus, no additional wildlife-vehicle collisions due to this RFD are predicted. No hunting policies for workers at RFDs are also assumed to be effective to limit cumulative effects to caribou from harvest. Winter or all-season access roads to RFDs, such as the NICO Project, may be used by the public, however, the RSA is already accessible through a network of existing trails at Base Case (PR#7; PR#28) and will still require use of these trails and winter roads to reach more suitable caribou habitat a considerable distance beyond the RSA. Climate warming is anticipated to reduce the operational period of winter roads in the region and the long-term feasibility of their use. Thus, use of winter roads to reach core winter ranges of barren-ground caribou outside the RSA for harvest may be temporary. Therefore, changes in the survival and reproduction of barren-ground caribou in the RSA due to RFDs, as well as the Project, are not expected to exceed the resilience or adaptability limits of barren-ground caribou in the RFD Case.

Climate change may also contribute cumulatively to changes in survival and reproduction of barren-ground caribou by altering the availability of spring snow cover and the distribution of food resources. A decline in the amount and duration of snowpack may reduce areas of deep snow where caribou are more susceptible to predation by wolves (Boertje 1985; Fancy and White 1987; Thomas et al. 1998). However, reduced canopy cover in burns leads to higher snow depths and loss of lichen stores which negatively affect caribou survival and reproduction (Boertje 1985; Fancy and White 1987; Thomas et al. 1998). A changing climate may also alter the composition of forested ecosystems and result in changes to ungulate distribution and abundance, although changes that negatively affect one species (e.g., caribou) may benefit another (e.g., moose), such as the loss of conifer forest cover. Overall, uncertainty is high regarding the potential effects of climate change on barren-ground caribou survival and reproduction because the predicted outcomes are variable.

Changes to barren-ground survival and reproduction in the RFD Case are predicted to be beyond regional, possible and permanent because the Project is expected to operate indefinitely and there is uncertainty regarding reclamation plans for RFDs. Climate change will affect barren-ground caribou populations, although the direction and magnitude of changes is uncertain because predictions are variable. There is also some uncertainty around the location, geographic extent, and feasibility of the development of RFDs. It is expected that RFDs will be required to implement mitigation that will limit cumulative effects on the survival and reproduction for this barren-ground caribou. Although there is uncertainty in the magnitude of changes to survival and reproduction, effects are not expected to exceed the resilience or adaptability limits of barren-ground caribou in the RFD Case.

To Table of Contents

4.5 Prediction Confidence and Uncertainty

Prediction confidence refers to the degree of certainty in the residual effects predictions and associated determination of significance. The ASR deals with predictions of future circumstances, and predicts interactions of the Project and other developments or activities within complex ecosystems. Scientific inference is associated with uncertainty, and prediction confidence (how confident we are in our assessment results) depends on the level of uncertainty and the manner in which it is addressed. Primary factors affecting confidence in the predictions made in the wildlife assessment include:

- availability and accuracy of baseline data
- accuracy of landcover maps (Ecological Landscape Classification data) and qualitative wildlife habitat models
- level of understanding of the strength of effects pathways (i.e., mechanisms) on each VC
- level of certainty associated with the effectiveness of proposed mitigation, where applicable
- level of understanding of the cumulative drivers of change in measurement indicators and associated effects on assessment endpoints

The level of certainty is considered during the effects assessment, and how uncertainty was addressed to increase the level of confidence so that residual effects will not be worse than predicted, such as building conservatism into the analysis and assessment. Uncertainty in the assessment was managed by:

- using the best available land cover data
- reviewing historical data and relevant wildlife studies conducted in the study areas
- collecting local and regional data to understand ecological relationships relevant to potential pathways, and inform the assessment
- using data to make inferences about ecological interactions and mechanisms of change
- comparing assessment results to relevant published literature

Remaining uncertainty was primarily addressed by making assumptions that overestimated rather than underestimated potential effects of the Project and RFDs (i.e., a precautionary assessment). For example, the Project will use existing access as much as possible to minimize new disturbance to the landscape; to be conservative and not underestimate effects of habitat loss, the assessment overestimated the Project footprint by about 56%. The Project footprint assessed included 13 borrow sites and access roads but development of the Project will likely not require the use of all these sites. Thus, predicted effects from changes in wildlife habitat availability and distribution due to the Project have a high level of confidence.

Similarly, for the purpose of this assessment the loss of wildlife habitat due to the preferred route of the Project and RFDs is assumed to be permanent because the Project is expected to operate indefinitely and reclamation plans are not available for planned RFDs. Some habitats disturbed by the Project through temporary laydown and storage yards, and construction camps are expected to be reclaimed, which would contribute to reducing residual Project effects. Therefore, the confidence in predictions concerning effects to wildlife from the Project is moderate to high.

To Table of Contents

Climate change models predict an increase in average global temperatures in the Project Case and the RFD Case; however, the effect of these changes on ecosystem processes is uncertain (Deser et al. 2010; Walther 2010). Predicting how an ecosystem or an individual species will cope with climate change is difficult and many scenarios are possible (Dawson et al. 2011). Climate warming is predicted to result in warmer conditions and changes in precipitation patterns in northern boreal forest, which will increase the occurrence and severity of fire and affect the composition of forested ecosystems as some plants expand their ranges northward (Weber and Flannigan 1997, GNWT-ENR 2008) and in the VC-specific RSAs. Changes in water levels and flows are uncertain, and may result in negative or positive effects to wildlife and wildlife habitat. For most species, climate change will have both positive and negative effects on habitat availability, habitat distribution and survival and reproduction (Nituch and Bowman 2013).

An increase in wildfire is predicted with climate change. The number, frequency, and severity of wildfires in many parts of the world have increased from 1960 to 2013 (Bladon et al. 2014). Climate change and fire suppression practices are thought to be the largest contributors to the trend. A recent prediction for Canada indicates the potential for a 74% to 118% increase in average burn area by the end of this century (Flannigan et al. 2005). Fire alters many components of the environment including air quality, water quality, soil characteristics, vegetation cover, and hydrological processes.

Climate change is also expected to alter the onset of spring and summer. Spring and summer are expected to begin earlier and the growing season is expected to last longer (GNWT-ENR 2008). These changes may provide migratory birds with opportunities to produce second broods or re-nest if the first attempt fails. However, climate change is also predicted to increase the frequency and intensity of extreme weather events which can result in reduced nest success for many bird species (Conrey et al. 2016; George et al. 1992). As expected, there is a low level of confidence in predicted effects from climate change to wildlife. However, where there was ambiguity in the response of a species to climate change, the assessment considered a precautionary outcome for each VC (i.e., adverse effect of climate change on wildlife populations in the RFD Case).

4.6 Effects Classification and Determination of Significance

4.6.1 Methods

Residual effects are described using the classification criteria identified in Table 4.6-1 and applied to the predicted changes in measurement indicators for each VC. Classification of residual effects on wildlife VCs considered direction (positive, negative or neutral), expected magnitude (e.g., number of hectares lost or gained, change in survival), geographic extent (e.g., distance covered or range of the effect), duration and reversibility (e.g., years, decades, permanent/irreversible), frequency (i.e., number of times the effect happens per unit time), and likelihood (e.g., how likely is the effect).

To Table of Contents

Table 4.6-1: Definitions of Effects Categories Used to Classify Predicted Residual Effects to Wildlife VCs

Criteria	Definition
Direct	■ Positive – net gain or benefit; effect is desirable ■ Neutral – no change compared with baseline conditions and trends ■ Negative – net loss or adverse effect; effect is undesirable
Magnitude	■ Magnitude will be expressed quantitatively or qualitatively for each VC to reflect VC-specific characteristics
Geographic extent	■ Local – predicted maximum spatial extent of direct and indirect effects from changes to a measurement indicator due to a project or activity are well within the RSA (e.g., confined to or immediately adjacent to the Project footprint). ■ Regional – effects from changes to a measurement indicator due to a project or activity extend to the RSA boundary and/or can include cumulative effects from other developments in the RSA ■ Beyond regional – effects from changes to a measurement indicator extends beyond the RSA boundary
Duration/reversibility	■ Short-term – residual effect from changes to a measurement indicator is reversible at the end of construction ■ Medium-term – residual effect from changes to a measurement indicator is reversible soon after operation begins ■ Long-term – residual effect from changes to a measurement indicator is reversible within a defined length of time during operation ■ Permanent – residual effect from changes to a measurement indicator is not reversible
Frequency/Timing	■ Infrequent – the effect from changes to a measurement indicator is expected to occur rarely ■ Frequent – the effect from changes to a measurement indicator is expected to occur intermittently ■ Continuous – the effect from changes to a measurement indicator is expected to occur continually
Likelihood	■ Unlikely – the effect is not likely to occur ■ Possible – the effect may occur, but is not likely ■ Probable – the effect is likely to occur ■ Certain – the effect will occur

Duration and frequency were described categorically using the categories identified in Table 4.6-1, but were also described more precisely using years, where applicable and possible. The more precise definition was applied to avoid confusion or misinterpretation of the effects assessment that sometimes accompanies broad categories.

Magnitude was not described categorically. Classifying magnitude using an ordinal scale (i.e., low, moderate, or high) in a manner meaningful for wildlife VCs requires that the effect size be placed in the ecological context of the VC, incorporating resilience, adaptability, and amount of historic disturbance. Universal effect size boundaries, such as a 20% change at the RSA scale used to define a high magnitude effect, work poorly because they fail to consider ecological context. A 20% additional loss in habitat availability and distribution from existing conditions in the RSA may be required to cause a high magnitude effect on some VCs, whereas a 2% loss may be sufficient for others, depending on ecological context (BC EAO 2013). Integrating ecological context to understand the point at which an effect size is large enough to be important for a VC is directly linked to the self-sustaining and ecologically effective status of the population, and therefore directly linked to significance. To avoid providing a definition of magnitude synonymous with the determination of significance, predicted effect sizes were provided in specific terms (i.e., a narrative or qualitative expression, or numeric quantification). The ecological context of the predicted effect size is discussed in a reasoned narrative for the determination of significance.

To Table of Contents

The predicted changes in measurement indicators and associated classification of residual effects provides the foundation for determining the significance of incremental and cumulative effects from the Project and other previous, existing, and RFDs on the assessment endpoints for wildlife VCs. Significance was determined based on combined effects because the effects of a single project infrequently cause an ecologically significant effect on their own (McCold and Saulsbury 1996), and many environmental effects of primary concern are cumulative (Canter and Ross 2010). Therefore, whether wildlife VCs would remain self-sustaining and ecologically effective was assessed by combining the effects identified at Base Case with the residual effects identified for the Project and RFDs to assess the total predicted combined effect. If a significant effect was identified, the contribution of the Project to the combined effect was clearly described.

Magnitude, geographic extent, and duration (which includes reversibility) are the primary criteria used to determine the significance of effects on VCs. Other criteria, such as frequency and likelihood are used as modifiers. The approach to determining the significance of combined effects for each VC incorporated the concepts of resilience and adaptability using the reasoned narrative provided in the Application and RFD cases. Although the determination of significance was informed by the classification of residual effects, the interaction between ecological context from the Base Case and the magnitude, duration, and geographic extent of the interacting residual effects were the most important factors. For example, the magnitude of an effect on wildlife VCs depends on the current level of disturbance, population status and resilience of the VC to further changes in habitat availability, connectivity and survival and reproduction. Similarly, duration includes consideration of reversibility, and the duration of residual effects to VCs with high resilience (ability to recover from disturbance) would be expected to be shorter relative to VCs with lower resilience to disturbance.

Because of the uncertainty regarding the effects of development on VCs, magnitude classification was applied conservatively to increase the level of confidence that effects will not be worse than predicted. Furthermore, the determination of significance considers the key sources of uncertainty in the effects analysis, the management of uncertainties, and the corresponding level of confidence in effects predictions.

Significance was predicted as a binary response, with effects classified as significant or not significant. Residual effects were determined to be significant if a VC is expected to no longer be: (1) self-sustaining, or (2) ecologically effective. Specifically:

- A VC was considered to be no longer self-sustaining where cumulative residual effects were expected to place the abundance of a VC, whether an open or closed population, on a declining trajectory that is not predicted to recover or stabilize. For example, loss of habitat that causes permanent adverse changes to survival and reproduction at the population level. Part of being self-sustaining, in this context, was that a VC population that stabilizes at a lower abundance is not expected to be extirpated because of unrelated stochastic events. Another part of being self-sustaining was the assumption that no additional mitigation or management actions beyond the proposed Project mitigation strategies and existing management strategies in the region would be required. Effects that are not significant could result in no change, stabilization at lower abundance, stabilization at higher abundance, or a temporary decline followed by recovery. Even where populations remain stable, fragmentation effects that cause populations to become isolated or substantially disconnected (e.g., severely reducing or eliminating gene flow and/or demographic rescue within one regional or meta-population or between two or more local populations) may be considered significant.

To Table of Contents

- A VC that has lost important ecological function would also result in determination of a significant adverse effect, regardless of its self-sustaining status. Loss of ecological function occurs when a population can no longer perform its ecological role, such that it might trigger ecological changes that result in degraded or simplified ecosystems (Soulé et al. 2003). The potential to lose ecological function is more common for highly interactive wildlife VCs that have important ecological effects on other species, such as predators or species described as ecosystem engineers (e.g., beavers, earthworms) (Soulé et al. 2003).

The level of confidence is also included in the evaluation of significance. Where uncertainty was high and the cumulative effect might be either significant or not significant, the assessment conservatively identified the effect as significant and provided additional follow-up to reduce uncertainty (i.e., precautionary approach).

4.6.2 Results

4.6.2.1 Boreal Caribou

The cumulative effects from the Project and other developments should not have a significant influence on the ability of the boreal caribou to be self-sustaining and ecologically effective in the NT1 range. For all primary pathways influencing the habitat availability of boreal caribou, cumulative impacts were determined to be regional in geographic extent due to climate change (Table 4.6-2), which implies that at least a portion of the population is affected during any given year, but likely not the entire population every year. The geographic extent of Project-specific effects ranged from local to regional. Local impacts from habitat loss were associated with the physical footprint and sensory disturbance from construction and operational activities, and are predicted to influence individuals that travel through or occupy habitats within 500 m of the Project site (Environment Canada 2012), and possibly more depending on traffic volumes. Regional effects are a function of incremental and cumulative changes to caribou habitat loss and sensory disturbance from Project-related traffic on the Highway 3 and human activities from other developments in the NT1 range. The likelihood of impacts occurring is expected to be possible to certain for all pathways (Table 4.6-2), which does not change the expected magnitude and duration (or environmental significance). Similarly, the frequency of most impacts is anticipated to occur continuously throughout the life of the Project, depending on presence of boreal caribou near the Project and other developments. Caribou presence may be low temporarily if developments overlap with burned areas that are less than 40 years old (Environment Canada 2012) as is the case with the Project and other previous, existing and future developments in the RFD Case. For the assessment of effects to caribou, physical disturbance to terrestrial habitat from developments was considered permanent (Table 4.6-2). Northern boreal ecosystems are slow to recover from disturbance (e.g., 40 years post-burn before caribou use), and it is uncertain as to what the revegetated landscape will look like long-term into the future.

Reductions in quality habitats due to the sensory disturbance from development may result in a decrease in the carrying capacity of the NT1 range, which was assessed for boreal caribou with buffered developments (Environment Canada 2012). Direct habitat and indirect loss from the Project and previous and existing developments (Application Case) removed 8.9% of the NT1 range but the Project accounted for less than a 0.1% reduction of undisturbed habitat. The cumulative direct disturbance from the Project and all previous, existing, and reasonably foreseeable future developments is predicted to be less than 0.4% of the total area in the NT1 range and will remove 0.2% of undisturbed habitat (Table 4.4-6.4). When human activities are present, caribou are known to alter their behaviour to avoid disturbed landscapes. Initially, the response of caribou to roads is avoidance (Polfus et al. 2011), but over time they can become habituated to the presence of roads and traffic (Haskell and Ballard 2008; ERM Rescan 2014a,b; Johnson and Russell 2014). At Base Case, boreal caribou are considered a

To Table of Contents

self-sustaining population based on greater than 65% undisturbed habitat in the NT1 range. Cumulative habitat loss from development through the RFD Case does not alter this conclusion.

The cumulative effects of fragmentation on boreal caribou across the NT1 range is expected from the conservative approach to the analyses that included overestimated (i.e., buffered) footprint areas and irreversible effects from human disturbance features (Section 4.5). Changes to habitat fragmentation from the Base Case to the RFD Case is expected to be negligible given the relatively low amount of development disturbance in the NT1 range. However, burned areas are considered unsuitable for boreal caribou for up to 40 years (Environment Canada 2012), and wildfire is the dominant but temporary form of habitat loss in the NT1 range. Fragmentation effects have less influence than direct habitat loss when there is a large proportion of undisturbed habitat on the landscape (Fahrig 1997, 2003; Andrén 1999; Flather and Bevers 2002; Swift and Hannon 2010), which is apparent across the NT1 range. Boreal caribou are predicted to be resilient to these small changes in physical habitat loss from development, and there should be a negligible effect on distribution or connectivity across the NT1 range.

The cumulative negative effects to boreal caribou are predicted to lower survival and reproduction. Per the previous discussion, changes to habitat loss and distribution are expected to be near but within the resilience limits and adaptive capacity of boreal caribou and so, are not predicted to significantly influence survival and reproduction. Cumulative effects to survival and reproduction from vehicle strikes and improved access are predicted to be negative, of low magnitude and regional. The predominant factors that contribute to road-related wildlife deaths are visibility, traffic volume and vehicle speed (EBA 2001; Neumann et al. 2012). These factors directly affect the success of an animal reaching the opposite side of the road. An increase in either factor reduces the probability of an animal crossing safely (Underhill and Angold 2000). The proportion of development in the NWT is relatively low (8.9%) with little road infrastructure and low traffic volume, likely related to NWT's small human population size. Boreal caribou are mobile and can avoid interactions with active areas, such as roads (Polfus et al. 2011). The risk of vehicle strikes is continuous and permanent for all-season roads but strikes may not be frequent enough to influence survival at the NT1 range scale, and therefore this effect is probable but predicted not to have a strong influence on caribou survival or reproduction.

All-Season roads may improve access and increase harvest of boreal caribou, which will reduce survival and productivity, regionally in the RFD Case. Harvest of boreal caribou will be dependent on their presence, which is likely to be a function of habitat quality and distribution but also hunter experience and skill. Boreal caribou populations occur at low densities (0.03 to 0.12 caribou/km^2) throughout the mid-continent (Stuart-Smith et al. 1997) and are a wide ranging species to facilitate access to resources across space and time (Johnson et al. 1992; Nathan et al. 2008; Taylor et al. 1993). Boreal caribou may avoid areas of activity including roads (Polfus et al. 2011), so boreal caribou may not always be present near roads all the time and be available for harvest. There are existing trails that provide access to trucks, ATVs and snowmobiles at Base Case where the Mackenzie Valley highway and the Project will be located and, which are already used for harvest (Section 5.2.10; PR#7; PR#28). At Base Case, hunters using existing trails are likely from nearby communities (Section 5.2.10; PR#28), and would have experience in the area. Whereas, hunters from more distance communities and using the all-season roads to access these areas would not in the Application Case or RFD Case. Thus, the magnitude of change from future development is predicted to lower survival and reproduction, although improved access will be continuous and permanent.

To Table of Contents

If climate change results in more frequent and severe fires in the NT1 range, habitat availability may decrease and lead to declines in recruitment. Large continuous tracts of undisturbed habitat are important to maintaining self-sustaining caribou populations. Nagy (2011) found a positive correlation between population growth rates and access to secure unburned habitat, particularly where most of the habitat was in patches greater than 500 km². Nagy et al. (2011) also showed that boreal caribou form two sub-populations of females organized as individuals across ranges separated by large areas burned by wildfires in the central NWT. This habitat discontinuity may be temporary if natural habitat regeneration occurs. Results from Nagy et al. (2011) are consistent with the observation of Bergerud (1996) that boreal caribou tend to form a near-continuum across a region of favourable calving sites, which are represented by very late seral-stage vegetation communities such as black spruce and bog-fen complexes. As such, changes to the amount and quality of habitat in the NT1 range is difficult to predict. Adding to the unpredictability of effects is the knowledge that caribou have behavioural plasticity to shift seasonal ranges to adapt to changes in range conditions (Nagy 2011). As well, climate change may also increase the amount of white-tailed deer habitat and their presence in the NWT, which could lead to an incidental predation of boreal caribou by wolves (Latham 2009; Latham et al. 2011; Serrouya et al. 2011), and is a beyond regional effect and possible.

Although future development is uncertain, the Mackenzie Valley highway, Canyon Creek road, Prairie Creek mine, Forest Management Agreements, NICO Project, and the Nailii Hydroelectric Project are reasonably foreseeable projects within the NT1 range (Section 4.4.3) that could affect caribou abundance, distribution, and population connectivity by decreasing habitat availability and distribution, and survival and reproduction. If developed, the Mackenzie Valley highway and Canyon Creek road will remove boreal caribou habitat and may influence animal movements and increase mortality from vehicle strikes or increased harvest within the NT1 range. However, these roads occur near or overlap with existing disturbance, which boreal caribou may already avoid. It is assumed that these developments will be required to have wildlife management plans that identify mitigation for these types of effects. The Nailii Hydroelectric Project is also is an uncertain, a future run-of-river 2 MW hydro facility connected to Whatì to reduce dependency on diesel generated power, and a transmission line to the existing Snare Hydro Complex to distribute power to Behchokǫ̀ and Yellowknife. Expansion of the hydroelectric grid could change caribou habitat use and distribution if animals avoid or restrict movements near the transmission lines (Vistnes and Nelleman 2008; Vistnes et al. 2008; Tyler et al. 2014). There are also several reasonably foreseeable protected areas that will limit future development disturbance of boreal caribou habitat.

Overall, the weight of evidence from the analysis of the primary pathways predicts that incremental and cumulative changes to measurement indicators from the Project and other developments should have no significant adverse effect on self-sustaining and ecologically effective boreal caribou populations. The confidence in this prediction is higher for the Application Case than the RFD Case. Extending the assessment into the future (RFD Case) decreases confidence in effects predictions, which is largely due the uncertainty in the actual timing (e.g., amount of overlap in time with the Project and existing developments), location and size of developments, and the variability inherent in making long-term predictions in ecological systems. The present structure and inputs of habitat models may not be applicable to future environments and caribou behavioural responses and population characteristics, which increases the uncertainty in cumulative effects from physical habitat loss and sensory disturbance on habitat availability and distribution. Still, confidence in the predictions for the RFD Case is based on the consistent low effect sizes (i.e., magnitudes of change) that were determined from the incremental and cumulative changes from the Project and other developments for habitat availability and distribution. Although each development likely influences the local movement and distribution of caribou, there is no strong

To Table of Contents

mechanism causing an adverse and long-term or permanent change in population survival and reproduction rates. The low traffic volume and speed limits is predicted to mitigate effects to injury and mortality and connectivity for self-sustaining and ecologically effective boreal caribou populations.

Table 4.6-2: Summary of Residual Effects Classification and Predicted Significance of Cumulative Effects on Boreal Caribou in the RFD Case

Indicator	Characteristic	Rating/Effect Size	Significance Determination
Habitat availability	Direction	Negative	Not significant
	Magnitude	■ Direct and indirect loss of 57,507 ha (0.2%) of undisturbed habitat in the NT1 range from Base Case to RFD Case. ■ Reduced habitat quality and possible avoidance in the NT1 range from sensory disturbance from construction through closure. ■ Reduction in carrying capacity from northern contraction of forest habitat due to climate change. ■ Magnitude will depend on the influences from climate change.	
	Geographic Extent	Beyond regional (due to climate change)	
	Duration/Reversibility	■ Long-term (direct loss to habitats and sensory disturbance) ■ Permanent (alterations from all-season roads and climate change)	
	Frequency/Timing	Continuous	
	Likelihood	■ Certain (direct loss) ■ Probable (sensory disturbance) ■ Possible (climate change)	
Habitat distribution	Direction	Negative	
	Magnitude	■ Small reduction in movements among habitat patches due to the Project and RFDs ■ Reduced forest patch size, diversity, and distribution due to climate change	
	Geographic Extent	Beyond regional (due to climate change)	
	Duration/Reversibility	■ Long-term (direct loss to habitats and sensory disturbance) ■ Permanent (alterations from all-season roads climate change)	
	Frequency/Timing	Continuous	
	Likelihood	■ Certain (direct loss) ■ Probable (sensory disturbance) ■ Possible (climate change)	
Survival and reproduction	Direction	Negative	
	Magnitude	Lower boreal caribou densities due to climate change	
	Geographic Extent	Regional (from improved access due to roads and strikes)	
	Duration/Reversibility	■ Long-term (direct loss habitats and sensory disturbance) ■ Permanent (alterations from climate change and roads)	
	Frequency/Timing	Continuous	
	Likelihood	■ Certain (direct loss) ■ Probable (sensory disturbance) ■ Probable (vehicle strikes and improved access) ■ Possible (climate change)	

To Table of Contents

4.6.2.2 Barren-ground Caribou

The cumulative effects from the Project and other developments should not have a significant influence on the ability of the barren-ground caribou to be self-sustaining and ecologically effective in the RSA. For all primary pathways influencing the habitat availability of barren-ground caribou, cumulative impacts were determined to be regional to beyond regional in geographic extent (Table 4.6-3). The geographic extent of Project-specific effects ranged from local to beyond regional. Local impacts from habitat loss were associated with the physical footprint and sensory disturbance from construction and operational activities, and are predicted to influence individuals that travel through or occupy habitats near the Project site. Beyond regional effects are a function of incremental and cumulative changes to sensory disturbance and access from Project-related traffic on the Gamètì and Wekweètì winter roads. The likelihood of impacts occurring is expected to be possible to certain for all pathways (Table 4.6-3), which does not change the expected magnitude and duration (or environmental significance). Similarly, the frequency of most impacts is anticipated to occur continuously throughout the life of the Project, depending on presence of barren-ground caribou near the Project and other developments. Caribou presence may be low temporarily if developments overlap with burned areas that are less than 40 years old (Thomas et al. 1998, Joly et al. 2007) as is the case with the Project. For the assessment of effects to caribou, physical disturbance to terrestrial habitat from developments was considered permanent (Table 4.6-3). Northern boreal ecosystems are slow to recover from disturbance (e.g., 40 years post-burn before caribou use), and it is uncertain as to what the revegetated landscape will look like long-term into the future. However, the degree of effects to habitat availability, distribution and survival and reproduction are anticipated to be within the adaptive capacity and resilience limits of barren-ground caribou.

Reductions in quality habitats due to the sensory disturbance from development may result in a decrease in the carrying capacity in the RSA, which was qualitatively assessed for barren-ground caribou. Direct habitat and indirect loss from the Project and previous and existing developments (Application Case) removed 0.2% of quality habitat in the RSA. The cumulative direct disturbance from the Project and all previous, existing, and reasonably foreseeable future developments is predicted to be 0.2% but only affect poor quality habitat. When human activities are present, caribou are known to alter their behaviour to avoid disturbed landscapes. Initially, the response of caribou to roads is avoidance, but over time it is possible that they may become habituated to the presence of roads and traffic (Haskell and Ballard 2008; Johnson and Russell 2014).

The cumulative effects of fragmentation on barren-ground caribou across the RSA is expected from the conservative approach to the analyses that included overestimated (i.e., buffered) footprint areas and irreversible effects from human disturbance features (Section 4.5). Changes to habitat fragmentation from the Base Case to the RFD Case are expected to be negligible given the relatively low amount of development disturbance in the RSA. However, burned areas are considered unsuitable for barren-ground caribou for 40 to 50 years (Thomas et al. 1998; Joly et al. 2007), and wildfire is the dominant but temporary form of habitat loss in the RSA. Fragmentation effects have less influence than direct habitat loss when there is a large proportion of undisturbed habitat on the landscape (Fahrig 1997, 2003; Andrén 1999; Flather and Bevers 2002; Swift and Hannon 2010), which is apparent across the RSA. Barren-ground caribou are predicted to be resilient to these small changes in physical habitat loss from development, and there should be a negligible effect on distribution or connectivity across the RSA.

The cumulative negative effects are predicted to lower the barren-ground caribou survival and reproduction. Per the previous discussion, changes to habitat loss and distribution are expected to be within the resilience limits

To Table of Contents

and adaptive capacity of barren-ground caribou and so, are not predicted to significantly influence survival and reproduction. Cumulative effects to survival and reproduction from vehicle strikes and improved access are predicted to be negative, of low magnitude and regional. The predominant factors that contribute to road-related wildlife deaths are visibility, traffic volume and vehicle speed (EBA 2001). These factors directly affect the success of an animal reaching the opposite side of the road. An increase in volume or speed and reduction in visibility reduces the probability of an animal crossing safely (Underhill and Angold 2000). Barren-ground caribou are mobile and can avoid interactions with active areas, such as roads (Vistnes and Nellemann 2001; Johnson and Russell 2014). The risk of vehicle strikes is continuous and permanent for all-season roads but strikes may not be frequent enough to influence survival at the population scale. This is because barren-ground caribou are likely only exposed to risk of strikes in winter when herd sizes are large enough that their distribution overlaps where the Project and winter roads occur during operation (PR#28). Therefore, this effect is possible but predicted not to have a strong influence on caribou survival or reproduction.

All-Season roads may improve access and increase harvest of barren-ground caribou, which will reduce survival and productivity, in the RFD Case. Collared caribou data from the Bluenose East and Bathurst herds since the mid-1990s indicate these herds tend to winter much further north of the RSA. Hunters may use the Project and existing Gamètì and Wekweètì winter roads to reach these areas as at Base Case (PR#7). Harvest of barren-ground caribou will be dependent on their presence, which is likely to be a function of habitat quality and distribution and herd size. Both of these herds are currently much less abundant than in the early 1990s when they were available for harvest in the RSA (PR#28; Section 5.2.10; Adamczewski et al. 2009). Range size is positively correlated to herd size in response to more selective use of resources, which may yield shifted and smaller seasonal ranges and is consistent with density-dependent resource selection (McLoughlin et al. 2006). Recent analysis on Bathurst collared caribou during the Dominion Diamond Ekati Corporation Jay Project environmental assessment found that individuals that ultimately wintered in the boreal forest were arriving later in the year as herd size declined (DDEC 2015), although not all caribou wintered below the treeline. As well, recent analysis of winter range selection indicates preference by this herd to winter above the treeline (Golder 2016). While the Bathurst herd currently has extreme harvest restrictions due to its significant vulnerability state, the Bluenose East herd has a regulated harvest. Thus, improved access provided by the Project and Gamètì and Wekweètì winter roads may result in increased harvest when the herds are much more abundant and closer to the Gamètì and Wekweètì winter roads but also at a time when the herd is more resilient to harvest (i.e., when more abundant). There is uncertainty about how long Gamètì and Wekweètì winter roads may be economically viable due to warming from climate change. Therefore, this effect is possible but predicted not to have a strong influence on caribou survival or reproduction.

If climate change results in more frequent and severe fires in the NWT, winter habitat availability may decrease and lead to declines in recruitment. Climate change is also expected to increase the frequency and intensity of wildfires and enable certain plant species to expand their ranges northward. As fires increase and plants move north, moose and wolves may also increase their northern distribution, which may negatively affect caribou populations and distributions (Sharma et al. 2009). Traditional Knowledge also contends that fire frequency and intensity affects caribou numbers and distribution (Kendrick et al. 2005). As such, changes to the habitat availability and distribution in the winter range of the Bathurst caribou herd are difficult to predict. Adding to the unpredictability of effects is the knowledge that caribou have behavioural plasticity to shift seasonal ranges to adapt to changes in range conditions (Messier et al. 1988; Ferguson and Messier 2000; Tyler 2010, Gustine et al. 2014). In addition

To Table of Contents

to habitat availability and distribution, climate change may also reduce the operational time of Gamètì and Wekweètì winter roads which will reduce access to barren-ground caribou.

Although future development is uncertain, the NICO Project, and the Nailii Hydroelectric Project are reasonably foreseeable projects (Section 4.4.3) that could affect caribou abundance, distribution, and population connectivity by decreasing habitat availability and distribution, and survival and reproduction. If developed, the NICO Project all-season access road will remove caribou habitat and may influence animal movements and increase mortality from vehicle strikes or increased harvest within Bathurst winter range outside of the RSA. However, this road will overlap with an existing trail north of Whatì, which barren-ground caribou may already avoid. It is assumed that these developments will be required to have wildlife management plans that identify mitigation for these types of effects. The Nailii Hydroelectric Project is also an uncertain, future run-of-river 2 MW hydro facility connected to Whatì to reduce their dependency on diesel generated power. It will include a transmission line to the existing Snare Hydro Complex to distribute power to Behchokǫ̀ and Yellowknife. Expansion of the hydroelectric grid could change caribou habitat use and distribution if animals avoid or restrict movements near the transmission lines (Vistnes and Nelleman 2008; Vistnes et al. 2008; Tyler et al. 2014).

Overall, the weight of evidence from the analysis of the primary pathways predicts that incremental and cumulative changes to measurement indicators from the Project and other developments should have no significant adverse effect on self-sustaining and ecologically effective barren-ground caribou populations. The confidence in this prediction is higher for the Application Case than the RFD Case. Extending the assessment into the future (RFD Case) decreases confidence in effects predictions, which is largely due to the uncertainty in the actual timing (e.g., amount of overlap in time with the Project and existing developments), location and size of developments, and the variability inherent in making long-term predictions in ecological systems. The present structure and inputs of habitat models may not be applicable to future environments and caribou behavioural responses and population characteristics, which increases the uncertainty in cumulative effects from physical habitat loss and sensory disturbance on habitat availability and distribution. Still, confidence in the predictions for the RFD Case is based on the consistent low effect sizes (i.e., magnitudes of change) that were determined from the incremental and cumulative changes from the Project and other developments for habitat availability and distribution. Although each development likely influences the local movement and distribution of caribou, there is no strong mechanism causing an adverse and long-term or permanent change in population survival and reproduction rates.

To Table of Contents

Table 4.6-3: Summary of Residual Effects Classification and Predicted Significance of Cumulative Effects on Barren-ground Caribou in the RFD Case

Indicator	Characteristic	Rating/Effect Size	Significance Determination
Habitat availability	Direction	Negative	Not significant
	Magnitude	■ Direct and indirect loss of 264 ha (0.2%) of undisturbed habitat in the RSA range from Base Case to RFD Case. ■ Reduced habitat quality and possible avoidance in the RSA from sensory disturbance from construction through closure. ■ Reduction in carrying capacity from northern contraction of forest winter habitat due to climate change. ■ Magnitude will depend on the influences from climate change.	
	Geographic Extent	Beyond regional (due to climate change)	
	Duration/Reversibility	■ Long-term (direct loss to habitats and sensory disturbance from non-road developments) ■ Permanent (direct loss to habitats and sensory disturbance alterations from all-season roads and climate change)	
	Frequency/Timing	Continuous	
	Likelihood	■ Certain (direct loss) ■ Probable (sensory disturbance) ■ Possible (climate change)	
Habitat distribution	Direction	Negative	
	Magnitude	■ Small reduction in movements among habitat patches due to the Project and RFDs ■ Reduced forest patch size, diversity, and distribution due to climate change	
	Geographic Extent	Beyond Regional (due to climate change)	
	Duration/Reversibility	■ Long-term (direct loss to habitats and sensory disturbance from non-road developments) ■ Permanent (alterations from all-season roads climate change)	
	Frequency/Timing	Continuous	
	Likelihood	■ Certain (direct loss) ■ Probable (sensory disturbance) ■ Possible (climate change)	
Survival and reproduction	Direction	Negative	
	Magnitude	Lower barren-ground caribou densities due to climate change	
	Geographic Extent	■ Beyond regional (from improved access due to roads and strikes) ■ Beyond regional (due to climate change)	
	Duration/Reversibility	■ Long-term (direct loss habitats and sensory disturbance and roads) ■ Permanent (alterations from climate change)	
	Frequency/Timing	Continuous	
	Likelihood	■ Certain (direct loss) ■ Possible (sensory disturbance) ■ Probable (vehicle strikes and improved access) ■ Possible (climate change)	

To Table of Contents

Table 4.6-5: Summary of Residual Effects Classification and Predicted Significance of Cumulative Effects on Wolverine in the RFD Case (continued)

Indicator	Characteristic	Rating/Effect Size	Significance Determination
Habitat distribution	Direction	Negative	
	Magnitude	■ Small reduction in movements among habitat patches due to the Project and RFDs ■ Reduced forest patch size, diversity, and distribution due to climate change	
	Geographic Extent	Beyond regional (due to climate change)	
	Duration/Reversibility	■ Long-term (direct loss to habitats and sensory disturbance) ■ Permanent (alterations from all-season roads and climate change)	
	Frequency/Timing	Continuous	
	Likelihood	■ Certain (direct loss) ■ Probable (sensory disturbance) ■ Possible (climate change)	
Survival and reproduction	Direction	Negative	
	Magnitude	Lower wolverine densities due to climate change	
	Geographic Extent	Beyond regional (due to climate change)	
	Duration/Reversibility	■ Long-term (direct loss habitats and sensory disturbance) ■ Permanent (alterations from climate change)	
	Frequency/Timing	Continuous	
	Likelihood	■ Certain (direct loss) ■ Possible (sensory disturbance) ■ Probable (vehicle strikes and improved access) ■ Possible (climate change)	

4.7 Monitoring and Follow-up

Monitoring activities are described in the Wildlife Management and Monitoring Plan (WMMP, PR#7). The WMMP is a draft version and amendments to remove, modify or add mitigation policies and practices, and monitoring activities may be incorporated during the EA review process. The WMMP will be finalized during the regulatory process. A summary of the conceptual monitoring activities relevant to the protection of wildlife and wildlife habitat are described below:

- The Environmental Monitor will monitor the Project during construction for incidental sensitive features (e.g., sensitive wildlife habitat) that have not previously been identified on or near the Project footprint. In the event that a sensitive feature is suspected, then GNWT-ENR will be consulted to determine next steps (e.g., suspension of activities, set-back distances).
- Environmental Monitors will be present during construction to observe wildlife and wildlife mitigation, alter mitigation as required or implement new mitigation and report findings to the Supervisor daily. Environmental Monitors will respond to wildlife-human conflicts including wildlife-vehicle and wildlife-construction interactions and support the management of such interactions. Environmental Monitors will liaise with the appropriate regulatory authorities should unique circumstances arise.
- Project staff will also be required to report wildlife when observed.

To Table of Contents

- Erosion and sedimentation control measures will be monitored to avoid and minimize sediment mobilization from disturbed areas to drainages, wetlands or watercourses.
- Soil topsoil piles and the ROW will be monitored for invasive species such as weeds. If invasive species are identified within the ROW, a response plan will be prepared.
- Reclamation concerns would be monitored and managed, and include soil erosion, re-vegetation and slope stability.
- In March 2017, ENR deployed 20 collars on boreal caribou in Wek'èezhìı that will be used to monitor boreal caribou movements and habitat use in response to the TASR. Details will be provided in an updated WMMP.

Monitoring information will be collected, reported and evaluated daily and weekly during construction as outlined in Figure 1 of the WMMP (PR#7). These time scales will allow management actions to be adjusted based on adaptive management principals and minimize impacts to wildlife and wildlife habitat. A summary report that provides impact predictions, monitoring results and mitigation effectiveness will be prepared and disseminated per permitting or licensing requirements. The report will also discuss the results of adaptive management including when mitigation was determined to be effective and no new management action was required. Finally, options for moving the GNWT-ENR check station to a new location to continue monitoring harvest of caribou and wildlife activity will be explored. The results of this monitoring will reduce uncertainty related to effects to harvest from improved access due to the Project.

To Table of Contents

5.0 ASSESSMENT OF SOCIO-ECONOMIC EFFECTS

5.1 Introduction

5.1.1 Purpose and Scope

The Tłı̨chǫ All-Season Road, once operational, represents a change in year-round access between the community of Whatì and other communities, most notably Behchokǫ̀ and Yellowknife. Scoping studies with the community of Whatì (PR# 7, Appendix B) have identified a number of potential Project benefits, as well as concerns regarding potential adverse effects. The change in access brought about by the Project is expected to bring about benefits for residents of the community, improving year-round access to goods, services and harvesting areas, and alleviating seasonal isolation. Changed access also, however, could bring about potentially adverse effects on the community such as greater access to illegal or controlled substances, erosion of traditional culture, and road safety challenges. The Whatì Inter-Agency Committee have been meeting since 2013 to undertake "community readiness" activities to limit the potential for adverse Project effects, while maximizing potential benefits. The socio-economic impact assessment (SEIA) identifies potential Project effects on social, economic, and cultural aspects of communities, proposes mitigations to address adverse effects and benefit enhancement measures to maximize positive effects, and determines the residual effect of the Project on communities. The SEIA is focused largely on the community of Whatì, and is scoped to focus on those issues deemed most important by the community's residents, and by the Tłı̨chǫ.

5.1.2 Valued Components

Valued socio-economic components (VSECs) are defined as features of the socio-economic environment that are important to people's wellbeing and quality of life. For a socio-economic feature to qualify as "valued" for purposes of SEIA, it must be known (or be reasonably expected) to occur in a project's area of influence. There must be a reasonable expectation that the feature could be meaningfully affected by a project, and people must articulate that value is in fact assigned to the feature.

A list of VSECs and topics for the Project SEIA was provided in the TOR (PR#9) based on community scoping meetings (Whatì, August 18, 2016; Yellowknife, August 24, 2016), comments and developer responses from the Wek'èezhìı Land and Water Board Online Review System, the developer's PDR (PR#7), ongoing consultation, and other information from MVEIRB's Public Registry.

VSECs and their associated indicators identified for purposes of this SEIA are listed in Table 5.1-1 in the order of presentation in the assessment of effects sections. The VSECs and measurement indicators are not organized to reflect relative importance to communities, but rather are organized in an effort to provide a narrative framework of cause and effect relationships that does not require excessive length, cross-referencing or repetition.

To Table of Contents

Table 5.1-1: Valued Socio-Economic Components, Topics and Indicators

VSEC	Topic	Indicator
Economic Wellbeing	Employment and Economy	Employment and incomes
		Training
		Business development
		Gross Domestic Product and government revenues[(a)]
	Traditional and Non-Wage Economy	Time for traditional activities
		Traditional harvesting and country food consumption
Stable and Healthy Communities	Population Sustainability	Out-migration, population mobility
		In-migration, population composition
	Use and Maintenance of Infrastructure	Housing
		Utilities
	Community Cohesion	Connecting families, alleviating isolation
		Outsiders coming in
		Social pressures[(b)]
	Public Safety	Road safety
		Protective, emergency and social services
	Equity and Vulnerability	Food Security
		Cost of Living
		Vulnerability
Traditional Use, Cultural and Heritage Resources	Traditional Use and Way of Life	Practice of traditional activities and culture
		Quantity or quality of traditionally harvested resources
		Perception of the land by traditional users
	Harvesting	Competition for resources
	Heritage and Cultural Resources	Archaeological sites
		Culturally significant areas

a) Gross Domestic Product and government revenues, while not identified in the MVEIRB Adequacy Statement (2016), have been included to reflect the existing work that has been conducted in relation to the Project's potential economic effects.

b) "Social Pressures (PR#7, Appendix B)" is defined as a number of concerns raised in consultations such as teen pregnancies, sexually transmitted infections, absentee parenting, drug and alcohol use and crime.

With regard to Table 5.1-1, elements not specifically identified here as VSECs are not unimportant. On the contrary, all elements of economic, social and cultural life integrate and contribute to overall individual, family and community quality of life. Most are subsumed (and will be discussed) within broader VSECs. Further, the diversity of human experience and the range of responses to a project have the result that every component of the socio-economic environment is important to at least some people. A significant effect on a component valued by even a limited number of individuals or families can be important to consider. In addition, there are a number of themes that cut across more than one VSEC; themes that are considered but are not easily framed as discrete VSECs. These include, as examples, gender, self-reliance, vulnerability to change, and sustainability.

In order to fully discuss the potential for the Project to influence the vulnerability of those most sensitive, the assessment must first determine the potential effects that could increase vulnerability, including changes to both economic and social conditions. As a result, while vulnerability was identified as a topic within the "Economic Wellbeing" VSEC by the TOR for the Project, for the purpose of this assessment it is addressed as a topic within the "Stable and Healthy Communities VSEC". The assessment of the Project's effects on vulnerability builds on the assessment of other Project effects to the economic and social situation in Whatì.

population of 800, relative to the current population of just over 500 (PR#98 TG IR 9.3). According to MACA, the water treatment plant is assessed to be in good condition and has the ability to increase its production. It is also possible to build storage tanks for treated water if needed. The solid waste site also has available area to construct new cells. These are normal upgrades that the community is able to handle within their capital planning and MACA staff are available to help.

5.2.7 Public Safety

Public safety in Whatì is the responsibility of the CGW and the RCMP. The Whatì RCMP detachment has two full-time officers, and delivers policing services in accordance with the Territorial Police Services Agreement between the GNWT and the federal Department of Public Safety. The GNWT funds 70% of policing services. The Minister of Justice can identify and recommend to the RCMP "G" Division the annual objectives, priorities and goals of the Territorial Police Service, and can determine the level of policing services provided (GNWT 2017).

The CGW deals with emergency response services within the boundaries of the Whatì municipality. Community governments are not mandated to provide ground ambulance or highway rescue services to residents. Although there are no formal rescue vehicles in the community, there is an active search and rescue group in Whatì, which is comprised of volunteers. Volunteers are personnel from public works and members of the Canadian Rangers (a sub-component of the Canadian Armed Forces). The Canadian Rangers have been doing training in the community of Whatì and occasionally train and provide support outside of community boundaries. Large investment would be required to establish such a search and rescue service due to the cost of equipment, maintenance and regular training. As well, search and rescue does not provide training for extraction or advanced medical responses such as Emergency Medical Technicians.

Currently, road safety issues associated with operation of the winter road are low. There have only been seven collisions on the Whatì winter road in the period of 1989 to 2016, none of which resulted in fatalities. Average Daily Traffic at the Whatì junction on the Tłı̨chǫ Winter Road System is presented in Table 5.2-3. Traffic on the winter road is spread throughout its operational period, with incidental spikes occurring at varying periods, depending on the year.

Table 5.2-3: Average Daily Traffic on the Whatì Winter Road

Year	Month				Average
	Jan	Feb	March	April	
2016	0	38	41	60	46
2015	87	38	54	51	39
2014	62	73	57	48	54
2013	66	7	114	97	47

Source: PR#96 TG IR 9.

Note: This table presents data for traffic entering/leaving Whatì. The low traffic volume in February 2013 is likely attributed to a traffic counter malfunction. As there is no traffic counter at the Whatì junction, ADT for Whatì was extrapolated using the other traffic counters available in the area.

5.2.8 Traditional and Non-Wage Economy

In terms of subsistence value, both general community knowledge and GNWT-collected statistics illustrate the high importance of the traditional economy to Tłı̨chǫ citizens. Tłı̨chǫ identify that the subsistence economy (and mixed economy such as trapping for pelt sales or personal use) plays a multitude of roles, including promoting the following Tłı̨chǫ values:

To Table of Contents

- developing functional skills and key Tłįchǫ personality traits (e.g., patience, acute observation, adaptability)
- self-sufficiency and pride therein
- insurance against fluctuations in the wage economy, and the high cost of store-bought foods, especially for food security
- strengthening cultural identity and continuity, practicing the same mode of life as prior generations and passing that on to future generations
- inter-generational relations, especially between Elders and youth
- getting out on the land as often as possible, which promotes physical and mental health
- healthy eating
- promoting TK of animals, their habitat, and the Tłįchǫ cultural landscape
- creating spiritual relationships with animals and the natural world
- having “eyes on the land” and identifying changes that need to be reported to decision-makers
- communal sharing of food, which strengths family and community bonds
- sharing knowledge, cultural practices and ceremonies, among other values (PR#7, Appendix B)

Until recently, the land-based traditional economy was the entire source of livelihood for the Tłįchǫ. Today, Tłįchǫ communities are still amongst the most reliant on country foods of any Aboriginal groups in the NWT. In 2013, over 90% of Tłįchǫ households consumed fish or meat obtained from hunting and fishing (PR#96 TG IR 1; GNWTBS 2013b). The consumption of country food is an especially important aspect of the cultural life in Whatì, and helps to provide food security for residents. Nearly 60% of households in Whatì reported that country food accounted for at least half or more of their diet in 2014 (GNWTBS 2015). This is slightly higher than the community of Behchokǫ̀ (58.9%), but notably lower than the communities of Gamètì (82.0%) and Wekweètì (88.6%). In 2014, 55.4% of Whatì residents hunted and fished, a higher percentage than what was reported in Behchokǫ̀ (40.5%) and Gamètì (52.9%), but lower than Wekweètì (73.8%). Transportation costs make it difficult to obtain fresh food at the local store year round (PR#7, Appendix B p. 14).

Some community members have observed and commented on a loss of community values and an increase in individualistic thinking, exemplified by less sharing of resources in the community. Some members of the community have the perception that “the environment is no longer viewed as communal food storage and is now seen as a pool used to fill freezers and individual food supplies” (PR#7, Appendix B).

The Tłįchǫ traditional economy extends beyond the direct participation in hunting, trapping and gathering activities. Traditional household economy also involves the preparation, cooking and distribution of country foods, activities carried out by men, women and children. While not represented in official statistics, these activities are key to sustaining Tłįchǫ traditional economy.

To Table of Contents

5.2.9 Traditional Use and Way of Life

The traditional way of life is considered to be invaluable to the Tłįchǫ, as it promotes key Tłįchǫ values, strengthens cultural identity, promotes TK of animals and their habitats, the Tłįchǫ cultural landscape, the sharing of traditional foods, knowledge and cultural practices (PR#73 IR 4.1). Tłįchǫ communities are amongst the most reliant on country foods of any Aboriginal groups in the NWT, and in 2013, over 90% of Tłįchǫ households were eating meat or fish obtained from hunting and fishing (PR#96 TG IR 4.1; GNWTBS 2013). The Whatì community in particular maintains strong ties to culture, traditional way of life and language, and have higher participation rates in traditional activities compared to both the Tłįchǫ and NWT averages (PR#7, Appendix B; PR#96 TG IR 4.1).

The Tłįchǫ have been using the Project area since time immemorial and the region is still used extensively for traditional and cultural activities (PR#28; PR#7, Appendix B). The TK study results indicated several hunting, trapping, fishing and culturally important sites such as travel routes, cabins, camp sites, grave sites, and sacred sites that overlap with the Project footprint and wider region (PR#28 Maps 4 and 5).

The Métis have deep ancestral connections to the local landscape, and traditional use of the land is a fundamental part of their Aboriginal well-being and way of life (PR#98 NSMA IR). NSMA members have been practicing traditional and cultural activities in the region north of Great Slave Lake historically and in recent years, and the Project area is currently used for hunting, trapping, fishing and other cultural and traditional purposes (PR#98 NSMA IR).

The traditional territory (Chief Drygeese Territory) of the Yellowknives Dene First Nation (YKDFN) extends south of the Project, and they have a long history of traditional use of the area, including harvesting and the existence of a number of culturally significant sites (PR#24). The Deh Gah Got'ie First Nations (DGGFN) also have treaty rights near the Project area (PR#60).

5.2.10 Harvesting

The Tłįchǫ Elders' knowledge of the land and wildlife derives from their intimate relationship of living off of the land, and hunting, trapping, and travelling to different areas throughout the year to harvest specific resources. Tsotìdeè (La Martre River) and its many small lakes are of central importance for traditional activities such as fishing, hunting and trapping. Fishing is conducted year round, and during the spring and summer of each year, large numbers of people camp on the islands of Tsotìdeè and set fishnets to prepare dry fish for the coming season. Bòts'ıtı̀ (Boyer Lake), southeast of Whatì, is also considered a good fishing location.

Trapping during the spring and summer occurs by boat or canoe where ponds and lakes are accessed to trap muskrat and beavers, and during the winter trapping occurs by snowmobile for furbearers such as marten, lynx, and wolverine. During the winter, trappers follow the numerous trails from Whatì and Behchokǫ̀ through the forest by snowmobile. To facilitate travel between lakes in the forested landscape, trails and portages are cut in the forest. K'àgòò tıl̨ ıı̀(the Old Airport Road), is used as a snowmobile trail during the winter to access the numerous lakes on both east and west sides of the trail, and traplines are run on small trails for about one kilometre off each side of K'àgòò tıl̨ ıı. Trappers hunt and fish for food while they are on the trapline using fish nets on lakes or under the ice. The Lakes K'ıshıt̀ ı̀ (Lac Levis) and Łıetı̀ are considered good fishing locations.

The interconnected trail system extends through the Project area (Map 5 PR#28). Traplines have been set from Whatì and Behchokǫ̀ all the way to Edeèzhıì (Horn Plateau). During the winter, trappers from Whatì generally use the following areas: (1) east from Whatì along Bòts'ıtı̀ and Tsotìdeè towards ʔehtł'ètì (James Lake), following

To Table of Contents

Màa tilì; (2) south along the water system from Bòts'ıtı̀ (Boyer Lake) to ʔehtł'ètıt̀ soa and to Tsigaàtı̀, and further south to Weghałaàtǫǫdaàtı (see Map 5 PR#28); and (3) south along K'àgòò tıl̨ ıı̀ where traplines are run on both east and west sides of the trail. Harvesters from Whatì trap about halfway down K'àgòò tıl̨ ıı. The Horn Plateau area has also been used by other Aboriginal communities (e.g., Deh Gah Got'ie First Nation).

The southern part of the K'àgòò tıl̨ ıı̀, from Tsigaàtì to Highway 3, and the surrounding area are utilized mostly by trappers from Behchokǫ̀ (see Map 5 PR#28). A cabin built by Joe Migwi, which was located along K'àgòò tıl̨ ıı̀ a few kilometres west of Highway 3, served as a strategic base and landmark for trappers and hunters; however, this cabin was destroyed during forest fires in 2014 and is no longer being utilized. The family of Joe Migwi is re-building the cabin.

The main trapping areas for the trappers from Behchokǫ̀ generally are: (1) from ʔehtł'ètı̀ (James Lake) to Tsigaàtı̀, to Weghałaàtǫǫdaàtı̀ and further southwest to K'ıshıt̀ ı̀ (Lac Levis); and (2) the trails from the southwest shore of ʔıı̨ dak'ètı̀ (Marian Lake) following the numerous lakes and ponds to Joe Migwi's cabin site on K'àgòò tıl̨ ıı̀. From Joe Migwi's cabin site, the traplines follow K'àgòò tıl̨ ıı̀north to ʔehtł'ètıd̀ ee (James River). Several traplines have been made going both eastward and westward from K'àgòò tıl̨ ıı̀, to numerous smaller lakes and ponds (see Map 5 PR#28). Traplines run west from the K'àgòò tıl̨ ıı̀ to Weghałaàtǫǫdaàtı̀, and from the K'àgòò tıl̨ ıı̀ to Łıetı̀. These are important as the trails connect with other trails in a westward direction towards K'àyetìdeè (Horn River) and Edeèzhıì (Horn Plateau).

Spring is considered the main trapping season for beaver and muskrat, and trappers use smaller canoes to portage more easily and access smaller lakes and ponds. Tsotìdeè (La Martre River) is a popular area for beaver and muskrat trapping, along the entire length from Whatì to ʔıı̨dak'ètı̀ (Marian Lake). The area around Bòts'ıtı̀ (Boyer Lake) is also an important habitat for beavers and muskrat. A short portage south from Tsotìdeè leads trappers to ʔehtł'ètıt̀ soa and ʔehtł'ètıd̀ aà (see Map 5 PR#28). Subsequent portages lead the trappers to ʔehtł'ètıt̀ so and to Tsigaàtı̀ and Tsigaàtıd̀eè. This entire water system is considered beaver and muskrat habitat and harvesters trap along these shores every year. From ʔehtł'ètı (James Lake), trappers follow the numerous small lakes and the ʔehtł'ètıd̀ eè (James River) towards Tsigaàtı. The area located southwest of Joe Migwi's cabin site used to be an important trapping area for beaver and muskrat during the spring. The numerous lakes and ponds around Łıetı̀ have been preferable trapping locations.

Tłı̨chǫ hunt for moose, woodland caribou, and barren-ground caribou in the Project area (see Map 5 PR#28). Barren-ground caribou migrate through the Project area on their annual migration route from the barren lands to their winter habitat in the forest. They feed in the forest during the winter before heading northward in March and April to the calving grounds on the barren lands. Tłı̨chǫ Elders stated that barren-ground caribou frequently used the area in the past, but they have not been observed in recent years which they attributed to increased development on the barren lands and on the wintering grounds. Barren-ground caribou were primarily hunted at Bòts'ıtı (Boyer Lake), and from Tsotìdeè (La Martre River) along the trail past Ts'otıt̀ so to ʔehtł'ètı (James Lake).Woodland caribou move throughout the entire Project area, but their main habitat is considered in the centre of the Project area, and mainly west of K'àgòò tıl̨ ıı̀ (the Old Airport Road). The areas south of Bòts'ıtı̀ (Boyer Lake) around the Lake Ethletitso and the smaller lakes west of Tsigatii towards Whatì are identified as key woodland caribou habitat, and is primarily where hunters travel to hunt them.

Moose can be found anywhere on the land, but prefer areas along shallow lakes. Moose use key habitat located east of ʔehtł'ètıt̀soa toward ʔehtł'ètıd̀eè, and the south side of Whatì where they share the same habitat as

woodland caribou (see Map 6 PR#28). Moose are hunted around the shore of Bòts'ıtı̀ (Boyer Lake) and along both sides of Tsotìdeè (La Martre River), where hunters use boats along the shorelines of lakes and rivers to search for moose in the fall.

Moose and caribou are harvested by NSMA, and caribou remains the principle item in their diet and a secure source of food (PR#99 NSMA IR). Bluenose East caribou are harvested based on a limited number of tags that are allocated by the GNWT, and the harvest of Bathurst caribou is currently not permitted until the population recovers. NSMA members are concerned about the Project potentially leading to declines in caribou health and abundance, particularly of the Bluenose East herd, which would adversely affect their connections to the land and community, and traditional and cultural values. Other concerns raised are related to adverse effects on the environment, particularly cumulative effects on caribou.

The YKDFN have a long history of harvesting in the Project area. YKDFN members have indicated concerns about the Project creating barriers to movement for barren-ground caribou, woodland caribou, bison and moose, which could potentially affect their long-term ability to engage in traditional practices (PR#24). The DGGFN also have treaty rights near the Project area and commonly hunt the same caribou as Tłı̨chǫ in the Horn Plateau area (PR#60).

5.2.11 Heritage and Cultural Resources

Tsotìdeè (La Martre River) is the main entry point to the entire area southeast of the community and runs eastward towards Ɂıı̨dak'ètı̀(Marian Lake) (PR#28). The river is considered integral to the traditional economy in terms of its cultural and economic significance. It provides several important resources and a secure source of food, and is the primary transportation route connecting to other Tłı̨chǫ communities and to other important land use areas. The river and its many small lakes are used extensively by Tłı̨chǫ during the summer as a canoe/boat route, and for hunting, trapping, fishing, and camping, and during the winter as a snowmobile route for trapping.

The river is accessed at T'oohdeèhoteè, an important portage site used during the summer and winter, and located where the existing route of K'àgòò tıl̨ıì̀ crosses Tsotìdeè (see Map 3 PR#28). People often camp at this portage when traveling on the river. Both sides of the portage at T'oohdeèhoteè are considered important fishing areas where grayling, suckers, and whitefish are fished, primarily during the summer and fall. The proposed Project route crosses the Tsotìdeè at T'oohdeèhoteè, where a bridge will be built to cross the river west of the portage.

The Nàıl̨ı̨ ̨waterfalls and the lake above the falls are considered sacred sites that are treated with great respect. Their cultural significance lies in the historical accounts of a battle at Whatì between the Chipewyan and the Tłı̨chǫ, and the ensuing pursuit ending at Nàıl̨ı̨. The Nàıl̨ı̨ ̨waterfalls are located east of the proposed Project.

Ewaashì is a culturally sensitive site located adjacent to the proposed Project route (see Map 4 PR#28). The site is considered sensitive because Elders and harvesters are unsure of the nature of the site and the type of beings or spirits that might dwell there. The appropriate protocol is to leave the site alone which avoids potentially disturbing the place. The Elders from Behchokǫ̀ identified Kweyì ı̨goèʔàa Wets'àts'ìdì as a culturally sensitive site meaning "cave tunnel" and "pay respect to", and is located approximately 40 km south of Edzo on Highway 3. Six grave sites were identified to the west of the Project, including two north of Tsotìdeè, one on the west side of Ɂehtł'ètıt̀ so, one by the portage between Ɂehtł'ètıt̀soa and Ɂehtł'ètıd̀aà, and two unidentified graves south of Ɂehtł'ètıd̀aà (see Map 4 PR#28) The gravesites are located between approximately 2.5 km and 10 km from the Project footprint. The Elders stated that grave sites are considered an important link for the Tłı̨chǫ to their land and are most often located by open water and rivers.

To Table of Contents

The Tłı̨chǫ have travelled through the Project area extensively, as evidenced by the numerous overland trails and water routes extending through the region. Several travel routes intersect with the Project footprint (see Map 4 PR#28).

The ʔelà etò is a canoe/boat route that travels east from Whatì along Tsotìdeè, to Marian River. It is used extensively by the Tłı̨chǫ during the summer who hunt and fish by boat. During the winter, Màa tıl̨ ıı̀ is a highly used snowmobile route for travellers between Whatì and Behchokǫ̀, and by trappers and hunters. The proposed Project route predominantly follows the route of an old overland military road, defined by Tłı̨chǫ Elders as K'àgòò tı̨lìı̀, meaning tractor trail, and referred to as the Old Airport Road. The trail is extensively used by Tłı̨chǫ as a snowmobile and ATV route that connects with numerous other trails intersecting it from east-west. The Campbell trail is also defined as a tractor trail, and travels from Whatì to ʔehtł'èt̀ı in an easterly direction. Whaàhdòò etò is an Ancestors' trail that travels from the southwest shore of Marian Lake to Joe Migwi's cabin site on K'àgòò tıl̨ ıı̀, and further southwest towards Łıetı̀, as an Whaàhdòòetò.

YKDFN members have indicated concerns about potential effects of the Project on important cultural and archaeological sites (PR#24).

5.3 Pathways Analysis

Pathway analysis is a screening step that is used to determine the existence and magnitude of linkages from the initial list of potential Project effects. This screening step is largely a qualitative assessment, and is intended to focus the effects analysis on pathways that require a more comprehensive assessment of effects on VSECs. Pathways are determined to be primary, secondary, or as having no linkage, following the methods described in Section 2.0.

It is generally accepted that a project will impact people and communities differently. While benefits can be expected (e.g., employment, business development, incomes), they may not be realized by all individuals, families or communities. Further, some may experience adverse project effects in the context of overall net socio-economic benefits. Mitigation can attempt to address adverse Project effects, and benefit enhancement measures can seek to maximize project benefits for a wider group of people, however the extent to which both are effective is not always apparent or measurable. This is in contrast to adverse biophysical Project effects, which are most often mitigated into insignificance through engineering design, good practice policies and management and other means. The approach to SEIA is thus more qualitative and nuanced than for biophysical assessment. In coming to conclusions, including describing pathways, there is necessarily a high dependence on engagement results and comparable experiences (in this case, with other roads). Considerable engagement has been carried out for the Project to date, including an issues scoping exercise (PR#7, Appendix B), and has yielded a number of pathways of potential effect.

Many socio-economic effects are difficult to predict and measure. For example, changes related to community cohesion and resiliency are difficult to measure without development of measurable and reliable indicators. Community cohesion is typically assessed qualitatively or through community member interviews and perception checking. Further, for some socio-economic features that *can* be measured, there may be no acceptable amount of change that would allow for a ranking of low, moderate or high in terms of significance. There is no acceptable (or manageable) level of increase in violent crime, for example. All socio-economic pathways determined to have a linkage to the Project are considered to be 'primary', regardless of whether the change is indirect or direct or whether it is felt by some or many. In this regard, the SEIA does not identify 'secondary' pathways of effect.

To Table of Contents

Some potential pathways, while important to address as they related to public concern over perceived effects, are not expected to materialize, or will have a weak linkage to the Project not resulting in a beyond-negligible effect. Where the assessment of potential effects (Section 5.4) finds this to be the case, the pathway is not carried forward for residual effects assessment.

A summary of socio-economic pathways is provided in Table 5.3-1, and further assessment of the effects of primary pathways is provided in Section 5.5 Residual Effects Analysis.

To Table of Contents

Table 5.3-1: Socio-Economic Pathways of Effect

VSEC	Topic	Indicator	Project Component / Activity	Potential Effects Pathway	Mitigation and Benefit Enhancement Measures
Economic Wellbeing	Employment and Economy	Employment opportunities	■ Construction – Two to Four year Period; ■ Operations – Year-round Maintenance	Project construction and operations would generate employment opportunities and associated incomes	**Tłı̨chǫ Government Benefit Enhancement** ■ Mobilization of the Economic Development Officers in communities to prepare the workforce for employment opportunities (Mitigation 4 of PR#96, Appendix D Motion 2015-018). ■ Development of a training strategy by the Tłı̨chǫ Regional Economic Development Working Group (TREDWG), in conjunction with Aurora College and the Mine Training Society, that identifies available skilled labour for construction employment opportunities in each of the communities (PR#96 TG IR 1). ■ To avoid inequitable distribution of employment to regional or migrant labour forces, the TREDWG has identified that the local labour force required for construction is available (PR#96 TG IR 1). ■ Planning for employment and local opportunity catchment is expected to reduce a surge in the required out-of-territory labour force during construction, reducing the potential for in-migration into the region. (PR#96 TG IR 1). **GNWT Benefit Enhancement** GNWT provided support in the form of funding and expertise to the Tłı̨chǫ Government to develop the Tłı̨chǫ Regional Economic Development and Training Strategy and assists with economic development and employment for the Tłı̨chǫ communities including Whatì.
		Training opportunities	Construction	Project construction could drive the uptake of ongoing training opportunities in the region by those seeking employment	**Tłı̨chǫ Government Benefit Enhancement** ■ Development of a training strategy by the TREDWG, in conjunction with Aurora College and the Mine Training Society, that identifies available skilled labour for construction employment opportunities in each of the communities (PR#96 TG IR 1). ■ The TREDWG will receive $10 million dollars over four years for Employment and Social Development Canada. This Training and Economic Development Strategy includes three Heavy Equipment Operators (HEO) training courses through Aurora College. This is a 9-week training program which costs approximately $400,000 to $425,000 to deliver. These HEO courses can be delivered in Behchokǫ̀ and Whatì, in the new fiscal year with Aboriginal Skills and Employment Training Strategy (ASETS) funding, partnered with the contractor. ■ The Tłı̨chǫ Government delivered a Commercial Camp Cook course (2014) at the Tłı̨chǫ Learning and Development Centre ($320,000 delivery costs) and 11 people graduated from that course. Over 12 weeks, students were taught how to prepare food for a large group of people, in a service camp setting (PR#96 TG IR 1). **GNWT Benefit Enhancement** ■ **In Partnership with the Mine Training Society, a two-week** Heavy Equipment Operator course was delivered by the GNWT Department of Municipal and Community Affairs in Whatì in July 2016. Training also included a three-week Safety Boot Camp delivered by Mine Training Society staff that provided the trainees with seven safety certifications that will assist them in obtaining employment with this Project (GNWT 2017). ■ ECE continues to partner with the Tłı̨chǫ Government in the implementation of the Tłı̨chǫ Regional Economic Development and Training Strategy, and community action plans. These identify priorities and actions that target specific training needs and help to fill those gaps. ■ There are Community Learning Centres in Behchokǫ̀, Gamètì, Whatì and Wekweètì. There are also Community Adult Educators in those communities who deliver Adult Literacy and Basic Education, and Literacy and Essential Skills courses.
		Business Development	Operations – Year-round Access to and from Whatì	Project operations could enhance opportunity for year-round tourism activities in the region	**Tłı̨chǫ Government Benefit Enhancement Measure** The Tłı̨chǫ Government currently maintains Economic Development Officers in the communities who assist Tłı̨chǫ residents in establishing their own businesses and building business acumen, and who focuses on local economic development issues (Mitigation 4 of PR#96, Appendix D Motion 2015-018). **GNWT Benefit Enhancement Measure** ■ Project construction and operations will be funded through the P3 procurement process, and so will be exempt from the GNWT Business Incentive Policy requirements. However, the GNWT will include conditions in bid contracts that include a requirement for Tłı̨chǫ and Northern hires. Contractors should demonstrate how local labour and businesses will be sourced, plans to provide and maximize on-the-job training for local residents, and an approach to communicating and collaborating with local governments and Aboriginal organizations regarding local involvement in construction and operations. ■ In the event that incidental Project activities are funded extra to the P3 process, the GNWT Business Incentive Policy will be applied, as appropriate.
			■ Construction – Two to Four year Period; ■ Operations – Year-round Maintenance	Project construction and operations could support existing local business, and could facilitate the development of new businesses in Whatì	
			Operations – Year-round Access to Whatì	Project operations could change the nature or viability of some existing local businesses	
		GDP and Government Revenues	■ Construction – Two to Four year Period; ■ Operations – Year-round Maintenance	Project construction and operation could contribute to GDP and to government revenues from taxation	Positive Pathway - No mitigation required, no practical benefit enhancement measures identified

To Table of Contents

Table 5.3-1: Socio-Economic Pathways of Effect (continued)

VSEC	Topic	Indicator	Project Component / Activity	Potential Effects Pathway	Mitigation and Benefit Enhancement Measures
Stable and Healthy Communities / Economic Wellbeing	Employment and Economy	Time for traditional activities	■ Construction – Two to Four Year Period; ■ Operations – Year-round Maintenance and Year-round Access to and from Whatì	Project construction and operations could change the time available for participation in the traditional economy	**Tłı̨chǫ Government Mitigation** ■ The Tłı̨chǫ Government will continue to manage cabin construction on Tłı̨chǫ lands. ■ To ensure effective management, the Tłı̨chǫ Government will investigate the need for regulations and policies to manage the construction of cabins and design of hunting, trapping, and fishing in the area, in order to minimize impacts on local animal populations. The Tłı̨chǫ Government will work to provide clear guidance on this topic. (Mitigation 10 of PR#96, Appendix D Motion 2015-018). **GNWT Mitigation** ■ GNWT-ENR will enforce the NWT's hunting regulations which are in place to ensure that wildlife is conserved for future generations and that hunting is done safely. ■ GNWT Department of Lands conducted a land use scoping study of the WRMA with an aim to establish land use guidelines in the WRMA (PR#7; GNWT 2017). ■ The GNWT, in collaboration with the Tłı̨chǫ Government and other planning partners, is in the process of working towards the development of a land use plan for public lands in the Wek'èezhìı Management Area.
		Traditional harvesting and country food consumption	Operations – Year-round Access to and from Whatì	Project operations could change the role of the traditional economy in the economic wellbeing of Whatì residents	
	Population Sustainability	Out-migration, population stability	Operations – Year-round Access to and from Whatì	Project operations could help to stabilize the existing Whatì population by removing the need to out-migrate for employment, or for better access to services	Positive Pathway - No mitigation required, no practical benefit enhancement measures identified
		In-migration, population composition	Operations – Year-round Access to and from Whatì	Project operations and associated economic growth could result in in-migration to Whatì	**Tłı̨chǫ Government Mitigation** Annual coordination between the Councils of Whatì and Behchokǫ̀ to ensure that any changes and impacts are being collectively considered, addressed and managed (Mitigation 13 of PR#96, Appendix D Motion 2015-018).
	Use and Maintenance of Infrastructure	Housing and Utilities	Operations – Year-round Access to and from Whatì	Project operations and associated in-migration could place additional demand on community services, housing and utilities in Whatì	**Tłı̨chǫ Government and GNWT Shared Mitigation** ■ A Local Housing Organization has been established in Whatì to assess ongoing housing stock and condition and a Tłı̨chǫ Government and GNWT housing working group has been established to identify and implement actions to address housing issues in Tłı̨chǫ communities. Current limitations to building more housing units include available skilled labour and trades, high costs of bringing in trades, high costs of building materials, and seasonality of accessing building materials. ■ Sewage is trucked, and an increase in population could be managed. The sewage ponds are currently being expanded and repaired and by 2019 will be able to service a population of 800 (PR#96 TG IR 9). The water treatment facility can accommodate a population of 800. Maximum water use according to the water licences for Whatì (W2007L3-0002) and Behchokǫ̀ (W2014L3-0002) are 30,000 m^3 and 300,000 m^3, respectively.
			Construction – demand generated by camp facilities	Project construction could place additional demand on waste disposal and utility infrastructure in Whatì	
	Community Cohesion	Connecting families, alleviating isolation	Operations - Year-Round Access to and from Whatì	Project operations could spread seasonal movements in and out of Whatì over a longer period, avoiding the "pulse" facilitated by winter road operation	Positive Pathway - No mitigation required, no practical benefit enhancement measures identified
			Operations – Year-round Access to and from Whatì	Project operations and associated access to and from Whatì could connect families and alleviate isolation	

To Table of Contents

Table 5.3-1: Socio-Economic Pathways of Effect (continued)

VSEC	Topic	Indicator	Project Component / Activity	Potential Effects Pathway	Mitigation and Benefit Enhancement Measures
Stable and Healthy Communities	Community Cohesion	Outsiders coming in	Operations – Year-round Access to and from Whatì	Project operations could increase the presence of outsiders in the community year-round, potentially creating a sense of reduced safety, security and community	**Tłı̨chǫ Government Mitigation** ■ The Community Government of Whatì is investigating a Community Bylaw Officer position to strengthen community security. This is an issue that needs to be addressed jointly by the Tłı̨chǫ Government and the Community Government of Whatì, as well as other supportive agencies. The Community Government of Whatì intends to increase by-law enforcement for the first year of operation (Mitigation 1 of PR#96, Appendix D Motion 2015-018). ■ Continuation of the Whatì Inter-Agency Committee[3]. The Whatì Inter-Agency Committee responds to issues related to community preparedness. Issues such as emergency response, social programs, and the community & lands concerns are all brought to this forum. Reasonable discussions about costs, liabilities and insurance will need to be addressed at this forum (Mitigation 6 of PR#96, Appendix D Motion 2015-018). ■ There is a need for locally agreed-upon goals and plans for Community Well-Being. The Whatì Inter-Agency Committee should develop a small set of community based goals of resilience. As an example: A number of local gardens, and the support of a community garden, could be an example, with goals set for 2020 and 2025. The Community Government of Whatì committed to forming a small set of community goals during the 2015 Strategic Planning process (March 6 & 7), and then monitoring progress towards goals over-time (Mitigation 9 of PR#96, Appendix D Motion 2015-018). ■ Annual coordination between the Councils of Whatì and Behchokǫ̀ to ensure that any changes and impacts are being collectively considered, addressed and managed (Mitigation 13 of PR#96, Appendix D Motion 2015-018). ■ The Whatì community emergency plan was updated in 2016, and an Emergency Management Bylaw (147-16) was passed by the Whatì council to address ongoing emergency preparedness (PR#96 TG IR 8.4). ■ To incorporate on-the-land treatment for substance abusers that incorporates guidance from Elders, it is recommended that the Nishi Program be introduced, subject to funding sources. **GNWT Mitigation** ■ The TCSA commits to providing more information for local health nurses on a range of health issues, such as sexually transmitted infections, among other issues (Mitigation 12 of PR#96, Appendix D Motion 2015-018). ■ The TCSA has a Social Worker and Mental Health Worker. Neither would actually monitor or keep track of people, but are used more as a means of responding to issues. For example, the social worker would not monitor children, but would respond if someone phoned regarding a child protection matter. ■ The TCSA will be participating in the Healthy Living Fairs in each community in order to provide community specific information and education to all community members. These fairs increase awareness of common infections, diseases and illnesses, and promote a healthy lifestyle. ■ Substance abuse and bootlegging have been identified as a priority by the community of Whatì in their Policing Priorities Action Plan the last two years. By continuing to include these as priorities in both the Whatì Policing Priorities Action Plan and the Community Justice Committee priorities, the Department of Justice Community Justice and Policing division and the RCMP can continue to focus efforts on providing education and awareness around these issues. One such example in 2016 was a community feast during Addictions Awareness Week organized by the Whatì Community Justice Committee with assistance from local RCMP Members (GNWT 2017). ■ In collaboration with the RCMP, each NWT community identifies its annual Policing Priorities and develops an Action Plan based on its priorities, taking into account the financial and human resources available. Working together on an Action Plan enhances communications between partners and increases the level of commitment towards achieving local goals. Communities benefit from this process by being active partners and having a direct role in making their community a safer place to live. If concerns with resourcing are raised, then the RCMP will work with the community to address the issue. ■ The RCMP will conduct patrols and check stops and will inspect vehicles for illegal substances if they have reasonable grounds to do so (PR#7, Table 8-8), and will work to address community-reported bootlegging and trafficking. ■ The GNWT has a number of initiatives in place for the prevention of family violence, including “What Will it Take?”, a territorial-level social marketing campaign aimed at changing attitudes and beliefs about family violence. As part of the campaign, a four-part Rant Series has been developed. The fourth rant, entitled “It’s a Community Issue” is planned to feature members of Tłı̨chǫ communities. The focus of this fourth rant in the series is on dispelling the myth that family violence is a private matter. People in the community often know when violence is happening and have the right to intervene safely and make a positive difference. ■ The GNWT also has services in place to help victims of family violence, such as the ability to apply for an emergency protection order “24/7”, community-based Victim Services, and funding to support victims of family violence (PR#7, Table 8-8; GNWT 2017). ■ There are no shelters in the Tłı̨chǫ region, however the TCSA and the GNWT are engaging with the communities to create community specific family violence protocols and response teams. This is done via a contribution agreement between the Department of Health and Social Services and the TCSA to cover the costs associated with community engagement and development of the protocols by a consultant. . ■ RCMP “G” Division has a Family Violence Coordinator position that monitors high risk files, provides training and support to Members responding to family violence situations, and represents the RCMP on family violence committees (PR#7, Table 8-8).
		Social Pressures	Operations – Year-round Access to and from Whatì	Project operations could increase access to drugs and alcohol, both in Whatì and for those travelling to other communities, exacerbating social pressures	
				Project operation and associated social pressures exacerbated by access to drugs and alcohol could increase demand for policing and social services	

[3] The Whatì Inter-agency Committee includes Aurora College, the GNWT-DOT, NWT Housing, the CGW, the Mezi School, Fortune Minerals, Air Tindi, the TCSA, MACA, the RCMP, the Tłı̨chǫ Government, the GNWT Department of Education, Culture and Employment, and the Tłı̨chǫ Investment Coprporation (PR#96 TG IR 3.3A).

To Table of Contents

Table 5.3-1: Socio-Economic Pathways of Effect (continued)

VSEC	Topic	Indicator	Project Component / Activity	Potential Effects Pathway	Mitigation and Benefit Enhancement Measures
Stable and Healthy Communities	Public Safety	Road safety	Construction – Two to Four year Period	Project construction could increase demand for emergency services in response to construction accidents	**Tłı̨chǫ Government Mitigation** ■ Investigate, with Northwest Tel, areas of no cellular coverage along the road with an aim to increase cell coverage to the full TASR, allowing for emergency communication in the event of an accident. ■ The CGW will continue public education locally to ensure that travellers of the road report when they depart, and when they arrive to track road users in the event of inclement weather (PR#96 TG IR 2.3). ■ The CGW is investigating the establishment of a Community Bylaw Officer to support policing efforts during Project operations to mitigate activities that could result in accidents or emergencies along the road. **GNWT Mitigation** Speed limits aimed at maintaining safe driving speeds for vehicles.
			Operations – Year-round Access to and from Whatì	Project operations could introduce the potential for year-round risk of traffic accidents for those travelling to and from Whatì	
			Operations – Year-round Access to and from Whatì	Project operations could reduce the potential risk of traffic accidents relative to the current winter road, spreading the otherwise temporally concentrated traffic out over the year	
			Operations – Year-round Access to and from Whatì	Project operations could reduce the potential for non-traffic related accidents associated with unstable winter road conditions during seasonal transition periods	
		Protective, emergency and social services	Operations – Year-round Access to and from Whatì	Project operations could improve the efficiency of search and rescue efforts	
			Operations – Year-round Access to and from Whatì	Project operations could reduce the seasonal demand for response services associated with winter road operations and enhance year-round emergency response services	
	Equity and Vulnerability	Food Security	Operations – Year-round Access to and from Whatì	Project operations could improve food security through enhanced year-round access to groceries	Positive Pathways - No mitigation required, no practical benefit enhancement measures identified
		Cost of Living	Operations – Year-round Access to and from Whatì	Project operations could change the cost of living for residents of Whatì	
		Vulnerability	Operations – Year-round Access to and from Whatì	Project operations could influence the vulnerability of those most sensitive to economic pressures	
			Operations – Year-round Access to and from Whatì	Project operations could influence the vulnerability of Youth	**Tłı̨chǫ Government Mitigation** ■ Continuation of the Whatì Inter-Agency Committee. The Inter-Agency Committee responds to issues related to community preparedness. Issues such as emergency response, social programs, and the community & lands concerns are all brought to this forum. Reasonable discussions about costs, liabilities and insurance will need to be addressed at this forum. (Mitigation 6 of PR#96, Appendix D Motion 2015-018). ■ Annual coordination between the Councils of Whatì and Behchokǫ̀ to ensure that any changes and impacts are being collectively considered, addressed and managed (Mitigation 13 of PR#96, Appendix D Motion 2015-018).
			Operations – Year-round Access to and from Whatì	Project construction and operations could influence the vulnerability of Young Women	
			Operations – Year-round Access to and from Whatì	Project operations could influence the vulnerability of Elders	

To Table of Contents

Table 5.3-1: Socio-Economic Pathways of Effect (continued)

VSEC	Topic	Indicator	Project Component / Activity	Potential Effects Pathway	Mitigation and Benefit Enhancement Measures
Traditional Use, Cultural and Heritage Resources	Traditional Use and Way of Life	Practice of traditional activities and culture	Operations – Year-round Access to Traditional Lands	Enhanced year-round access to hunting, trapping and fishing areas for harvesters	Positive Pathway - No Mitigation Required
			Construction	Direct disturbance to preferred traditional use areas including culturally significant areas	■ The current layout of the Project footprint will minimize the amount of new disturbance by primarily following an existing trail and intersecting areas previously burned. ■ Disturbance will be minimized by limiting the Proposed TASR corridor to 60 m wide not including the borrow sites and access corridors. ■ Disturbance by the Project will be minimized, such as, by locating construction camps and laydown areas within borrow sites and the ROW. ■ The mitigation strategies recommended by Lands' *Northern Land Use Guidelines* will be considered, which includes best practices for avoiding, minimizing and rehabilitation of impacts to vegetation and topography **GNWT Mitigation** ■ Bridges will mitigate effects to navigability of waterways ■ Suitable road crossings, pullouts and signage should be installed at access points of winter snowmobile trails, or summer ATV trails that intersect the TASR, to ensure that travel is not impeded (PR#28; PR#7).
			Operations – Year-round Access to Traditional Lands	Increased mobility and time spent away from the community may result in changes to traditional way of life and culture	**Tłı̨chǫ Government Mitigation** ■ Continuation of the Whatì Inter-Agency Committee. The Whatì Inter-Agency Committee responds to issues related to community preparedness. Issues such as emergency response, social programs, and the community & lands concerns are all brought to this forum. Reasonable discussions about costs, liabilities and insurance will need to be addressed at this forum (Mitigation 6 of PR#96, Appendix D Motion 2015-018). ■ Annual coordination between the Councils of Whatì and Behchokǫ̀ to ensure that any changes and impacts are being collectively considered, addressed and managed (Mitigation 13 of PR#96, Appendix D Motion 2015-018). ■ Maintain the K-12 language program in Whatì to encourage retention of traditional language. ■ Explore the possibility of having a medium for youth to express themselves and communicate in Tłı̨chǫ (e.g., radio show, video programming)
		Quantity or quality of traditionally harvested resources	Operations – Year-round Access to Traditional Lands	Effects to wildlife and fish resulting in changes in the availability of traditional resources for harvesting	Refer to mitigations identified for effects to wildlife and fish.
		Perception of the land by traditional users	Operations – Year-round Access to Traditional Lands	Effects to wildlife and fish resulting in changed traditional perceptions of the land	No practical mitigation
	Harvesting	Competition for resources	Operations – Year-round Access to Traditional Lands	Increased access and use of the region may result in increased harvesting pressure on wildlife and fish by outside harvesters	**Tłı̨chǫ Government Mitigation** ■ The Tłı̨chǫ Government will continue to manage cabin construction on Tłı̨chǫ lands ■ To ensure effective management, the Tłı̨chǫ Government will investigate the need for regulations and policies to manage the construction of cabins and design of hunting, trapping, and fishing in the area, in order to minimize impacts on local animal populations. The Tłı̨chǫ Government will work to provide clear guidance on this topic. (Mitigation 10 of PR#96, Appendix D Motion 2015-018). **GNWT Mitigation** ■ GNWT-ENR will enforce the NWT's hunting regulations which are in place to ensure that wildlife is conserved for future generations and that hunting is done safely. ■ GNWT Department of Lands conducted a land use scoping study of the WRMA with an aim to establish land use guidelines in the WRMA (PR#7; GNWT 2017). ■ The GNWT, in collaboration with the Tłı̨chǫ Government and other planning partners, is in the process of working towards the development of a land use plan for public lands in the Wek'èezhìı Management Area. **Tłı̨chǫ Government and GNWT Mitigation** The Tłı̨chǫ Government has the authority and jurisdiction to write laws, develop its own strategies, and maintain a balance between subsistence harvesting and industrial development on its lands (see the Tłı̨chǫ Agreement and Tłı̨chǫ Land Use Plan). The Tłı̨chǫ Government will work with the GNWT to review the mitigations that are developed and considered for managing harvesting impacts that occur as a result of the new all-season access of the TASR. (PR#96 IR 4.3, page 69)
	Heritage and Cultural Resources	Archaeological sites	■ Construction – Two to Four year Period; ■ Operations – Year-round Maintenance and Use	Construction activities and operational maintenance and use of the Project could result in disturbances to archaeological sites	**GNWT Mitigation** Implement the Archaeological Site Find Protocol to provide guidance to employees and contractors conducting ground disturbing operations
		Culturally significant areas	■ Construction – Two to Four year Period; ■ Operations – Year-round Maintenance and Use	Construction activities and operational maintenance and use of the Project could result in disturbances to culturally significant areas	**Tłı̨chǫ Government Mitigation** The Tłı̨chǫ Government and/or the CGW will erect signage to prevent damage to culturally significant areas (such as the La Martre Falls)

economic modelling of the Project's fiscal effects, and will evolve as Project construction and operations planning advance.

Employment income generated by direct and indirect Project construction and operations employment will be taxed. So too will incomes earned by businesses directly supporting Project construction, and those that are formed indirectly in response to increased tourism facilitated by the Project. This taxation will result in increased government revenues. The Tłı̨chǫ Government (PR#96 TG IR 6) anticipates that the increase in government revenues associated with the Project, along with the reduced annual capital cost relative to the construction and operation of the winter road, may offset some of the costs associated with mitigating the Project's potential adverse effects, and enhancing benefits to communities.

While the Project has the potential to reduce GDP during operations, taxation is expected to offset potential changes to government revenues. The Project is, therefore, expected to have a positive overall effect on government revenues. This effect is anticipated to be negligible, however, relative to other revenue sources, and so has not been carried forward for residual effects assessment.

5.4.1.2 Traditional and Non-wage Economy

Determining the Project's effect on the economic wellbeing of the people of Whatì as a result of changes to the traditional economy is complex. The Tłı̨chǫ Government and the GNWT do not calculate the value of the traditional economy in dollars. To do so is culturally unacceptable and efforts to commodify the traditional economy have been largely invalidated by policy makers, Elders, knowledge holders and the academic community[4]. It is illusory and contradictory to the intent of the Tłı̨chǫ Agreement, as well as core Tłı̨chǫ cultural values, to try to translate the Tłı̨chǫ way of life on the land to an economic value. The assessment of the Project's potential effect on the traditional, non-wage economy as related to economic wellbeing focuses, therefore, on changes to the reliance on traditional resources to offset cost of living and provide country foods. Further discussion regarding the Project's potential effects on competition for traditional resources harvested as part of the traditional economy is provided in Section 5.4.3 Traditional Use, Culture and Heritage.

- *Project construction and operations could change the time available for participation in the traditional economy.*

Participation in construction employment may require Tłı̨chǫ workers to be away from their home community for extended on-rotation periods of time, potentially impacting their time available to participate in traditional hunting, fishing and trapping activities. Construction activities will not be continuous, and will be staggered depending on the stage of road construction. Despite these points, reduced time available for participation in traditional activities by the Project's construction workforce could result in a lower amount of country foods present in Tłı̨chǫ communities. Further, less time spent undertaking traditional activities with younger generations can impact the transmission of TK and hinder the development of skills required to hunt in the future. This in turn could increase reliance on store-bought foods and could potentially impact food security for those more reliant on country foods such as Elders (discussed further in Section 5.4.2.5).

[4] Non-exclusive examples from this literature include: Brody 1981; Kuokkanen 2011; Natcher 2009, Usher et al. 2003.

To Table of Contents

Operations employment is expected to be limited to six to eight maintenance positions. Those employed for ongoing Project maintenance would not work on a rotational basis, and so would not be taken away from their community. Project operation is not expected to result in a change in the time available for workers to participate in traditional harvesting or fishing activities, relative to any other form of wage employment.

Given that the potential for a reduced amount of time to participate in traditional activities during Project construction is, from an economic wellbeing perspective, offset to an extent by enhanced access to goods from outside markets, no beyond-negligible residual effect to the economic wellbeing of the residents of Whatì is anticipated. This pathway has not been carried forward for residual effects assessment. Further discussion of the potential for and nature of the residual effect of less time for participation in traditional activities, relative to traditional use and culture, is provided in Section 5.4.3 and 5.5.3.

- *Project operations could change the role of the traditional economy in the economic wellbeing of Whatì residents.*

The traditional economy plays an important role in the economic wellbeing of residents of Whatì, acting to offset cost of living by providing country foods as an alternative to store-bought groceries. The Project is expected to increase access to traditional harvesting and fishing areas around Whatì for other non-resident users, potentially placing increased pressure on and competition for traditional resources. This in turn could reduce the availability of country foods for home consumption, and increase reliance on store-bought foods to supplement diets. Further, enhanced access to groceries from outside the community year-round could reduce the reliance on country foods in Whatì residents' diets.

To avoid or otherwise mitigate the potential loss of animals, reduced harvesting success, increased costs of food or change in diet, the Tłı̨chǫ Government will continue to manage cabin construction on Tłı̨chǫ lands. To ensure effective management, the Tłı̨chǫ Government will also investigate the need for regulations and policies to manage the construction of cabins and hunting, trapping, and fishing activities in the area, in order to minimize impacts on local animal populations. One of the priorities identified in the GNWT Recreational Leasing Management Framework (RLMF) is to engage in a dialogue with Aboriginal governments about respectful and effective ways to identify and manage rights-based cabins (GNWT 2017).

The Tłı̨chǫ Government has the authority and jurisdiction to write laws, develop its own strategies, and maintain a balance between subsistence harvesting and industrial development on its lands (see the Tłı̨chǫ Agreement and Tłı̨chǫ Land Use Plan). The Tłı̨chǫ Government will work with the GNWT to review the mitigations that are developed and considered for managing harvesting impacts that occur as a result of the new all-season access of the Project. The Project's effect of increasing access to groceries year-round, and the associated potential for decreased reliance on country foods is predicted to change the role of the traditional economy in the day to day lives of the residents of Whatì. The extent to which this occurs will depend on the response of individuals and households to this enhanced access, and choices around dietary composition. Country food consumption, while potentially reduced, is not expected to be eliminated from the diet of Whatì residents, and will continue to be an important source of nutrition.

The link between the Project and the role of country foods in the economic wellbeing of residents of Whatì is considered to be weak, and no residual effect of a beyond-negligible magnitude is anticipated. This pathway has not been carried forward for residual effects assessment.

of the dangers associated with hitchhiking, the risk still remains. Attempting to assess the magnitude of this risk is inappropriate, as it cannot be assumed that abductions will or will not happen simply for the purpose of effects assessment. Rather, this assessment acknowledges the introduction of this risk to the vulnerability of young women during Project operations.

- *Project operations could influence the vulnerability of Elders.*

Elders have suggested that the largest risks posed by Project operations are associated with the potential for lack of support from younger generations, and decreased food security (PR#7, Appendix B).

Community members have suggested that the Project could, as discussed above, result in a “ghost town” effect in the event that people leave the community, particularly on the weekends, and that this could leave many vulnerable Elders unsupported (PR#7, Appendix B). It is felt that fewer people would be available to bring Elders fire wood and country foods, or to assist with day to day chores and care. Elders expressed concern that, with increased year-round access to and from the community, there won’t be young people around to help them (PR#7, Appendix B). If entire families choose to leave the community for extended visits elsewhere during the months when the winter road would otherwise be non-operational, this could result in a loss of communication with Elders, affecting the connection of younger generations with their cultural roots (PR#96 TG IR 3).

Protecting Elders has been identified as one of the highest priorities for the community of Whatì in response to development, including the Project (PR#7, Appendix B). Scoping studies in support of the Project suggest that economic marginalization of Elders is already a recognized issue in the community. There are strong concerns amongst some Elders that they could be particularly vulnerable should the Project result in increased inflation, cost of living, or a reduction in the availability of country foods to offset the cost of groceries. Further, Elders have expressed concern that they will also not be able to benefit from the economic and employment opportunities associated with Project construction and operations, and so cannot offset the adverse effects of economic growth.

While the Project is not expected to result in increased inflation, and will actually have a positive effect on the cost of living in Whatì , there remains the potential Project effect of a decreased reliance on the traditional economy for the provision of country foods offsetting the cost of store bought foods. While this can be a neutral effect for many, for Elders relying on country foods provided by relatives for sustenance, a reduction in the availability of country foods in the community due to less time or need for participation in traditional harvesting could jeopardize their food security. While some may have their diets supplemented by store-bought food provided by family members, those without support could still be at risk. While Old Age Security and Guaranteed Income Supplement payments are made to senior Elders over the age of 65, and can offset this risk to some extent, there are those under this age that are still highly dependent on country foods.

5.4.3 Traditional Use, Culture and Heritage Resources

5.4.3.1 Traditional Use and Way of Life

Effects on Traditional Use, Culture and Heritage Resources include both direct and indirect effects. For the purposes of this assessment, direct effects are related to changes in access to traditional use areas, including culturally significant sites (e.g., spiritual, grave sites), or disturbance to land that would result in the land no longer being available for traditional activities. Direct effects also include direct disturbance (i.e., alteration, damage or destruction) to heritage or cultural resources.

To Table of Contents

Indirect effects are related to changes in the availability of traditional resources, such as wildlife and fish used by traditional harvesters. Indirect effects are therefore related to residual adverse effects on other aspects of the environment, such as changes in the quantity, or abundance and distribution of wildlife and fish resources, and changes in the quality of these resources. As a result, the assessment of Project effects on Traditional Use, Culture and Heritage Resources considers the results of effects assessments of VCs for Wildlife and Wildlife Habitat (Section 4.3) and for Fish and Fish Habitat (Section 3.3). For culturally significant areas, indirect effects include landscape disturbances reducing connection to the cultural landscape or specific traditional use sites based on changes in quality (e.g., noise, visual or dust disturbance). Indirect effects are also related to changes in traditional use or value of traditional use areas based on people's changed perceptions of the land or resources.

This assessment also considers the intangible aspects of Traditional Use, Culture and Heritage Resources, such as connection to land, transfer of TK, and continued practice of the Indigenous way of life on the land, which are important considerations for Indigenous people in the WRMA (PR#7). By enhancing access to traditional use areas, the Project plays a role in the connection of people, including youth, to their culture. The ability of the Project to reduce isolation is discussed further in Section 5.4.2.3 above.

- *Enhanced year-round access to hunting, trapping and fishing areas for harvesters.*

The Project is situated in an area that has been used by the Tłı̨chǫ since time immemorial and is still used extensively for traditional and cultural activities, as evidenced by the vast network of overland trails and water routes extending throughout the region (PR#28; PR#7 Appendix B). The TK study results indicated several hunting, trapping, fishing and berry picking areas, and culturally important sites such as travel routes, cabins, camp sites, grave sites, and sacred sites that overlap with the Project footprint and wider region (PR#28 Maps 4 and 5). NSMA members also indicated that the Project area is used for hunting, trapping and fishing and other traditional purposes (PR#98 NSMA IR).

The proposed road predominantly follows the old Airport Road, defined by Tłı̨chǫ Elders as K'àgòò tı̨lìì, meaning tractor trail, and is currently used by Tłı̨chǫ community members and other NWT residents via snowmobiles, dog sleds, ATVs and trucks in some parts (PR#7). The K'àgòò tı̨lìì is located in an important harvesting area itself and is used by harvesters to access other hunting and trapping areas, along numerous intersecting trails running east-west (PR#28). Whatì community members identified one of the potential benefits of an all-weather road as improved community access to the old military road area, potentially increasing Tłı̨chǫ hunting and trapping in the area (PR#7, Appendix B 2015). NSMA members stated that the TASR would considerably increase access to the numerous water routes that will be crossed by the TASR (PR#98 NSMA IR). These perceived benefits are supported by the results of the literature review on the impacts of all-weather-roads introduced in remote regions showing improved access to water resources, berries, hunting grounds, fishing holes, and trapping areas (PR#7, Appendix B). Operation of the TASR is expected to lead to increased use and facilitate access to the existing trail network used by Tłı̨chǫ and NSMA harvesters, and to preferred traditional use areas and potentially other new hunting, trapping and fishing areas in the region by opening new territory previously inaccessible most of the year. The opportunity to explore new land use areas is expected to promote increased participation in traditional activities among Tłı̨chǫ community members, particularly younger harvesters who are interested in expanding their understanding of the cultural landscape and in discovering new areas with valuable wildlife and fish harvesting opportunities over previously inaccessible areas (PR#97 IR 2).

To Table of Contents

- *Direct disturbance to preferred traditional use areas including culturally significant areas.*

Construction activities will result in direct disturbance to the land, which may result in areas no longer being available for traditional or cultural use. As previously described, the proposed TASR predominantly follows the Old Airport Road locally known as K'àgòò tı̨lìì, which is still used by Tłı̨chǫ and other NWT residents today, and therefore the alignment has remained disturbed (PR#7). The disturbance level along the route varies based on ease of access and terrain type. According to Tłı̨chǫ Elders, the route is considered a 'tractor trail' and is not considered as culturally significant as an Ancestor trail, which was built directly by Tłı̨chǫ Elders (PR#7). Direct disturbance to culturally important sites from Project construction activities is discussed in Section 5.4.3.3 (Heritage and cultural resources).

The Project will cross two major rivers considered culturally important to Tłı̨chǫ; Tsotìdeè (La Martre River) which is used extensively during the summer as a canoe/boat route and for hunting and fishing, and during the winter as a snowmobile route and for hunting and trapping, and the ʔehtł'èt̀ìdeè (James River), which is used for trapping during the summer and winter, and for fishing. Tsotìdeè (La Martre River) is accessed at T'oohdeehotee, an important portage site used during the summer and winter, and located where the existing route of K'àgòò tı̨lıìì crosses Tsotìdeè. The Elders stressed the importance of not disturbing this portage site, and ensuring that the Tsotìdeè (La Martre River) is unobstructed during construction to maintain access during the summer and winter (PR#28). The Project will be designed to avoid direct disturbance of Tsotìdeè (La Martre River) through the construction of a bridge approximately 240 metres northwest of T'oohdeèhoteè (PR#7). A bridge will also be constructed at ʔehtł'èt̀ìdeè (James River), therefore navigability of both river travel routes will be maintained (PR#7).

Spring and summer trapping areas for beaver and muskrat are not anticipated to be affected by the Project since most of these trails follow a north-south direction near Boyer and Mud Lakes and are located approximately 3.5 km from the Project footprint (PR#7). Spring and summer trapping also occurs along La Martre River into James Lake. The Project footprint crosses this trapping area near La Martre River portage site, where a bridge will be installed, therefore it is unlikely that this trapping area will be affected due to direct disturbance (PR#7).

Winter trapping for wolverine, marten and lynx occurs over a wide area, and several traditional use areas intersect with the Project footprint. Winter trapping areas identified in the TK study follow La Martre River and the Màa tı̨lıì trail into James Lake, and along the Campbell trail which intersects with the TASR near James River. Whaàhdòò etò, meaning Ancestor's trail, extends southwest from Marian Lake to Łıetı and intersects with the Project footprint at approximately KM 45.2 and continues west towards the Horn Plateau Fort Providence areas, and an Ancestor Trail travels from Behchokǫ̀ to Joe Migwi's cabin site (within the first 8 km of the proposed road) and continues westward (PR#7). Construction of the TASR is estimated to take between two to four years and will occur year-round, and different sections of the road will be constructed at varying times, depending on engineering and design components (PR#7). Construction activities should not affect access to winter trapping areas that intersect with the Project footprint, since snowmobiles will be able to travel around construction equipment. During operations, access along winter routes will be maintained with the installation of bridges over the La Martre River, James River and the Whaàhdòò etò trail (PR#7). Suitable road crossings, pullouts and signage should be installed at access points of other winter snowmobile trails, or summer ATV trails that intersect the TASR, to ensure that travel is not impeded (PR#28; PR#7). Safety concerns of vehicles on the TASR and users of the land will play a key role in the design and implementation of any access points during both construction and operation.

To Table of Contents

A minimal loss of moderate to high wolverine habitat will occur within the entire wolverine range; therefore, harvesters will still be able to access preferred trapping areas, since the majority of furbearer key habitat will remain available across the landscape (Section 4.4.2.4). Individual trappers who have active traplines in the area have already received compensation to relocate their traplines as a result of the impact of fires in recent years, therefore traplines intersecting with the Project are not expected to be affected by Project construction (PR#7).

Direct disturbance to preferred hunting areas for caribou and moose is expected to be low.

A limited amount of suitable barren-ground caribou and boreal caribou habitat will be lost within their entire ranges, and harvesters will still be able to access preferred hunting areas since the majority of caribou key habitat will remain available across the landscape (Section 4.3). Direct disturbance to preferred areas used for hunting will be minimized through mitigation that limits the amount of vegetation clearing disturbance during construction; this includes aligning the Project route along the existing trail and intersecting areas previously disturbed by fire (Section 4.4.2). Lac La Martre is not crossed by the Project footprint, and therefore will not be directly disturbed. Overall, with the implementation of mitigation measures, Project construction is not expected to result in a residual effect on preferred traditional use areas including culturally significant areas, due to direct disturbance.

- *Increased mobility and time spent away from the community may result in changes to traditional way of life and culture.*

The traditional economy is considered to be invaluable to the Tłı̨chǫ, and it continues to promote key Tłı̨chǫ values, including strengthening cultural identity and continuity (PR#96 TG IR 4.1). Data from the GNWT indicated that Tłı̨chǫ communities are amongst the most reliant on country foods of any Aboriginal groups in the NWT, and in 2013, over 90% of Tłı̨chǫ households were eating meat or fish obtained from hunting and fishing (PR#96 TG IR 4.1). The Whatì community in particular maintains strong ties to culture, traditional way of life and language, and have higher participation rates in traditional activities compared to both the Tłı̨chǫ and NWT averages (PR#7, Appendix B; PR#96 TG IR 4.1). However, a decline in traditional practices has been observed in recent years, especially among youth (PR#7, Appendix B). Whatì community members are concerned that the TASR will contribute to further declines in traditional way of life of community members, including hunting, trapping, fishing and cultural activities, and reduced reliance on country foods. Other important aspects of the traditional economy include, but are not limited to, the sharing of country foods, the transfer of TK between generations, and contributing to the continuation of the Tłı̨chǫ way of life (PR#96 TG IR 4.1). For further discussion of the traditional economy refer to Section 5.2.8 and 5.4.1.2.

Whatì community members indicated that some of the potential benefits of an all-season road included potential increased Tłı̨chǫ hunting and trapping in the old military road area because of enhanced access, and reduced pressure to stock up on resources in a short amount of time, therefore leaving adequate time to continue traditional harvesting practices throughout the winter season (PR#7, Appendix B). Conversely, community members are concerned that increased mobility and access to a wider region over an extended period will result in decreased use of traditional areas near the community. Harvesting is expected to still be practiced at preferred traditional land use sites near the community, but other areas located further away will also likely be used more frequently. Use of all of these areas will be extended over the year rather than condensed in a relatively short period over a few months, which may be perceived as both a benefit and risk. Although the new road will facilitate access to and potentially increased consumption of store-bought food, it is also expected to facilitate continued harvesting,

To Table of Contents

therefore access to traditional resources and country foods is expected to be maintained. There is uncertainty regarding how the Project will affect the reliance on country foods over time; however, maintaining access to traditional resources and healthy food options will be critical, given that the consumption of country foods is considered an especially important aspect of the cultural life and well-being in Whatì.

Results of the literature review conducted during the Scoping Study (PR#7, Appendix B) on effects of all-season roads introduced to remote regions included both positive and negative impacts on culture. Positive impacts included increased access to water resources, berries, hunting grounds, fishing holes, and trapping areas; increased options for practicing traditional activities; and increased means by which individuals and communities could occupy their traditional territory. Negative impacts were also identified, including losses of traditional practices and cultural values (PR#7, Appendix B). The community of Whatì is already vulnerable to the declining interest and practice of cultural activities and language skills among youth, and community members are concerned that these critical elements of well-being and cultural identity will be further threatened by a number of pressures should an all-weather road be developed (PR#7, Appendix B). For example, one community member stated that given the ease and speed of transit along the all-season-road, Tłı̨chǫ citizens may choose to use traditional land and water travel routes to important cultural sites less frequently (PR#7, Appendix B).

Although the Project will bring faster and easier travel by vehicle, it is located along a route that is already traditionally used by Tłı̨chǫ, and use of the area is expected to increase thereby fostering participation in traditional activities. Furthermore, the existing route is considered a main artery that provides access to several other traditional trails that can only be used by boat/canoe or ATVs during the summer and by snowmobile during the winter. The Project will allow these trails to be reached quicker, and the mode of travel used on traditional trails is expected to remain unchanged. The installation of roadside pullouts and snowmobile crossing structures and signs along the Project will facilitate the continued use of traditional trails (PR#97 IR 2; PR#7).

Youth are particularly concerned about keeping their culture alive and the transfer of TK and skills (PR#7, Appendix B). The TREDWG will continue to work with the youth in Whatì so they are provided with the opportunity to continue discussions and contribute to the development of appropriate mitigations (PR#7 Section 5.2.1.2). The Project will enhance connectivity between Whatì and Behchokǫ̀, which will facilitate more opportunities to participate in cultural activities such as hand game tournaments and drum dances (PR#96 Table 1-1). The CGW and Community Government of Behchokǫ̀ wish to proactively induce these benefits and have therefore committed to the annual coordination and planning (e.g., hand games or joint cultural events), between the councils of Whatì and Behchokǫ̀ and to ensure that any changes and impacts are being collectively considered, addressed and managed. There are several cultural programs that Whatì community members are currently engaged in that are considered a strength in the community and could potentially be enhanced, such as the trappers program and “on the land program” (PR#96 TG IR 1). Additionally, the continued development of traditional arts and crafts can be promoted with the establishment of a craft store and the anticipated increase in tourism from the Project. The maintenance of traditions and culture will help Tłı̨chǫ community members become more resilient to social and economic pressures (PR#96 TG IR 1).

The Project may have a negative effect on knowledge and use of Tłı̨chǫ language, as was observed in the community of Behchokǫ̀ following the development of a road (PR#96 TG IR 1) The Tłı̨chǫ Government and CGW will explore the possibility of having a medium for youth to express themselves and communicate in Tłı̨chǫ (e.g., radio show, video programming), and the K-12 language program will be maintained in Whatì to encourage retention of traditional language (PR#96). The Project may strengthen family ties by providing year-round access

To Table of Contents

between communities (PR#96 TG IR 1). Whatì has been relatively isolated from other communities for much of the year, and the road may facilitate the sharing of traditional foods, and traditional and cultural knowledge among family and community members (PR#7, Appendix B).

There is uncertainty in how the Project will affect traditional way of life and culture, and this assessment does not presume to determine how individuals will respond to change; rather it is acknowledged that Project operations could represent both benefits and risks to Tłı̨chǫ traditional way of life and culture. It is expected that proactive planning and ongoing communication with Tłı̨chǫ community members by the Tłı̨chǫ government will help to reduce perceived risks and address uncertainty about the potential effects of the Project on cultural identity and well-being, and that policies and programs will be developed to help manage and monitor the Project to reduce risks and maximize benefits (PR#7, Appendix B).

- *Effects to wildlife and fish resulting in changes in the availability of traditional resources for harvesting.*

Tłı̨chǫ Elders' knowledge of the land and resources derives from the intimate relationship of living on the land and the practice of hunting, trapping, fishing and travelling to different locations to harvest resources at each season of the year (PR#28). Tłı̨chǫ Elders emphasized that people live off the land and that the land provides for the people in terms of food, materials, and well-being (PR#28 pg. 38). Wildlife and fish resources are of critical importance to the Tłı̨chǫ, evidenced by the high number of people who rely on meat and fish obtained from hunting and fishing.

Results of the TK study indicated that Tłı̨chǫ Elders and harvesters are concerned about potential impacts of the Project on the animals they hunt and their habitat, and the subsequent adverse effects on hunters' ability to hunt in the area. Impacts to wildlife would affect both the local hunting economy and the cultural practices related to being on the land (PR#28 pg.37). Specific concerns raised were related to animals avoiding the area as a result of noise, dust, smells and pollution from road construction and continuous traffic on the road; the growth of new types of habitat near the road and introduction of new wildlife species (i.e., bison) resulting in avoidance of the area by woodland caribou and moose; changes in the abundance and migration routes of barren-ground caribou due to development; and increased difficulty hunting woodland caribou and moose, and bringing meat home to one's family. These concerns stem from uncertainty of the sustainability of the Tłı̨chǫ hunting and trapping economy and way of life, if wildlife populations were to decline or disappear from the area around K'àgòò tı̨lìì (PR#28). Additional concerns were raised about contamination of the environment from potential spills on the road, and the possibility of more development in wildlife habitat and preferred harvesting areas.

NSMA members emphasized that hunting and fishing have been and continue to be very important to their well-being and way of life. Moose and caribou are harvested, and the Bluenose East caribou herd provides an important food source (PR#98 NSMA IR). NSMA members are concerned that declines in caribou health and abundance, especially to the Bluenose East herd, would adversely affect their connections to the land and community, and traditional cultural values. Other concerns raised were related to adverse effects on the environment, particularly the cumulative effects on caribou.

YKDFN members expressed concerns about the Project on wildlife and their habitat, including barriers to wildlife movement, habitat loss for wintering barren-ground caribou, woodland caribou, bison and moose, and cumulative effects on caribou (PR#24).

To Table of Contents

The wildlife and wildlife habitat assessment (Section 4.4) assessed the potential effects of the Project on ungulates and furbearers, including changes in abundance and distribution, and therefore changes in the availability of resources for harvesting. Residual effects were determined for boreal caribou, barren-ground caribou, moose and wolverine. For the purposes of this assessment, effects to wolverine represent effects to other furbearers considered important for trapping, since it is considered an umbrella species with large habitat requirements and protecting this species indirectly protects other furbearers (Section 4.1.2).

Road construction and operations may affect the distribution of boreal and barren-ground caribou at the regional scale which may affect harvesting patterns. The implementation of mitigation measures, including preferential land clearing primarily during winter to avoid sensitive periods, limiting the amount of noise and lights during construction, reducing disturbance from dust within the ROW and enforcing speed limits will help to minimize the effects of sensory disturbance and barriers to movement (Section 4.3-1). Construction will be temporarily suspended when species at risk and barren-ground caribou are known to be within construction activities, and environmental monitors will be used to help identify the presence of caribou. Low traffic volumes and speeds will reduce the risk of vehicle collisions. Increased access and harvest by non-Tłı̨chǫ residents of both boreal caribou and barren-ground caribou may reduce survival and productivity at the regional scale, which is discussed in more detail in Section 4.4.2.1 and 4.4.2.2.

Under the direction of GNWT-ENR, caribou movement patterns will continue to be monitored in collaboration with Aboriginal government, co-management boards (such as the Wek'èezhìı Renewable Resources Board), caribou management boards and neighbouring jurisdictions. The GNWT will continue to monitor caribou and implement strategies as needed, as described in the Wildlife Management and Monitoring Plan (PR#7).

Similarly, changes in moose and wolverine movement and local distributions are expected during Project construction and operations, which may affect harvesting patterns. The majority of moderate and highly suitable moose habitat will remain abundant and well-connected across the landscape, and a reduction in moose populations is not expected at the regional scale (Section 4.4.2.3). Moose may be attracted to regenerating vegetation along the TASR, which may increase the interaction of moose with wolves, vehicles, and hunters, leading to increased mortality. Environmental Monitors will be present during construction, and the low speed limit and low predicted traffic volume on the road during operations will reduce the likelihood of a collision. Wolverines that avoid suitable habitat during construction due to temporary sensory disturbance are expected to reoccupy the habitat once the disturbance is removed (Section 4.4.2.4). Traffic volumes are not anticipated to be high enough during operations to affect the crossing rate across the TASR.

Tłı̨chǫ Elders stated that construction of a bridge across the Rivers Tsotìdeè (La Martre River) and ʔehtł'èdeè (James River) would not have any impact on fish populations as long as the rivers were untouched and the timing of construction avoided the peak migration periods of certain fish species to reduce the possibility of disturbance (PR#28). NSMA is interested in discussing mitigation measures that will improve the management of fisheries based on improved access to water routes, including to Lac La Martre (PR#98 NSMA IR).

The fish and fish habitat assessment (Section 3.4) assessed the potential effects of the Project on fish habitat availability and distribution and fish abundance. Bridges will be installed at four major crossings with high quality habitat, including Duport River, James River, La Martre River, and the unnamed watercourse at km 45.2 (crossing #9), which will minimize disturbance and maintain fish passage. Culverts will be designed and installed to allow fish movement and maintain water flow at other water crossings. The construction of crossings is expected

to result in minor and localized changes to fish abundance and distribution. In-water work will be timed to avoid sensitive life history periods or life stages to protect fish. During operation of the road, potential effects from dust and debris, and spills are expected to result in negligible changes to fish abundance and distribution with the effective implementation of best management practices and mitigation measures.

Given implementation of mitigation measures described in Section 3.4, there are no anticipated residual effects from construction activities, or from dust, debris and spills during operations on the maintenance of self-sustaining populations of Arctic Grayling, Lake Trout, Northern Pike, Walleye, and Whitefish species. However, there is the potential for the overexploitation of large-bodied fish populations due to improved road access, which may result in changes to the availability of fish for harvesting by Tłı̨chǫ residents. Changes in fish abundance and distribution due to increased harvesting pressure is discussed in Section 3.4.

There will be increased contamination risks through dust, spills, accidents and greater human presence on the TASR during construction and operations. The GNWT-ENR keeps precise records of the types of spills that occur on highways, and manages spill response using best management practices (PR#7). Approved dust suppression techniques will be utilized during construction to reduce areas impacted by dust during construction, and an approved spill contingency plan (PR#7, Appendix L) will be followed in the event of a spill.

The GNWT will be refining the draft WMMP, submitted with the PDR and expanding it to include a Wildlife Effects Monitoring Plan. The WMMP will identify the mitigations that will be implemented to address the potential impacts of the Project, and will demonstrate how potential impacts and the effectiveness of mitigation will be monitored. Should greater than expected adverse effects on wildlife occur, or more refined information be revealed, an adaptive management plan would be implemented. Additionally, GNWT-ENR has developed the NWT Boreal Caribou Recovery Strategy and is in the process of developing regional range plans to demonstrate how the requirements in the federal Recovery Strategy for the Woodland Caribou, Boreal population in Canada will be met in the NWT.

Furthermore, the Tłı̨chǫ Government has the authority and jurisdiction to write laws, develop its own strategies, and maintain a balance between subsistence harvesting and industrial development on its lands (see the Tłı̨chǫ Agreement and Tłı̨chǫ Land Use Plan). The Tłı̨chǫ Government will also develop a mineral policy for Tłı̨chǫ lands, so that there is clear and predictable regulation in the region (Mitigation 11 of PR#96, Appendix D Motion 2015-018). Any proposed exploration or mining development would have to adhere to the land use permit and proponents are required to apply for approval. The implementation of these mitigation measures are expected to minimize the negative residual effects of the Project on the availability of traditional resources for harvesting due to effects to wildlife and fish.

- *Effects on wildlife and fish resulting in changed traditional perceptions of the land.*

There is uncertainty in how the Project will affect perceptions of the land and value of the land, and this assessment does not presume to determine how individuals will respond to change. Cultural change is not necessarily either unidirectional or predetermined in nature. Different people in Whatì or other communities may experience the effects of change from the Project in positive and negative ways. People are generally risk averse by nature and want to protect what they already have in the face of uncertainty, leading to fear of change and the likelihood of seeing more risks than benefits (PR#7, Appendix B). Perceptions of risk, or harm are primarily due to a lack of familiarity with a Project, uncertainty about outcomes that may arise, knowledge or experience of similar Projects

with poor outcomes, fear of outcomes that are expected or foreseen, and level of confidence in the organizations responsible for managing impacts.

Results of consultation with Tłı̨chǫ, NSMA, and YKDFN community members indicated concerns about the potential adverse effects of the Project on traditional way of life and culture due to potential effects on wildlife, fish, and the land. Engaging communities in learning about risks and benefits, characterizing their likelihood, magnitude and the ability to manage them, empowers people to confront and overcome these concerns in a meaningful way (PR#7, Appendix B). As already described above for potential changes to traditional way of life and culture, it is expected that the Tłı̨chǫ Government will continue to engage with communities to address uncertainty and develop policies and programs to help manage and monitor the Project to reduce risks and maximize benefits (PR#7, Appendix B).

5.4.3.2 Harvesting

- *Increased access and use of the region may result in increased harvesting pressure on wildlife and fish by outside harvesters.*

As previously discussed, Tłı̨chǫ communities are amongst the most reliant on country foods of any Aboriginal groups in the NWT, and in 2013, over 90% of Tłı̨chǫ households were eating fish or meat obtained from hunting and fishing. Whatì community members are highly engaged in traditional cultural and harvesting activities with higher participation rates compared to both Tłı̨chǫ and NWT averages (PR#96 TG IR 4.1). Similarly, NSMA members reported that hunting and fishing are fundamental aspects of Aboriginal well-being and way of life, and that caribou remains the principal item in their diet (PR#98 NSMA IR). YKDFN members indicated their long history of traditional use in the Chief Drygeese Territory for harvesting, and expressed concerns about the Project potentially affecting their long-term ability to engage in traditional practices (PR#24).

Tłı̨chǫ Elders and harvesters expressed concern that the TASR may potentially lead to the construction of new cabins by non-Tłı̨chǫ residents in the region and increased use of trails and harvesting pressure on local furbearers and ungulate populations near the TASR. This in turn could result in increased competition for traditional resources, and may pose difficulties for the maintenance of Tłı̨chǫ hunting and trapping economy and way of life. Concerns were also raised regarding increased pressure on various fish populations resulting from an increased number of outsiders fishing in Tsotìdeè and Lac La Martre. NSMA members are concerned about the effective implementation of mitigation measures to improve the management of fisheries potentially affected by the Project because of increased access to water routes.

Tłı̨chǫ harvesters stated that increased development in the barren-grounds have disrupted caribou migration into the Whatì area, which is a concern since they now have to travel further north towards Grandin Lake and Gamètì to be able to hunt barren-ground caribou (p. 38 PR#28; PR#97 IR 2). The GNWT (PR#7 page 5-10) anticipates that a Whatì community access road will extend the winter road season to Gamètì and Wekweètì by approximately 4 weeks, which may also extend access to barren-ground caribou habitat for non-Tłı̨chǫ harvesters. Historical winter road operational periods indicate that the Wekweètì winter access road is variable and trending toward opening later in the year, consistent with predictions of climate warming. Therefore, there is uncertainty in how much earlier the winter roads north of Whatì will be open and improved earlier access for trucks with snowmobile trailers may be temporary (Section 4.4). Furthermore, both the Wekweètì and Gamètì winter access roads historically close mid-April. The BNE and Bathurst caribou herds begin their migration to northern calving areas in

early April and mid-April, respectively, meaning caribou may not be available past mid-April even if the winter roads have a longer operational period (Section 4.4.2.2).

It is unlikely that there will be increased harvesting pressure from outsiders on the Bathurst herd because of low population numbers occurring below the treeline and in the Project area (PR#7). Harvest restrictions on Bathurst caribou were in effect for the 2010 to 2014 harvest seasons, and a no-hunting mobile conservation zone was implemented by GNWT-ENR in 2015. The number of tags were further reduced to zero from 2016 until 2019 (WRRB 2016). Non-Tłįchǫ harvesters may be able to drive to Gamètì later in the season to hunt the Bluenose East Caribou on their migration to northern calving grounds, thereby increasing competition for resources (PR#97 IR 2). Although the Bluenose East herd does winter below the treeline, its harvest is currently heavily restricted with a harvest allowance of 750 bulls from 2016 to 2019, and all Aboriginal harvesters require authorization cards from the GNWT-ENR. Non-aboriginal harvest of barren-ground caribou is regulated by GNWT-ENR, and non-residents cannot harvest barren-ground caribou in the NWT (GNWT-ENR 2017). It is unlikely that non-Aboriginal residents will expend the time and energy to engage in an illegal activity with extremely strict restrictions in place. Although the winter road season will be extended, Tłįchǫ Government, WRRB, and GNWT-ENR are monitoring the herd and harvesting activity (PR#97 IR 2). During construction, a no hunting policy for wildlife by workers will limit harvest of wintering barren-ground Caribou, and access roads to borrow sites will be blocked when no longer active to minimize access (Table 4.3-1). NSMA members currently have an equitable allocation of tags of the limited Aboriginal harvest permitted for the Bluenose East herd for the 2014-2017 harvest seasons. While there is no longer any harvest of the Bathurst caribou herd permitted, the GNWT will provide the NSMA with an equitable allocation of harvesting tags once the population recovers. The GNWT and the NSMA regularly engage in consultation regarding the management of caribou herds and other wildlife in the NWT, and regarding the *NWT Wildlife Act*, Transboundary Water Agreements and the Northwest Territory Métis Nation Agreement in Principle. NSMA also sits on a number of committees dedicated to managing and preserving the health of caribou affected by the TASR (PR#99 NSMA IR).

There is the potential for the Project to result in increased harvesting pressure and competition for boreal caribou and moose by non-Tłįchǫ harvesters (Section 4.4). As there is a limited number of existing roads in the North Slave region for accessing the broader landscape, there is likely to be an increase of outside traffic on an all-season road (PR#97 IR 2). A reduction in boreal caribou populations as a result of greater access is predicted to be small given that boreal caribou occur in low densities and use large areas of undisturbed habitat (Section 4.4.2.1). Furthermore, reductions in boreal caribou and moose populations are expected to be limited because the Project ROW follows an existing linear feature that is currently used by hunters to harvest caribou and moose, and to access the WRMA (Sections 4.4.2.1 and 4.4.2.3). To ensure effective management, the Tłįchǫ Government will continue to manage the construction of cabins on Tłįchǫ lands, and hunting, trapping, and fishing activities in the area, in order to minimize impacts on local animal populations. Non-aboriginal harvest of woodland caribou is regulated by GNWT-ENR, and the GNWT Department of Lands is responsible for managing and administering the issuance of recreational leases for cabins on Territorial land and is currently working on the development of a Recreational Leasing Management Framework (PR#7). To protect wildlife, organizations such as WRRB, Tłįchǫ Government, and GNWT Departments of Lands and GNWT-ENR will need to continue to work together to develop guidelines and conditions for use within the WRMA. The GNWT-ENR will enforce the NWT's hunting regulations, which are in place to ensure that wildlife is conserved for future generations and that hunting is done safely. The Tłįchǫ Government has the authority and jurisdiction to write laws, develop its own strategies, and maintain a balance between subsistence harvesting and industrial development on its lands (see the Tłįchǫ

To Table of Contents

Agreement and Tłı̨chǫ Land Use Plan). The Tłı̨chǫ Government will work with the GNWT to review the mitigations that are developed and considered for managing harvesting impacts that occur as a result of the new all-season access of the Project (PR#96 TG IR 4.3). Additionally, the Tłı̨chǫ Government could establish a public awareness program that would include signage along the proposed TASR corridor highlighting hunting restrictions and discouraging excessive hunting. Options for new check stations and better and more accurate community reporting are also being explored (PR#7 Section 8.7.1.4).

The fish and fish habitat assessment analysed the potential effects of overexploitation of large-bodied fish populations due to improved access (Section 3.4). Changes in access to water bodies for non-Tłı̨chǫ fishers varied, depending on the location. Implementation of mitigation measures to minimize potential adverse effects on fishing due to overharvesting by outsiders include implementation of restricted fishing during sensitive periods and of daily catch limits, as needed, by the Tłı̨chǫ Government on Tłı̨chǫ lands; maintenance of existing NWT fishing regulations by DFO; and, sustainable development of tourism opportunities DFO is the management authority for fish and fish habitat in the NWT, and they are responsible for managing regional fisheries resources to ensure the sustainability of fish populations in the NWT. Cabins cannot be constructed along Lac La Martre without approval of the Department of Culture and Lands Protection.

Harvesting wildlife and fish by non-Tłı̨chǫ residents must follow appropriate territorial and federal regulations, which prevent overharvesting (PR#7). These regulations are reviewed periodically to ensure that wildlife and fish harvesting remains sustainable, and restrictions can be implemented for certain species if they are identified to be at risk. Due to the rules and restrictions outlined in the Tłı̨chǫ Land Use Plan, exploitation of Tłı̨chǫ resources by unauthorized users is anticipated to be low (PR#7). The implementation of these mitigation measures are expected to limit the adverse residual effects on harvesting from increased competition due to harvesting pressure by outsiders.

5.4.3.3 Heritage and Cultural Resources

- *Construction activities and operational maintenance and use of the Project could result in disturbances to heritage resources and culturally important sites.*

Results of the Tłı̨chǫ TK Study identified several cultural value sites in the vicinity of the Project, and include important Tłı̨chǫ trails, water routes, sacred sites, and burial locations (Map 4, PR#28; IR 3). Potential effects of the Project to overland trails and water routes and mitigation are discussed in Section 5.4.1.3. Map 3-1 and Table 3-1 of PR#97 IR 3 illustrate the heritage resources and culturally important sites identified in the TK study within a 5 km local study area centered on the TASR corridor. There were no specific cultural sites identified by NSMA in the Project area. NSMA members would like further Archaeological studies to be undertaken in consultation with them so that their traditional way of life and history can be preserved for future generations (PR#99 NSMA IR). Similarly, YKDFN did not identify any specific cultural sites in the Project area, but they are concerned about potential effects of the Project on culturally significant and archaeological sites.

Ewaashì is a culturally sensitive site in which the nature of the site and type of spirits that dwell there is unknown. The Elders requested that the site is undisturbed and should be respected (PR#28). Project design and construction activities will avoid passing through this culturally sensitive area (PR#7). Six grave sites were identified in the vicinity of the TASR, which represent an important connection to the land for the Tłı̨chǫ. No grave sites were identified in the immediate proximity to the Project footprint, and no mitigation is required. Kweyì ı̨goèʔàa

To Table of Contents

Wets'àts'ìdì is a culturally sensitive site meaning "cave tunnel" and "pay respect to", and is located approximately 40 kilometres south of Edzo on Highway 3. The Elders requested that this site is not disturbed, and suggested closing the trail leading to it to avoid any potential disturbance (PR#28). A number of cabins and camp sites were identified within 5 km of the Project footprint; however these sites were destroyed during the 2014 forest fires and therefore no direct or indirect disturbance to these sites is expected to occur (PR#97 IR 3). The family of Joe Migwi is re-building their cabin. The Tłı̨chǫ Government and the CGW will erect signage to prevent damage to culturally significant areas (such as La Martre Falls) (PR#7 pg 8-33). The Tłı̨chǫ Government is committed to ensuring the protection and management of cultural heritage throughout the construction and operation of the TASR.

In addition to the TK Study conducted by the Tłı̨chǫ Government, an Archaeological Impact Assessment (PR#7, Appendix U) was conducted on the TASR. This study involved a ground reconnaissance via helicopter across the length of the TASR, ground truthing of areas with high archaeological potential and shovel testing. The results of the Archaeological Impact Assessment indicated that no newly recorded sites were discovered (PR#97 IR 3). The potential for the construction of the proposed TASR to affect archaeology sites exists and GNWT will establish a minimum buffer of 30 m around identified sites to ensure ongoing avoidance and where practical, a 100 m buffer will be established (PR#7). Should the proposed TASR footprint change and encroach on the 30 m buffer zone of the previously recorded archaeology site (identified in PR#7, Appendix U), consultation with the community and with the Department of Education, Culture and Employment (GNWT-ECE) will be conducted to ensure there are no concerns with the impact of this location. This site is perceived to have low heritage value based on conversations with Tłı̨chǫ residents and evidence of recent use at this previously recorded archaeology site (PR#7, Appendix U).

A follow-up Archaeological Overview Assessment to guide development of selected borrow source areas was conducted in December 2016 and an Archaeological Impact Assessment is planned for the spring or summer of 2017. GNWT-ECE accepted the results of the 2016 Archaeological Overview Assessment and will continue to work with GNWT-DOT to ensure the selection of borrow source areas considers the protection of archaeological sites.

Routing options have been developed to avoid the significant cultural sites identified in the TK Study, such as the La Martre Falls. Should the proposed TASR footprint change during final alignment decisions, these identified sites will again be considered and an appropriate buffer will be used and communities will be consulted, where required. Furthermore, the GNWT-DOT in consultation with the GNWT-ECE has drafted an Archaeological Site Find Protocol (PR#7, Appendix Y) to provide guidance to employees and contractors conducting ground disturbing operations for the TASR. The document provides the framework for identifying archaeological deposits and avoiding unforeseen disturbance to cultural heritage resources. The Protocol ensures that employees and contractors are educated of the regulations, how to identify archaeological sites prior to engaging in ground disturbing operations and what procedural steps should be followed if a suspected archaeological or heritage resource is discovered (PR#7).

With the implementation of mitigation measures, Project construction and operations for the TASR are not expected to result in a residual effect on heritage resources and culturally important sites.

To Table of Contents

changing demands from consumers and other businesses it might work with. This change is neither assessed as positive nor negative, and the application of a magnitude rating is not considered appropriate. The change is expected to be isolated to the Community Store (local) and is expected to be permanent, persisting indefinitely with Project operation.

5.5.1.2 Traditional and Non-wage Economy

No beyond-negligible residual effects to the traditional and non-wage economy, as related to economic wellbeing, are anticipated. Please refer to Section 5.5.3 for further discussion of residual effects on traditional use and culture.

5.5.2 Stable and Healthy Communities

5.5.2.1 Population Sustainability

- *Project operations could help to stabilize the existing Whatì population.*

The potential residual effect of the Project on the current and projected trend of out-migration from Whatì is expected to be positive. The magnitude of this effect is difficult to predict with certainty. Should Project operations prompt those who would otherwise out-migrate for better access to goods, services and employment opportunities elsewhere to instead remain in the community, the effect could be of moderate magnitude relative to the existing trend. However, should some still choose to leave the community, and the trend continues to a lesser extent, the magnitude of this effect could be low. The Project's residual effect of potentially stabilizing out-migration is local to Whatì, and will persist into the long-term with Project operations.

- *Project operations and associated economic growth could result in in-migration to Whatì.*

The Project's residual effect of potential in-migration to Whatì is considered to be manageable by the CGW, and to not result in inflation, and so is assessed as neutral, and of low magnitude, depending on the number of people who in-migrate in hopes of securing employment. In the event that in-migration during Project operations is substantially below the manageable threshold identified by the CGW, this determination of magnitude could reduce to negligible. In-migration would be local to Whatì, and, while a spike could be expected in the early years of Project operation, could persist over the long-term with Project operations.

5.5.2.2 Use and Maintenance of Infrastructure

Project construction and operation is not anticipated to push existing housing, waste, or water infrastructure and services in Whatì beyond current capacity, or beyond manageability by the CGW, the Tłı̨chǫ Government, or the GNWT. Therefore, no beyond-negligible residual effects are anticipated.

5.5.2.3 Community Cohesion

Determining with certainty or accuracy whether or not potential Project effects to community cohesion will materialize is difficult. The potential for an effect to be realized is highly dependent on individual responses to the Project and the enhanced access to and from Whatì that it brings about. For example, it is not realistic to assume that an EA can determine how people will choose to move between communities seasonally with year-round access, the extent to which people will use the Project to visit relatives, or whether or not outsiders will decide to venture into Whatì. Determining the Project's residual effects on community cohesion is even more problematic, as the effectiveness of mitigations and benefit enhancement measures are highly dependent on uptake by those

To Table of Contents

5.5.3 Traditional Use, Culture and Heritage Resources

5.5.3.1 Traditional Use and Way of Life

- *Enhanced year-round access to hunting, trapping and fishing areas for harvesters.*

Project operations will improve access to the existing trail network and preferred hunting, trapping, fishing and culturally important areas for Tłı̨chǫ and NSMA members, and potentially to new areas in the region previously inaccessible most of the year. Increased access to the land will likely lead to increased opportunities for traditional use and promote greater participation in traditional activities among Tłı̨chǫ residents.

Enhanced access to hunting, trapping, fishing and other traditional land use areas for Tłı̨chǫ and NSMA harvesters is predicted to be moderate in magnitude, regional in context, permanent and continuous throughout operation of the TASR. The ability of Tłı̨chǫ, NSMA, YKDFN and DGGFN members to continue practicing traditional land and resource use activities and maintain their traditional way of life will not be significantly affected due to the Project.

- *Increased mobility and time spent away from the community may result in changes to traditional way of life and culture.*

As discussed in Section 5.4.3, Project operations can have both positive and negative effects on traditional way of life and culture due to increased mobility and time spent away from the community. Determining with certainty or accuracy whether or not potential Project effects to traditional way of life and culture will materialize is difficult. The potential for an effect to be realized is highly dependent on individual responses to change brought about by increased access in the region. It is not realistic to assume that an environmental and socio-economic assessment can determine how people will choose to spend their time seasonally with year-round access, and whether their interest in traditional and cultural activities will increase or decrease. Determining the Project's residual effects on traditional way of life and culture is even more difficult, as the effectiveness of mitigations measures are highly dependent on the level of participation and resilience to change from development by those potentially affected by the Project.

With this uncertainty, it is not possible to accurately assign residual effects criteria for the Project's potential effects on traditional way of life and culture. The SEIA recognizes the possibility for these effects to occur; however the monitoring, assessment and management of Project-related adverse changes to traditional way of life and culture in Whatì, should they occur, will fall to the CGW and the Tłı̨chǫ Government.

- *Effects to wildlife and fish resulting in changes in the availability of traditional resources for harvesting.*

Changes in the availability of traditional resources for harvesting are anticipated due to Project and cumulative effects on wildlife, and Project effects on fish. Changes in boreal caribou and barren-ground caribou distribution, survival and reproduction are anticipated to be regional and beyond regional in scale, respectively, permanent in duration and continuous (Section 4.4). However, residual effects on distribution are expected to be negligible, given the relatively low amount of development disturbance in the ranges for caribou, and adverse and long-term changes in caribou populations are not anticipated. Similarly, changes in moose and wolverine distribution, survival and reproduction are anticipated to be beyond regional in scale, permanent in duration and continuous (Section 4.4). Given the relatively low amount of development disturbance in the wildlife RSA range of moose and

wolverine, negligible effects on distribution and connectivity are expected, and adverse and long-term changes in population survival and reproduction rates are not anticipated.

Residual effects of the Project on the availability of wildlife resources for harvesting is predicted to be permanent and continuous, since wildlife availability may decrease in certain preferred harvesting areas. However, this effect is expected to be limited since the regional area contains high proportions of habitat undisturbed by anthropogenic sources for boreal caribou, barren-ground caribou, moose and furbearers where they can be harvested.

Residual effects of the Project on fish populations were only identified for the potential overexploitation of large-bodied fish populations due to improved road access (Section 3.4). Changes in fish harvesting due to increased competition is discussed under Harvesting below. Residual effects of the Project on the availability of fish resources is predicted to be negligible to low in magnitude, permanent and continuous, since fish availability may decrease in certain preferred fishing areas.

It is anticipated that DFO will continue to be able to manage regional fisheries resources and support sustainable fish populations in the NWT, and the Tłı̨chǫ Government will further manage the fisheries on Tłı̨chǫ lands to ensure sustainable subsistence fishing is available for Tłı̨chǫ people.

- *Effects on wildlife and fish resulting in changed traditional perceptions of the land.*

The Project has the potential to result in both positive and adverse effects on people's perceptions of the land, and how they value the land. As with potential changes in traditional way of life and culture, potential changes in perceptions can be positive or negative, depending on how people experience and respond to change; therefore, they are not appropriately assessed through the assignment of residual effects criteria. Furthermore, determining the effect of changed perceptions of the land on traditional use and value of the land is even more difficult to do, and will depend on people's responses to development and their resilience to change. Therefore, the SEIA does not characterize residual Project effects on perceptions of the land using EA criteria and processes. Rather, it is acknowledged that the potential for positive and negative residual Project effects is expected during Project operation.

5.5.3.2 Harvesting

- *Increased access and use of the region may result in increased harvesting pressure on wildlife and fish by outside harvesters.*

Increased harvesting pressure on wildlife and fish by non-Tłı̨chǫ harvesters is expected due to TASR operations, leading to increased competition of resources. Residual effects to the survival and reproduction of boreal caribou, barren-ground caribou, moose and wolverine due to increased harvesting were predicted to be low in magnitude, permanent and continuous, but adverse and long-term changes in wildlife populations are not anticipated (Section 4.6.2). Residual effects of the Project on wildlife harvesting due to increased competition from overharvesting by outsiders is predicted to be low in magnitude, regional (boreal caribou) to beyond regional (barren-ground caribou, moose and wolverine) in geographic extent, permanent and continuous.

Residual effects on fish abundance due to changes in fish harvesting pressure is expected to range from negligible to low in magnitude, local to regional in geographical extent, and will be permanent (Section 3.3). DFO will continue

To Table of Contents

to enforce the NWT's fishery regulations which are in place to prevent overfishing in any one area. Tłı̨chǫ lands are regulated and administered by the Department of Culture and Lands Protection of the Tłı̨chǫ Government. While NWT fishing regulations still apply on Tłı̨chǫ lands, additional access and fishing regulations may be implemented and regulated by the Tłı̨chǫ Government to ensure that lakes and watercourses continue to have productive fisheries with abundant resources (i.e., Lac La Martre, La Martre River, and Boyer Lake). Residual effects of the Project on fish harvesting due to increased competition from overharvesting by outsiders is predicted to be negligible to low in magnitude, local to regional in geographic extent, permanent and continuous.

Overall, residual effects of the Project on wildlife and fish due to increased competition from overharvesting by non-Tłı̨chǫ residents will not have a significantly adverse effect on the ability of wildlife and fish to be self-sustaining, and therefore on the ability of Tłı̨chǫ, NSMA, YKDFN and DGGFN members to continue harvesting.

5.5.3.3 Heritage and Cultural Resources

Project construction and operation is not anticipated to disturb heritage resources, or impede use of culturally important sites in a meaningful way. Therefore, no residual effects to heritage and cultural resources are anticipated.

5.5.4 Summary of Residual Socio-Economic Effects

A summary of the Project's residual effects on VSECs is provided in Table 5.5-1.

To Table of Contents

Table 5.5-1: Summary of Residual Project Socio-Economic Effects

VSEC	Topic	Indicator	Effects Pathway	Direction	Magnitude	Geographic Extent	Duration
Economic Wellbeing	Employment and Economy	Employment opportunities	Project construction and operations would generate employment opportunities and associated incomes	Positive	Moderate	Local	Short- to Long-term
		Training opportunities	Project construction could drive the uptake of ongoing training opportunities in the region by those seeking employment	Positive	Moderate	Local	Short-term
		Business development	Project operations could enhance opportunity for year-round tourism activities in the region	Positive	Low	Local	Long-term
			Project construction and operations could support existing local business, and could facilitate the development of new businesses in Whatì	Positive	Moderate	Local	Short- to Long-term
			Project operations could change the nature or viability of some existing local businesses	Neutral	n/a	Local	Long-term
Stable and Healthy Communities	Population Sustainability	Out-migration, population mobility	Project operations could help to stabilize the existing Whatì population	Positive	n/a	Local	Long-term
		In-migration, population composition	Project operations and associated economic growth could result in in-migration to Whatì	Neutral	Low	Local	Long-term
	Community Cohesion	Connecting families, alleviating isolation	Project operations could spread seasonal movements in and out of Whatì over a longer period, avoiding the “pulse” facilitated by winter road operation	Positive	Not applicable – Please refer to Sections 5.5.2.3, 5.5.2.4, and 5.5.2.5 for further discussion as to why residual effects criteria are not appropriately assigned to these Project pathways.		
			Project operations and associated access to and from Whatì could connect families and alleviate isolation	Positive			
		Outsiders coming in	Project operations could increase the presence of outsiders in the community year-round, potentially creating a sense of reduced safety, security and community	Negative			
		Social pressures	Project operations could increase access to drugs and alcohol, both in Whatì and for those travelling to other communities, exacerbating social pressures	Negative			
			Project operation and associated social pressures exacerbated by access to drugs and alcohol could increase demand for policing and social services	Negative			
	Public Safety	Road safety	Project construction could increase demand for emergency services in response to construction accidents	Negative			
			Project operations could introduce the potential for year-round risk of traffic accidents for those travelling to and from Whatì	Negative			
			Project operations could reduce the potential risk of traffic collisions relative to the current winter road, spreading the otherwise temporally concentrated traffic out over the year	Positive			
			Project operations could reduce the potential for non-traffic related accidents associated with unstable winter road conditions during seasonal transition periods	Positive			
		Protective, emergency and social services	Project operations could improve the efficiency of search and rescue efforts	Positive			
			Project operations could reduce the seasonal demand for response services associated with winter road operations and enhance year-round emergency response services	Positive			
	Equity and Vulnerability	Food security	Project operations could improve food security through enhanced year-round access to groceries	Positive			
		Cost of living	Project operations could change the cost of living for residents of Whatì	Positive			
		Vulnerability	Project operations could influence the vulnerability of those most sensitive to economic pressures	Positive			
			Project operations could influence the vulnerability of Youth	Positive and Negative			
			Project construction and operations could influence the vulnerability of Young Women	Positive and Negative			
			Project operations could influence the vulnerability of Elders	Positive and Negative			
Traditional Use, Culture and Heritage Resources	Traditional Use and Way of Life	Practice of traditional activities and culture	Enhanced year-round access to hunting, trapping and fishing areas for harvesters	Positive	Moderate	Local	Long-term
			Increased mobility and time spent away from the community may result in changes to traditional way of life and culture	Positive and Negative	n/a	Local	Long-term
		Quantity or quality of traditionally harvested resources	Effects to wildlife and fish resulting in changes in the availability of traditional resources for harvesting	Negative	n/a (wildlife); Negligible to low (fish)	Regional to beyond regional (wildlife); Local to regional (fish)	Permanent (wildlife); Permanent (fish)
		Perception of the land by traditional users	Effects to wildlife and fish resulting in changed traditional perceptions of the land	Positive and Negative	n/a	Local	Long-term
	Harvesting	Competition for resources	Increased access and use of the region may result in increased harvesting pressure on wildlife and fish by outside harvesters	Negative	n/a (wildlife); Negligible to low (fish)	Regional to beyond regional (wildlife); Local to regional (fish)	Permanent (wildlife); Permanent (fish)

To Table of Contents

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To Table of Contents

5.6 Monitoring and Follow-up

Socio-economic monitoring will continue through the GNWT, CGW, TCSA and the Whatì Inter-Agency Committee, as relevant to each organization's jurisdiction. The Communities and Diamonds initiative, while not directly attributing socio-economic change in diamond-mining affected communities to any one development such as the Project, will continue to identify community-level socio-economic conditions and trends in Whatì. Ongoing consultation activities will identify community concerns and adverse trends. Adaptive management in response to changing social and economic conditions, as described throughout Section 5.5, will be employed by the appropriate authority in an effort to mitigate adverse socio-economic trends, while maximizing potential benefits.

To Table of Contents

APPENDIX A

Concordance Table

Table A-1: EA-1617-01 Terms of Reference Concordance Table

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
2.2.1 Statutory scope of assessment requirements	Section 117(2) of the MVRMA stipulates that the every EA shall include consideration of the impact of the development on the environment, including: ▪ Cumulative Effects– the Review Board is required to assess the cumulative effects of the proposed development under paragraph 117(2)(a) of the MVRMA. Direction on this topic is provided in section 4.2, which describes the assessment methodology, and in section 7, which requests a summary of cumulative effects. ▪ Accidents and Malfunctions – The Review Board is required to assess the effects of potential accidents and malfunctions under paragraph 117(2)(a) of the MVRMA. Direction on this topic is found in section 4.1.	9.0 8.13	2.0 3.0 4.0 5.0	2.3 3.1.4; 3.3.3 4.1.3; 4.4.3; 4.6 5.5 3.2; 4.3; 5.3
2.2.2 Valued components	Valued components are elements of the biophysical or human environment identified as having scientific, social, cultural, economic, historical, archaeological or aesthetic importance. After reviewing the body of evidence on the public record, the Review Board has determined that there is a potential for significant adverse impacts on the following valued components; these valued components will be the focus of this environmental assessment: ▪ Fish and fish habitat ▪ Caribou ▪ Wildlife and species at risk ▪ Traditional use, culture and heritage resources ▪ Economic well−being ▪ Stable and healthy communities	8.9 8.7 8.10 8.11	3.0 4.0 5.0	3.1.3 4.1.2 5.1.2
	Table 1 lists topics related to each valued component that the Review Board requires the developer to address in the DAR. The developer will discuss how potential direct and indirect Project effects are likely to affect the valued components in the context of each related topic.	N/A	N/A	N/A
	Topics for Valued Component: Fish and fish habitat ▪ Fish habitat ▪ Fish harvesting	8.9	3.0	3.2; 3.3; 3.5
	Topics for Valued Component: Caribou ▪ Barren−ground caribou ▪ Boreal caribou	8.9	4.0	4.2.3; 4.4; 4.6
	Topics for Valued Component: Wildlife, including species at risk[(a)] ▪ Mammals (moose, bison and wolverine) ▪ Mammals (bats), birds, fish, plants, amphibians, ▪ insects	8.9	4.0	4.3; 4.4; 4.6

Table A-1: EA-1617-01 Terms of Reference Concordance Table (cont'd)

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
2.2.2 Valued components (cont'd)	Topics for Valued Component: Traditional use, culture and heritage resources ▪ Traditional use and way of life ▪ Harvesting ▪ Heritage and cultural resources	N/A	5.0	5.5.3
	Topics for Valued Component: Economic well−being ▪ Equity and vulnerability(b) ▪ Traditional and non−wage economy	N/A	5.0	5.1.1; 5.5
	Topics for Valued Component: Stable and healthy Communities ▪ Community cohesion ▪ Use and maintenance of infrastructure ▪ Public safety ▪ Population sustainability	N/A	5.0	5.5.2
2.2.3 Geographic scope of assessment	The DAR must define the spatial boundaries (geographic scope) for the assessment of potential impacts to each valued component in the DAR. The geographic scope of assessment for each valued component should be appropriate to the characteristics of that component, or to the nature and extent of the impact and/or impact source.	N/A	N/A	N/A
	In defining the geographic scope of assessment, the developer should consider: ▪ the habitat range of wildlife species; ▪ the extent to which Project effects are no longer measurable (e.g. downstream water quality); ▪ community and traditional knowledge; ▪ current or traditional land and resource use by Indigenous groups; and ▪ other ecological, technical, social and cultural considerations.	N/A	3.0 4.0 5.0	3.1.4.1 4.1.3.1 5.1.3
	For cumulative impacts, the geographic scope will generally include a much larger study area that combines effects from past, present and reasonably foreseeable future projects that are predicted to combine with the impacts of the Project over its lifespan. This will include cumulative impacts to valued components associated with the extended operating period of the winter roads to Gamètì and Wekweètì.	N/A	2.0 3.0 4.0 5.0	2.3 3.1.4; 3.3.3 4.1.3; 4.4.3; 4.6 5.5
	The developer will indicate and provide rationale for the geographic scope of assessment selected for each valued component.	N/A	3.0 4.0 5.0	3.1.4.1 4.1.3.1 5.1.3

Table A-1: EA-1617-01 Terms of Reference Concordance Table (cont'd)

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
2.2.4 Temporal Scope of Assessment	In addition to geographic scope, the developer must define and provide rationale for the temporal scope for the assessment of potential impacts on each valued component. For example, while some impacts may be very short or limited to a particular Project phase (e.g. sensory disturbance to caribou during road construction), others may occur over a longer period (e.g. barrier effects to caribou over the life of a project).	N/A	3.0 4.0 5.0	3.1.4.2 4.1.3.2 5.1.3
	In defining the temporal scope of assessment, the developer should consider: ▪ periods during the development when predicted effects are most intense (such as during initial construction); ▪ periods when valued components are most sensitive to potential impacts (such as key times for wildlife, migration periods, population cycles, shifts in distribution/range or wildlife harvesting periods); ▪ the duration of effects, with attention to how these effects relate to the life of the Project; and ▪ appropriate temporal boundaries for considering any impacts that may require long-term monitoring and management.	N/A	3.0 4.0 5.0	3.1.4.2 4.1.3.2 5.1.3
	For cumulative impacts, the temporal scope includes the period of effects of past, present and reasonably foreseeable future projects that are predicted to combine with the impacts of the proposed Project.	9.0	3.0 4.0 5.0	3.3.3 4.4.3 5.5
3.2 Incorporation of traditional knowledge	In accordance with section 115.1 of the MVRMA, the Review Board must consider both traditional knowledge and scientific information that is made available during an EA. In addition, paragraph 115(1)(c) of the MVRMA requires that the EA process have regard for the importance of conservation to the well−being and way of life of the Aboriginal peoples of Canada to whom Section 35 of the Constitution Act 1982 applies and who use an area of the Mackenzie Valley. As such, the developer should make all reasonable efforts to collect and use traditional knowledge, where applicable, in project design and in evaluating impacts and proposing mitigations in the PDR/ASR.	Traditional Knowledge Study Report	2.0	2.4
	The Board is encouraged by the collaboration between the Tłı̨chǫ Government and the developer and by the former's satisfaction with the developer's work in this regard. However, the ASR must contain a comprehensive, stand−alone section summarizing the use and consideration of traditional knowledge, as described below. This will assist the Board in evaluating the incorporation and use of traditional knowledge in its determinations of significant adverse impacts. This summary will explain how traditional knowledge has been incorporated into specific aspects of: Project design; impact predictions; and potential mitigations.	N/A	2.0	2.4
	The methods used in the acquisition, analysis and presentation of traditional knowledge are at the developer's discretion but should be consistent with the Review Board's Guidelines for Incorporating Traditional Knowledge into the Environmental Impact Assessment Process.	N/A	2.0	2.4

Table A-1: EA-1617-01 Terms of Reference Concordance Table (cont'd)

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
3.3 Public engagement	The Review Board acknowledges the engagement activities (described in the PDR, PR#7, Appendix E) the developer has already undertaken with communities, Aboriginal groups and other organizations with interests related to the construction and operation of an all−season road. For any additional engagement activities that have occurred during the environmental assessment, and up to the submission of the PDR/ASR, the developer will submit an updated engagement log and summary at the time of the PDR/ASR submission. This engagement log and summary should describe dates, individuals and organizations engaged with, as well as the mode of communication, discussion topics and positions taken by participants, including: ▪ all commitments and agreements made in response to issues raised by the public during these discussions, and how these commitments altered the planning of the proposed Project; and ▪ all issues that remain unresolved, documenting any further efforts envisioned by the parties to resolve them.	Appendix E	Appendix E	N/A
3.4 Developer commitments and mitigation measures	The Review Board acknowledges that the developer has listed numerous mitigation measures in their PDR. For the Review Board to consider this information as part of the PDR/ASR, the proponent will provide a commitments table listing all mitigation measures the developer will undertake related to the TASR. This includes, but is not limited to any commitments and mitigation measures identified in the PDR and on the public record, including from the Preliminary Screening process. The commitments table will also contain the following summary information: ▪ describe the purpose of the mitigation; and ▪ identify the responsible authority for implementing and enforcing the mitigation measure.	N/A	1.0 2.0 3.0 4.0 5.0 Appendix F	1.3 2.3.1 3.2 4.3 5.3
3.5 Summary materials	The following summary materials will be required in the PDR/ASR: ▪ a plain language summary of the PDR/ASR in English and Tłı̨chǫ; ▪ a concordance table for new materials that cross references the items in the TOR and Adequacy Statement with relevant sections of the PDR/ASR; and, ▪ an updated list of anticipated authorizations, permits, licenses and other approvals, including any authorizations required from the Tłı̨chǫ Government, DFO or other responsible authorities that are not already covered in the PDR	N/A	Plain Language Summary Appendix A 1.0	N/A N/A 1.5

Table A-1: EA-1617-01 Terms of Reference Concordance Table (cont'd)

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
3.6 Development description	The developer will ensure that a description of all Project components and activities is included in the PDR/ASR, including any proposed or existing components and activities not listed in Section 2.1 of these TOR.	4.0	1.0	1.2
	Where the developer feels it would be helpful to reviewers, the PDR/ASR should describe alternative development components, management systems or alternative locations for physical works and activities considered for the Project. Where applicable, the developer will provide reference to research that identifies the successful use of the specific technologies being proposed, and their relevance for this environmental setting.	N/A	N/A	N/A
	Describe the proposed Project, providing details and a schedule for all physical works and activities throughout the construction and operations phases, with a description of major activities by phase. Include milestone events (e.g. bridge construction, halfway point, project completion, etc.) and anticipated progress of construction activities (e.g. length of road constructed per year).	N/A	Appendix B	N/A
	The development description will describe all Project components and activities for the construction and operations phases including, but not limited to: ▪ project components (i.e. physical infrastructure) ▪ use of chemicals and explosives ▪ stockpiling of material ▪ water usage, management and treatment ▪ waste management ▪ power generation ▪ transportation needs ▪ maintenance ▪ public safety ▪ management and monitoring plans	4.0	1.0	1.2
3.7 Land use Plans	The TASR is entirely within the Wek'èezhìı Resource Management Area. Seventeen kilometers of the TASR cross Tłı̨chǫ lands and are thus subject to the Tłı̨chǫ Land Use Plan. The developer should demonstrate how the Project conforms to this land use plan and/or if an exemption from the land use plan would be required for any specific activities. If an exemption is required, the Developer will state if the exemption is likely to alter the Project. In such a case, the developer will describe the likelihood of those changes, and any additional direct or indirect impacts on valued components that might result.	N/A	1.0	1.4

Table A-1: EA-1617-01 Terms of Reference Concordance Table (cont'd)

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
3.8 Developer information	The following information about the developer is required: (a) how the developer will ensure that its contractors and subcontractors honour commitments made by the developer in the context of the EA; (b) environmental performance record for the GNWT−DOT on its regulatory compliance on previous construction projects; and (c) description of any corporate policies, codes of practice, programs or plans concerning the developer's environmental, sustainable development, community engagement, northern hiring, and workplace health and safety policies, with corresponding description of how they relate to the Project.		Appendix D	N/A
4 Assessment Methodology	The purpose of the PDR/ASR is to assess the potential impacts on the environment from the Project. The major steps in impact assessment are: ▪ describing the pathways of effect that link the development to valued components of the environment; ▪ forming and refining impact predictions with the help of consultation and expert knowledge (including traditional knowledge); ▪ identifying mitigation measures to reduce or avoid adverse impacts; and ▪ predicting and characterizing residual impacts[(c)]. Any deviation from the listed methodology must be accompanied by detailed rationale regarding the selected methodology in assessing Project effects on the environment.	N/A	2.0	2.2; 2.3
4.1 Impact assessment steps	For each valued component identified in section 2.2.2, the developer will complete an impact assessment, considering scientific and traditional knowledge as applicable, using the following methodology: 1. Identify the natural range of the baseline conditions without the Project, considering variability (including seasonal, inter−annual, and spatial variability for applicable/ appropriate parameters) and trends over time. 2. Identify the potential effect pathways, or interactions, between the Project and the valued component. 3. Predict potential direct and indirect impacts. a. describe the techniques used in the impact predictions (e.g. models,); b. describe all assumptions and the level of uncertainty associated with each prediction; c. consider likely climate change and fire scenarios and how scenarios affect predicted effects of the Project on valued components; and d. consider and predict how accidents and malfunctions may contribute to predicted impacts. Provide a brief risk assessment for identified accidents or malfunctions on the valued component that includes any residual effects affecting that valued component. 4. Describe the impacts in terms of: a. the mechanism that causes the predicted impact; b. geographical extent of the impact and rationale for its selection; c. the duration and frequency of the impact;	N/A	2.0 3.0 4.0 2.0	N/A

Table A-1: EA-1617-01 Terms of Reference Concordance Table (cont'd)

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
4.1 Impact assessment steps (cont'd)	d. magnitude of the impact (what degree of change is expected); e. reversibility of the impact; f. uncertainty associated with prediction; g. overall implication of the impact on the valued component; and h. likelihood of the impact. When describing impacts, compare the predicted impacts to pre−development conditions or to conditions without the Project, as appropriate. 5. Identify and describe any proposed mitigation measures: a. describe the link between the mitigation measure and the Project component responsible for the impact, and demonstrate how the proposed mitigation measures will reduce or avoid the predicted impacts. Include predictions that will help evaluate the effectiveness of the mitigation measures; and b. evaluate the technical and economic feasibility of the mitigation measures, discussing constraints, uncertainties and implementation challenges. 6. Predict the residual impacts by updating the impact predictions in step 3 to include the proposed mitigation measures. Describe any residual impacts according to step 4, and discuss the overall implication of the impacts on the valued component. 7. Describe any monitoring, evaluation and adaptive management plans that will be used to: a. detect unexpected changes; b. determine whether impact predictions are accurate; c. evaluate the effectiveness of mitigations; and d. adjust management actions to minimize adverse impacts. Demonstrate how the plans adhere to adaptive management best practices, such as those described in guidelines listed in Appendix A.			

Table A-1: EA-1617-01 Terms of Reference Concordance Table (cont'd)

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
4.2 Cumulative effects assessment steps	A cumulative effect is an impact (biophysical, socio−economic, or cultural) that results from the proposed development in combination with other past, present or reasonably foreseeable future developments. In the PDR/ASR, the developer will conduct a cumulative effects assessment for any valued component that is susceptible to cumulative effects.	9.0	3.0 4.0 5.0	3.3 4.4 5.5
	In conducting a cumulative effects assessment for each applicable valued component, the developer will use the steps below: 1. Describe and provide rationale for which past, present or reasonably foreseeable future developments, human activities, climate and fire scenarios are being considered in the cumulative effects assessment. 2. Combine the Project−related residual impact predicted under step 6 in section 4.1 with the impacts from the developments and human activities identified above: a. identify and discuss the way in which a cumulative impact may occur; b. predict the potential direct and indirect cumulative impacts; c. describe techniques utilized in impact prediction (e.g. models,), assumptions and the level of uncertainty; and d. discuss the contribution of the Project to the overall cumulative impact. 3. Characterize the cumulative impact according to steps 4 – 6 in section 4.1.	9.2	3.0 4.0 5.0	3.3 4.4 5.5
	Consideration should also be given to identifying ways in which the developer, either on its own or cooperatively with others, can reduce or avoid any predicted cumulative impacts. Current efforts on cumulative effects assessment and management should be described, including (if applicable) the developer's efforts to coordinate its monitoring and management to contribute towards a regional approach. Lessons learned from previous or current relevant cumulative effects initiatives should be discussed.		3.0 4.0 5.0	3.3 4.4 5.5
5 Baseline Information Requirements	In order to complete the impact assessment in the PDR/ASR, additional baseline information related to the assessment of specific valued components may be required. Step 1 of the impact assessment steps in section 4.1 requires the developer to identify the baseline conditions needed to assess impacts to valued components. The developer is required to incorporate sufficient baseline information so that the linkage between Project activities and impacts to valued components as a result of the Project are clearly described and evaluated.	6.0 7.0	3.0 4.0 5.0	3.1.5 4.2 5.2
7 Cumulative Effects Summary	Cumulative effects must be assessed for all relevant valued components as described in section 4.2. The developer will also provide a summary of the assessment of cumulative impacts. The summary will include a discussion of any proposed mitigations by which the developer, either on its own or cooperatively with others, will reduce or avoid any predicted cumulative impacts.	N/A	3.0 4.0 5.0	3.3 4.4 5.5

Table A-1: EA-1617-01 Terms of Reference Concordance Table (cont'd)

TOR Section	Description	Applicable Section in PDR	Applicable Section in ASR	Applicable Sub-Section in ASR
8 Follow−Up and Monitoring Programs	The PDR/ASR will include a section that summarizes proposed follow−up, monitoring and adaptive management plans and programs. This summary will: 1. Describe any monitoring, evaluation and adaptive management plans that will be used to achieve the following objectives: a. detect unexpected changes; b. determine whether impact predictions are accurate; c. evaluate the effectiveness of mitigations; d. adjust management actions to minimize adverse impacts; and e. discuss responsibilities for data collection, analysis and dissemination. 2. Describe how Project−specific monitoring will be compatible with the NWT Cumulative Impact Monitoring Program or other regional monitoring and research programs. 3. Demonstrate how the plans adhere to adaptive management best practices, such as those described in guidelines listed in Appendix A. 4. Clearly describe how these plans relate to regulatory and non−regulatory monitoring requirements for the life of the Project.		1.0 3.0 4.0 5.0	1.6 3.6 4.7 5.6
	The developer is encouraged to discuss and adopt common data collection and monitoring protocols with local and regional monitoring programs including GNWT−Environment and Natural Resources to facilitate Project impact analysis. The extent and quality of data used to establish the baseline conditions for any monitoring program should be explained.	N/A	1.0	1.6
	In addition, the developer is encouraged to use management response plans to accomplish adaptive management. Guidance on a management response framework, how to link monitoring results to management decisions and how management activities can be developed adaptively in response to changes in the environment can be found in the WLWB document Guidelines for Adaptive Management – a Response Framework for Aquatic Effects Monitoring. Draft. Oct 17, 2010	10.0 and updated plans	N/A	N/A

Notes:
a) For this EA, "species at risk" includes any species whose range is within the scope of assessment that is listed under the Species at Risk Act or the Species at Risk (NWT) Act; a species in the Northwest Territories under consideration for listing (as of July 2016); or a species considered "at risk" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).
b) According to the International Association for Impact Assessment (IAIA) guidelines on Socio-economic Impact Assessment, vulnerability is defined as "a situation or condition characterized by low resilience and/or higher risk and reduced ability of an individual, group or community to cope with shock or negative impacts. Vulnerability is associated with having low socio-economic status, disability, ethnicity, or one or more of the many factors that influence people's ability to access resources and development opportunities."
c) Residual impacts are effects that remain after the application of mitigation measures.

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description	Applicable Section in ASR	Applicable Sub-Section in ASR
3.1 Presentation of Material	Provide all ASR material according to the instructions in Section 3.1 of the TOR	Entire document	N/A
3.2 Incorporation of TK	Provide a stand-alone TK summary section in the ASR based on the instructions in Section 3.2 of the TOR.	2.0	2.4
3.3 Public Engagement	Reporting on ongoing engagement will follow the instructions in Section 3.3 of the TOR.	1.2.5, Appendix E	N/A
3.4 Developer Commitments	Provide a table of commitments, based on the instructions in Section 3.4 of the TOR.	Tables 3.2-1, 4.3-1, 5.3-1 and Appendix F	N/A
3.5 Summary Materials	Based on the instructions in Section 3.5 of the TOR, provide: ▪ a plain language summary of the response to the Adequacy Statement; ▪ a concordance table (against requirements in Adequacy Statement); and ▪ an updated list of anticipated authorizations, permits, licenses and other approvals, including any authorizations required from the Tłı̨chǫ Government, DFO or other responsible authorities that are not already covered in the PDR	Plain Language Summary Appendix A 1.0	N/A N/A 1.5
3.6 Development description	Based on the instructions in Section 3.6 of the TOR, provide: ▪ a detailed schedule for project activities (including estimated duration for each activity and any seasonal timing constraints and contingency plans), milestones, and timing of construction based on the estimated schedule; and ▪ an updated description of activities during the operations phase.	1.0 Appendix B	1.2 N/A
3.7 Land Use Plans	GNWT-DOT needs to state if accessing the borrow sources within the cultural heritage zone will alter the project and list any ensuing impacts that might result to valued components.	1.0	1.4
3.8 Developer	Provide information required under item b of Section 3.8 of the TOR.	Appendix D	N/A
4 Assessment Methodology	Project-related effects: refer to sections 4.1, 4.2, and 4.3 of this document for elaboration. Cumulative effects: refer to section 4.3 of this document for elaboration.	2.0	3.3 4.4 5.5
5 Assessment Methodology	Refer to Sections 4 and 4.3 of the Adequacy Statement	See above	N/A
6 Detailed Requirements Assessment	Refer to Section 4.3 of the Adequacy Statement	See above	N/A
7 Cumulative Effects Summary	Provide a summary of cumulative effects, based on the instructions in Section 7 of the TOR.	3.0 4.0 5.0	3.3 4.4 5.5

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description	Applicable Section in ASR	Applicable Sub-Section in ASR
8 Follow-up & Monitoring	Provide a summary, based on the instructions in Section 8 of the TOR.	3.0 4.0 5.0	3.6 4.7 5.5
4.1 Potential impacts and mitigation measures	The assessment of each Project-related environmental impact begins with a description of the mechanisms whereby specific Project components and activities could result in an impact to a valued component. For each valued component topic identified in section 2.2.2 of the Terms of Reference, the developer will clearly describe for all phases of the project: ▪ the potential impacts that may occur; ▪ the project component(s) and/or activities to which the impact is linked; and ▪ how the proposed mitigations will reduce or avoid the potential impact.	3.0 4.0 5.0	3.2 4.3 5.3
	The developer will provide a thorough description of the potential impacts and proposed mitigations associated with the adequacy items identified in section 4.3 of this document. The results should be summarized in a table.	3.0 4.0 5.0	3.2 4.3 5.3
4.2 Residual impacts	Building on the description required under section 4.1 above, the developer will predict and characterize residual environmental impacts (i.e. the environmental impacts that remain after mitigation has been applied) for all Project components. Thorough characterization of residual impacts is critical for the Review Board to make a final determination on significance at the end of the environmental assessment.	2.0 3.0 4.0 5.0	2.3 3.3 4.4 5.5
4.3 Cumulative impacts	In order to fully assess potential cumulative impacts, the developer will conduct a cumulative effects assessment for any valued component listed in Table 1 of the Terms of Reference (section 2.2.2): a) that is susceptible to cumulative effects: and b) for which project-related residual impacts are predicted.	3.0 4.0 5.0	3.3 4.4 5.5
	To complete the cumulative effects assessment for each relevant valued component, the developer will: ▪ Combine the Project-related residual impacts predicted (see section 4.2 of this document) with the impacts from the developments, human activities, climate and fire scenarios identified in the PDR: – identify and discuss the way in which a cumulative impact may occur; – predict the potential direct and indirect cumulative impacts according to the same methodology applied for assessing project-specific impacts; – describe techniques and assumptions utilized in impact prediction (e.g. models); and – discuss the contribution of the project to the overall cumulative impact. ▪ Characterize the cumulative impact according to steps 4 to 6 in section 4.1 of the Terms of Reference.	3.0 4.0 5.0	3.3 4.4 5.5

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description				Applicable Section in ASR	Applicable Sub-Section in ASR
	Topic	Adequacy Item	Relevant Methodology	Additional Requirement		
5.1 Valued Component: Fish and fish habitat	Fish Habitat	Water quality	Adequacy 4.1	Describe the potential impacts and mitigation measures to water quality related to fish and fish habitat from the use of explosives.	3.0	3.2
			Adequacy 4.2	Conduct a residual impact assessment to address potential project effects to water	3.0	3.3
		Accidents and spills	Adequacy 4.1	Describe the potential impacts and mitigation measures to fish habitat and water quality resulting from accidents or spills during construction and operation phases.	3.0	3.2
			Adequacy 4.2	Conduct a residual impact assessment to address potential project effects to fish habitat and water quality resulting from accidents or spills. Where appropriate, distinguish between construction and operation phases of the Project.	3.0	3.3
		Physical Impacts	Adequacy 4.1	Expand on the impact information listed on page 8-28 of the PDR, as per the requirements of assessment step.4.1 (Appendix A), providing all information requested in Table 4-1 of the Adequacy Statement. Indicate the species, critical life stages, and habitat these effects may apply to.	3.0	3.2
			Adequacy 4.2	Confirm whether or not the list of anticipated residual impacts on page 6 of Appendix T of the PDR is also the comprehensive list of residual impacts from all potential effects listed from pages 8-28 to 8-30 of the PDR. Conduct a residual impact assessment to address any potential project effects to fish habitat.	3.0	3.3
	Fish Harvesting		Adequacy 4.2	Conduct a residual impact assessment to address potential project effects to fish harvesting resulting from accidents or spills. Where appropriate, distinguish between construction and operation phases of the Project. Consider responses from Review Board IR#1.	3.0	3.3
			Adequacy 4.2	Conduct a residual impact assessment to address project effects on fish harvesting due to increased access and pressure from road users. Include an estimate of the likely number of additional users by category (accounting for seasonal variation): ▪ Aboriginal, non-Tłı̨chǫ harvesters ▪ NWT resident fishers ▪ Non-NWT fishers	3.0	3.3
		Important Fishing Areas	Adequacy 4.1	Describe the potential impacts and mitigation measures from increased access to the areas identified in the Traditional Knowledge Study Report (PR#28) and from responses to Review Board IR#1	3.0	3.2
			Adequacy 4.2	Conduct a residual impact assessment on the ability of the areas identified in the Traditional Knowledge Study Report (PR#28) to sustain increased use and fishery pressure.	3.0	3.3

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description				Applicable Section in ASR	Applicable Sub-Section in ASR
	Topic	Adequacy Item	Relevant Methodology	Additional Requirement	N/A	
5.2 Valued Component: Caribou	Barren- ground caribou	Mortality	Adequacy 4.1	Describe the potential impacts and mitigation measures related to barren-ground caribou as a result of increased harvesting pressure along the roads north of Whatì. Include consideration of the longer winter road season and a potential for increased road users.	4.0	4.3
			Adequacy 4.2	Conduct a residual impact assessment for barren- ground caribou from increased harvesting pressure related to the longer winter road season, including consideration of: ▪ potential impacts and mitigations that may affect population recovery; and ▪ overall effects on abundance, distribution and population trends of barren-ground caribou.	4.0	4.4
	Boreal caribou	Mortality risk	Adequacy 4.1	Describe potential impacts and mitigation measures related to boreal caribou as a result of construction and operation, including: ▪ change in harvesting pressure from a change in ▪ access into region; ▪ change in harvesting pressure north of Whatì ▪ due to extended season winter road; ▪ vehicle collisions; and ▪ changes in predator-prey relationships.	4.0	4.3; 4.4
			Adequacy 4.2	Conduct a residual impact assessment on boreal caribou from project-related activities, including the above identified effects.	4.0	4.4
		Habitat	TOR 4.1 step 1	Discuss the baseline range for boreal caribou in relation to the project and its effects, including: ▪ seasonal variation; and ▪ location of critical habitat along the road corridor.	4.0	4.2.2.1

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description				Applicable Section in ASR	Applicable Sub-Section in ASR
5.2 Valued Component: Caribou (cont'd)	Boreal caribou (cont'd)	Habitat (cont'd)	Adequacy 4.1	Describe potential impacts and mitigations from direct and indirect alteration of boreal caribou habitat, inclusive of disturbance, displacement, and barrier effects. Include potential impacts: ▪ from the road disturbance footprint; ▪ from visual, smell, noise, light, and other sensory disturbances (including potential habitat avoidance or loss of effective habitat); ▪ on critical habitat areas for various life stages and movement corridors; ▪ from dusting to boreal caribou and habitat; ▪ to loss of functional habitat due to competition with other wildlife species (in particular bison); ▪ to movement patterns, including any changes in interactions with other caribou herds; and ▪ to habitat availability and distribution, due to any increases in fires resulting from use of the road.	4.0	4.4
			Adequacy 4.2	Conduct a residual impact assessment on boreal caribou habitat from project-related activities, including the above identified impacts.	4.0	4.4
		Population health	TOR 4.1 step 1	Describe the abundance, distribution, and population of boreal caribou populations	4.0	4.4
			Adequacy 4.1	Describe the potential impacts and mitigations related to boreal caribou populations and population trends, including: ▪ potential effects on sensitive life stages or sensitive or critical habitat; ▪ potential effects on habitat use by boreal caribou; ▪ potential changes to the ability of boreal caribou habitat or populations to recover; and ▪ overall effects on abundance, distribution, and population trends of boreal caribou.	4.0	4.4
			Adequacy 4.2	Conduct a residual impact assessment on boreal caribou population health from project-related activities, including the above identified impacts.	4.0	4.4

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description				Applicable Section in ASR	Applicable Sub-Section in ASR
5.3 Valued component: Wildlife, including species at risk	The PDR provides information in sections 6.6.3, 6.5.3, and 6.8.3 regarding which wildlife (including birds, amphibians, and insects), vegetation and fish species at risk may occur in the project area. However, additional information is required regarding the habitat ranges of wildlife and species at risk and the likelihood of their presence in the immediate vicinity of the project area.				4.0	4.2
	In their PDR, the developer proposed a number of mitigations that would address project-related effects to wildlife (e.g. PR#7 p5-2, p8-15, pp8-22 to 8-25). As mentioned for caribou, above, the effectiveness of some of these mitigation measures was challenged during the preliminary screening process (see PR#24 NSMA#1- Attachment letter p8) and was a supporting rationale in the Review Board's Reasons for Decision for Environmental Assessment to refer the TASR to EA (PR#2 p1). A discussion of how likely these mitigation measures are to reduce or eliminate concerns to wildlife and species at risk has not occurred. Neither has a description of any residual effects following implementation of the mitigation measures occurred. Both steps are required to assess potential impacts of the project to wildlife and other species at risk. Table 5-3 outlines the additional assessment required for this topic.				4.0	4.3
	Topic	Adequacy Item	Relevant Methodology	Additional Requirement	N/A	N/A
	Moose, bison, wolverine	Competition	Adequacy 4.1	Describe the potential impacts and mitigations related to moose, bison and wolverine from loss of functional habitat due to competition with other species. Include the potential impact of bison moving into the project area on moose.	4.0	4.3
			Adequacy 4.2	Conduct a residual impact assessment on moose, bison and wolverine from project-related activities, including the above identified impacts.	4.0	4.4
		Mortality risk	Adequacy 4.1	Describe potential impacts and mitigation measures to reduce impacts to moose, bison and wolverine as a result of project components, including: ▪ changes in harvesting from changes in access into region; ▪ vehicle collisions; and ▪ changes in predator-prey relationships.	4.0	4.3
			Adequacy 4.2	Conduct a residual impact assessment on moose, bison and wolverine from project-related activities, including the above identified impacts.	4.0	4.4
	Species at risk	Impacts on species at risk including monitoring	Adequacy 4.2	Conduct a residual effects assessment on species at risk from project-related activities. ▪ Assess potential impacts ▪ Identify mitigation ▪ Propose monitor that considers the effectiveness of mitigation and consistency with recovery or management strategies	4.0	4.4

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description				Applicable Section in ASR	Applicable Sub-Section in ASR
5.3 Valued component: Wildlife, including species at risk (cont'd)	Species at risk for mammals, birds, fish, plants, amphibians, insects (excluding boreal caribou)	Population health	Adequacy 4.1	Describe the potential impacts to any mammal (including bats), bird, fish, plant, amphibian, and insect species at risk that have the potential to occur in the vicinity of the project	4.0	4.3
			Adequacy 4.2	Conduct a residual impact assessment on any mammal, bird, fish, plant, amphibian, and insect species at risk from project components.	4.0	4.4
5.4 Valued component: traditional use, culture, and heritage resources	Topic	Adequacy Item	Relevant Methodology	Additional Requirement	N/A	N/A
	Traditional use and way of life	Traditional use	Adequacy 4.1	Describe any potential impacts and mitigations to traditional use and way of life from project-related activities, including those identified in responses from Review Board IR#2 and from: ▪ anticipated disturbances to wildlife and wildlife movement associated with the operation of an all-season road affecting the perception of the land by traditional users; ▪ a change in perception of the land resulting in changes to traditional use or value of the area; and ▪ from increased mobility and time spent away from the community, including youth.	5.0	5.3; 5.4
			Adequacy 4.2	Conduct a residual impact assessment on traditional use and way of life affected by project-related activities, including the above-identified impacts.	5.0	5.5
	Harvesting	Wildlife harvesting	Adequacy 4.1	Describe any potential impacts and mitigations to traditional use and way of life of Whatì residents from increased competition for harvest resources resulting from increased access and use of region by outside harvesters.	5.0	5.3; 5.4
			Adequacy 4.2	Conduct a residual impact assessment on harvesting affected by project-related activities, including the above identified impacts.	5.0	5.5
	Heritage and cultural resources	Heritage resources	TOR 4.1 step 1	Describe important heritage resources for aboriginal groups that may be affected by the project and its related activities, including those identified in responses to Review Board IR#3.	5.0	5.2.11
			Adequacy 4.1	Describe any potential impacts and mitigations to heritage resources for any areas identified as valued heritage resources, including those identified in responses to Review Board IR#3.	5.0	5.4.3.3
			Adequacy 4.2	Conduct a residual impact assessment on heritage resources for any additional identified resources.	5.0	5.5.3.3
	In addition, the Review Board acknowledges that archaeological work has been completed (AOA and AIA) for the road corridor, but requires further clarification on assessing the archaeological potential of borrow sources and access to these locations.				5.0	5.4.3.3

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description				Applicable Section in ASR	Applicable Sub-Section in ASR
5.5 Valued Component: Economic Well-being	Topic	Adequacy Item	Relevant Methodology	Additional Requirement	N/A	N/A
	Equity and vulnerability	Vulnerability	TOR 4.1 step 1	Identify the most vulnerable groups in the community least likely to benefit from the Project or from reasonably foreseeable future economic activities, including those identified in the responses to Review Board information requests.	5.0	5.2
			Adequacy 4.1	Describe any potential impacts and mitigation measures related to vulnerable groups as a result of anticipated economic benefits associated with the Project, including any corresponding impact on community cohesion, and considering the responses to Review Board information requests.	5.0	5.4.2.5
			Adequacy 4.2	Conduct a residual impact assessment on vulnerable groups affected by project-related activities, including the above identified impacts.	5.0	5.5.2.5
	Traditional and Non- wage economy	Non-wage economy	TOR 4.1 step 1	Describe the non-wage economy in Whatì and the degree of local reliance on it to offset cost of living.	5.0	5.2; 5.4.3.1
			Adequacy 4.1	Describe any potential impacts and mitigation measures related to the non-wage economy from an anticipated increase in harvesting pressure and competition associated with increased access to the region.	5.0	5.4.3.1
			Adequacy 4.2	Conduct a residual impact assessment on aspects of the non-wage economy affected by project- related activities, including the above identified impacts.	5.0	5.5.1.2
5.6 Valued component: Stable and Healthy Communities	Topic	Adequacy Item	Relevant Methodology	Additional Requirement	N/A	N/A
	Use and maintenance of infrastructure	Solid waste & sewage treatment facilities	Adequacy 4.1	Describe any potential impacts and mitigations to community solid waste facilities and sewage treatment facilities used by the Project during construction and maintenance activities, including consideration of: ▪ the anticipated incremental demand on the infrastructure from construction and maintenance (e.g. tonnes of waste or volume of sewage); and ▪ the existing capacity of the infrastructure to accommodate the increased demand.	5.0	5.4.2.2
			Adequacy 4.2	Conduct a residual impact assessment on community solid waste facilities and sewage treatment facilities used by the Project during construction and maintenance activities, including the above identified impacts.	5.0	5.5.2.2

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description				Applicable Section in ASR	Applicable Sub-Section in ASR
5.6 Valued component: Stable and Healthy Communities (cont'd)	Public safety	Traffic safety	TOR 4.1 step 1	Describe the current levels of mobility for Whatì residents (i.e. movement in and out of), including: ▪ as a percentage of the community population; ▪ by age and gender; ▪ frequency during winter road season; ▪ frequency outside of winter road season; and ▪ by mode of transport.	5.0 Appendix C	Appendix C Tables C-1, C-2, C-3, C-4
			TOR 4.1 step 3a, 3b, 3d	Elaborate on how the vehicle traffic number of 20-40 vehicles per day was derived, including: ▪ proportion of public vs private traffic; ▪ seasonal variations; and ▪ anticipated rate of increase corresponding to anticipated population change and economic opportunities.	Appendix C	N/A
			TOR 4.1 step 3d	Provide an estimate on the likelihood, number and severity of motor vehicle accidents affecting Whatì and/or NWT residents on the all-season road using data from other NWT communities with road access as a reference point. Include any statistics from vehicle accidents on the annual winter road to Whatì.	5.0	N/A
	Public Safety	Accidents & Emergency Response	TOR 4.1 step 1	Describe the emergency response services for accidents on NWT public highways, including: ▪ how traffic accidents are currently managed; and ▪ who the responsible authorities are for emergency response and the planning thereof.	5.0	5.4.2.4
			TOR 8	Provide an emergency response plan for how accidents and emergencies will be addressed on the proposed TASR highway, including the responsible authorities for implementation. List any new requirements and expenses for mentioned organizations to implement the plan.	5.0	5.4.2.4

Table A-2: EA-1617-01 Adequacy Statement Concordance Table

Adequacy Statement Section	Adequacy Statement Description				Applicable Section in ASR	Applicable Sub-Section in ASR
5.6 Valued component: Stable and Healthy Communities (cont'd)	Public Safety and Community Cohesion	Well-being indicators	Adequacy 4.1	Describe potential impacts to public safety and community cohesion from construction camps, including: ▪ pregnancy; ▪ sexually transmitted infections; ▪ drug and alcohol use; and ▪ crime-violent and property.	5.0	5.4.2
			Adequacy 4.2	Conduct a residual impact assessment for the above noted indicators and their overall effect on community cohesion.	5.0	5.5
	Population sustainability	Population growth	TOR 4.1 step 3	Describe the anticipated population level change resulting from the operation of an all-season road, including: ▪ estimate the rate of population change from the time the road is constructed and projected through to include reasonable foreseeable economic activities; and ▪ list the likely source populations for people moving to Whatì. For smaller communities, provide an estimate of the migrants as a percentage of the community of origin (e.g. 10% of Gamètì).	5.0	5.2.1
			Adequacy 4.1	Describe any potential impacts and mitigation measures of the anticipated population change, including those identified in the response to the Review Board's information request to TG and CGW on population growth, and to: ▪ community stability for affected communities; and ▪ community of Whatì infrastructure (i.e. housing, sewage treatment, solid waste facility, law enforcement and health and social services).	5.0	5.4.2.1
			Adequacy 4.2	Conduct a residual impact assessment for the anticipated population change and its effect on affected communities (e.g. community stability & infrastructure).	5.0	5.5.2.1

To Table of Contents

APPENDIX F

GNWT Commitments

Most mitigation is outlined within the ASR effects pathway tables. Table F-1 lists additional mitigation not already mentioned in the ASR pathway tables. All mitigation described in the ASR and Table F-1 will be implemented by the GNWT, unless otherwise indicated.

Table F-1: GNWT Commitments to Mitigate Environmental Effects Relevant to the TASR

Document Source	Subject	Discipline	Commitment
Section 4.7 PDR	Equipment	Fish	All materials stored within the ROW will be located a minimum of 30 m from the ordinary high water mark of all adjacent waterbodies and well outside of the tree line to avoid damage to riparian habitat
ORS Comments Table Row 76	In-Field Water Analysis Plan	Fish	Water quality grab samples upstream and downstream of the four major water crossings can be added to the In-Field Water Analysis Plan to demonstrate best water quality management practices.
ORS Comments Table Row 89	ECCC #1 - Monitoring Plan In-Field Water Analysis	Fish	The plan will be updated to include grab samples of TSS at select sites/time periods over the course of construction to ensure turbidity testing remains comparable
ORS Comment Table Row 91	ECCC #2 - Baseline Data In-Field Water Analysis	Fish	Baseline data will be collected upstream of the construction activity at the same time as the downstream samples to provide surety of any difference in turbidity levels
ORS Comment Table Row 95	ECCC#4 -Turbidity sampling	Fish	The In-Field Analysis Plan can be updated to indicate the management actions that would be implemented depending on the difference between the upstream and downstream turbidity levels (including immediate response triggers such as more frequent monitoring and assessment of mitigation measure)
ORS Comment Table Row 103	ECCC#8 - Surface Water Management	Fish	The Quarry Operations Plan will follow Lands' Guidelines. Should pit drainage be planned, appropriate management techniques will be utilized. This includes designing and constructing the quarry to drain naturally without ponding or the requirement for pumping, ensuring water exists naturally through diffuse flow back into the natural environment with the avoidance of distinct run-off channels and ensuring buffer zones of undisturbed land and vegetation for water to flow exists.
ORS Comment Table Row 107	ECCC#10 - Sampling and Testing for ML/ARD	Fish	A consultant will be hired to analyze laboratory results and will indicate what parameters should be analyzed prior to sending samples to the laboratory during in-field geotechnical investigations
ORS Comments Table Row 89	ECCC #1 - Monitoring Plan In-Field Water Analysis	Fish	The In-Field Water Analysis Plan will be updated to include an appendix with the locations of the watercourse crossings and associated station numbers to be set up at the commencement of construction.
ORS Comment Table Row 97	ECCC#5 -Turbidity Regression Curve	Fish	The In-Field Water Analysis Plan will be updated to include one set of confirmatory TSS (during construction around immediate water crossing) to identify the ballpark relationship of TSS and turbidity at each site

Table F-1: GNWT Commitments to Mitigate Environmental Effects Relevant to the TASR (cont'd)

Document Source	Subject	Discipline	Commitment
ORS Comment Table Row 99	ECCC#6 - Erosion and Sediment Control Plans	Fish	DOT will be using the DOT ESC Manual as guidance in the development of an ESC plan, including monitoring, reporting and adaptive management. These plans will be finalized by the contractor ensuring the contractor is fully aware and capable of the requirements in that plan, while DOT provides oversight while remaining accountable
ORS Comment Table Row 93 & 94	ECCC #3 - Mitigation Measures for Water Quality	Fish	■ Ammonia management best practices will be implemented during use, storage, transport, and loading of ammonia explosives to mitigate impacts on water quality should AN explosives be selected by the contractor for blasting operations. ■ Should concrete be required (and cannot be precast), un-cured/partly cured concrete will be isolated from watercourses.. ■ Areas for cleaning equipment (including equipment used in concrete work) will be a minimum 30 m away (and 100 m where possible) from watercourses and will not drain into or toward watercourses In instances where fuel storage does not already incorporate 110% containment (such as drums and jerry cans vs. the larger double-walled storage tanks), containment pads will be provided for all fuel storage, dispensing and transfer sites
Section 7.1.2 PDR	Traditional Knowledge Study	Socio-Ec	Verify that the cabin sites near the Project footprint are at least 50 m away. May need to double check coordinate locations with TG prior to construction and ensure that the two cabins that will be rebuilt (burnt as a result of 2014 fire) are far enough away.
Section 5.1.2 PDR	Concerns and Mitigation	Socio-Ec	Maintain safe access to T'oohdeèhoteè, an important portage site at the La Martre River
Section 5.1.2 PDR	Concerns and Mitigation	Socio-Ec	■ Install roadside pullouts and/or snowmobile crossing signs along the TASR in areas identified as a concern. ■ During final design phase, consideration will be taken to ensure a safe snowmobile crossing is established near bridge near km 45.2. ■ Make sure other important crossings have suitable and safe crossings for snowmobiles
ORS Comments Table Row 58	Wildlife - Boreal Caribou	Wildlife	Gentle moving of caribou during construction activities will be considered when deemed safe and effective by ENR and will involve the slow approach of environmental monitors to the caribou encourage them to move. If caribou are unwilling to leave the area, operations should be suspended and people should leave the area. This may only be done when the safety of the caribou, workers or equipment are at imminent risk, otherwise operations should be suspended to allow caribou to move away on their own accord.
ORS Comments Table Row 61	Wildlife - Harvest Monitoring Barren-Ground Caribou	Wildlife	The GNWT (via ENR) will approach the Barren-Ground Caribou Technical Working Group, regarding possible approaches for monitoring wildlife harvest in relation to TASR.
OSR Comment Table Row 121	ECCC#16 Wood Bison	Wildlife	The Wildlife Management and Monitoring Plan will be updated to be consistent with the proposed Wood Bison recovery strategy to the extent feasible.

Annual Ranges of Bathurst and Bluenose East Barren-ground Herds

With respect to barren-ground caribou, please find attached two maps:

a) Bathurst Annual Density Based on Data from 1996-2015
b) Bluenose East Annual Density Based on Data 2005-2015

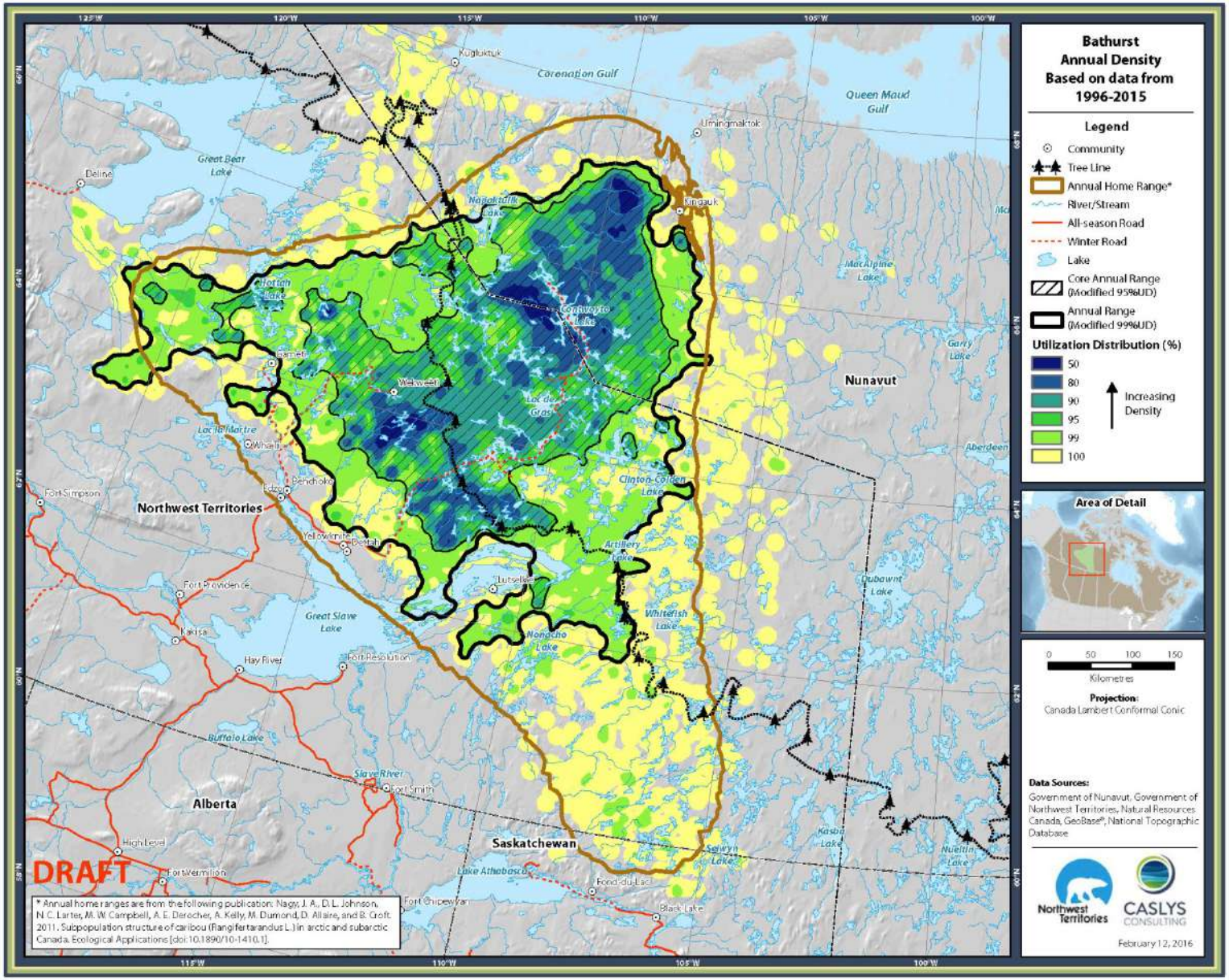
Each map depicts annual herd ranges based on caribou collaring data that have been derived from two main sources.

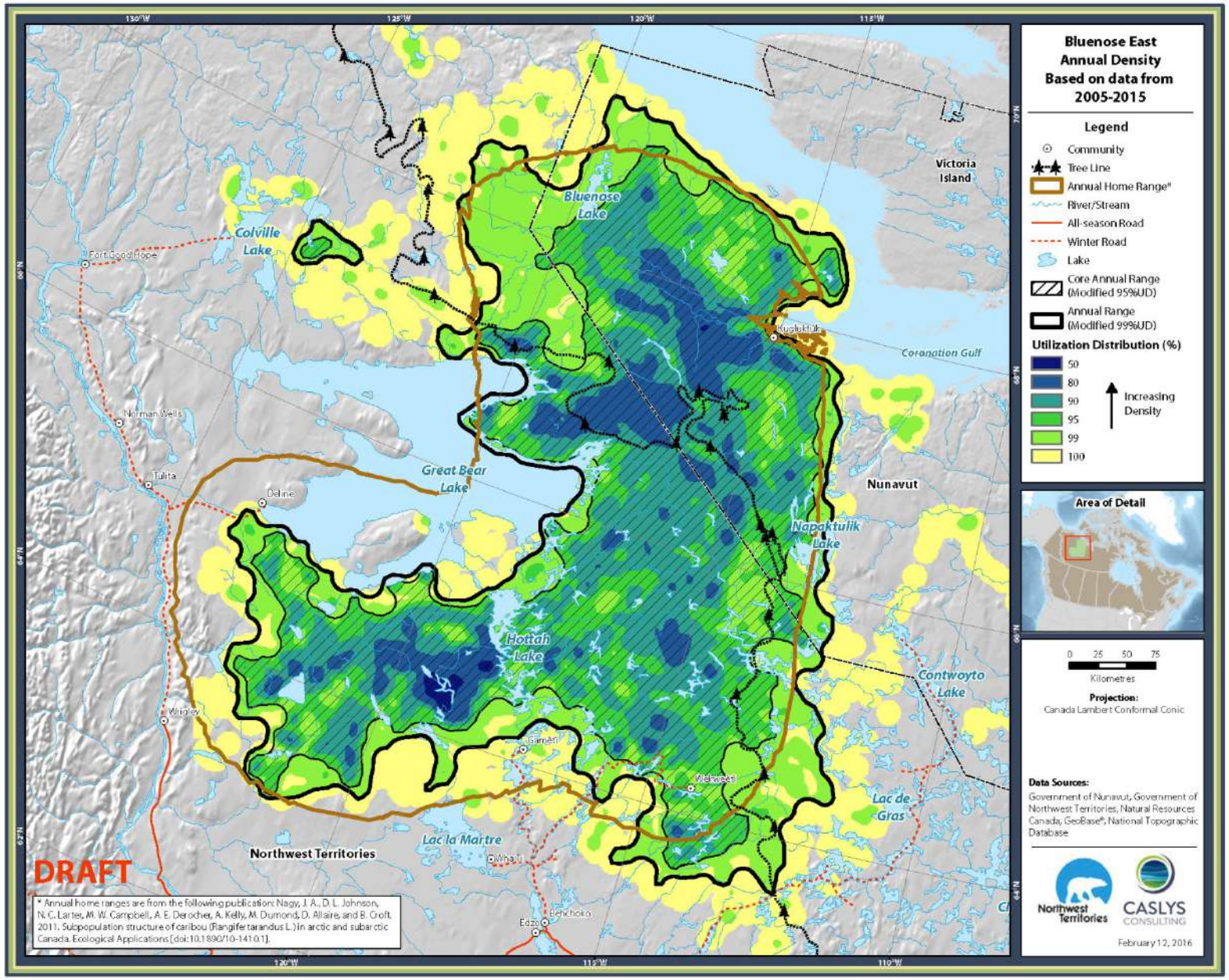
1) Nagy et al. 2011. Subpopulation structure of caribou (*Rangifer tarandus* L.) in arctic and subarctic Canada. Ecological Applications 21:2334–2348. http://dx.doi.org/10.1890/10-1410.1

- The annual range developed by Nagy et al. 2011 is shown by the brown outline in both maps, and captures the ranges at a time of relatively high population.
- This analysis was based on collared caribou telemetry data from 1996 to 2009 only. They used a hierarchical and fuzzy clustering analysis approach to generate a 90% utilization distributions, which they defined as the core range.

2) Caribou Map Atlas produced by Caslys Consulting Ltd for the Government of Nunavut, Department of Environment and the Government of Northwest Territories, Department of Environment and Natural Resources.

- The telemetry data used for this analysis is more current and ranges from 2002 to 2015.
- Satellite and GPS telemetry locations were used in a kernel density analysis to develop a Utilization Distribution (UD) which shows the density and distribution of the telemetry locations for these herds over time. The percentages associated with the UD indicate the probability of finding a caribou within the range over the specified time period and can be considered an indication of the concentration of use within the range. The maps display areas with colour gradations ranging from dark blue depicting areas that were used more frequently by collared caribou to yellow depicting areas that were less frequently used. The 100% class encompasses the full extent of all caribou locations, whereas the classes with lower percentage values are all nested within the higher classes (i.e., the 100% class contains the full extent of the 90% class, which in turn contains the full extent of all classes beneath it). Areas with a higher utilization distribution are less critical because they encompass a larger extent of the landscape. For example, within a home range there is a 100% probability of caribou being present but much of the range is not being heavily utilized at any given time. Higher use key habitat are those with lower probabilities of caribou being present relative to the whole range.
- The annual range was defined at the 99% utilization distribution.


Bathurst
Annual Density
Based on data from
1996-2015
Legend
Community
Tree Line
Annual Home Range*
River/Stream
All-season Road
Winter Road
Lake
Core Annual Range
(Modified 95%UD)
Annual Range
(Modified 99%UD)
Utilization Distribution (%)
50
80
90
95
99
100
Increasing
Density
Area of Detail
0 50 100 150
Kilometres
Projection:
Canada Lambert Conformal Conic
Data Sources:
Government of Nunavut, Government of Northwest Territories, Natural Resources Canada, GeoBase®, National Topographic Database
Northwest Territories
CASLYS CONSULTING
February 12, 2016
DRAFT
* Annual home ranges are from the following publication: Nagy, J. A., D. L. Johnson, N. C. Larter, M. W. Campbell, A. E. Derocher, A. Kelly, M. Dumond, D. Allaire, and B. Croft. 2011. Subpopulation structure of caribou (Rangifer tarandus L.) in arctic and subarctic Canada. Ecological Applications [doi:10.1890/10-1410.1].
Nunavut
Northwest Territories
Alberta
Saskatchewan
Kugluktuk
Coronation Gulf
Queen Maud Gulf
Umingmaktok
Great Bear Lake
Deline
Najoktalik Lake
Kingauk
MacAlpine Lake
Hottah Lake
Contwoyto Lake
Garry Lake
Aberdeen
Clinton-Colden Lake
Fort Simpson
Fort Providence
Great Slave Lake
Kakisa
Hay River
Fort Resolution
Buffalo Lake
Slave River
Fort Smith
High Level
Fort Vermilion
Lake Athabasca
Fond-du-Lac
Black Lake
Kasba Lake
Nueltin Lake
Selwyn Lake
Dubawnt Lake
Whitefish Lake
Nonacho Lake
Artillery Lake
Lutselke
Yellowknife
Behchoko
Edzo
Wekweeti
Lac de Gras
Lac La Martre
Wha Ti
Gamèti


Bluenose East
Annual Density
Based on data from
2005-2015
Legend
Community
Tree Line
Annual Home Range*
River/Stream
All-season Road
Winter Road
Lake
Core Annual Range
(Modified 95%UD)
Annual Range
(Modified 99%UD)
Utilization Distribution (%)
50
80
90
95
99
100
Increasing
Density
Area of Detail
0 25 50 75
Kilometres
Projection:
Canada Lambert Conformal Conic
Data Sources:
Government of Nunavut, Government of Northwest Territories, Natural Resources Canada, GeoBase®, National Topographic Database
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Bluenose Lake
Colville Lake
Fort Good Hope
Norman Wells
Tulita
Deline
Great Bear Lake
Victoria Island
Kugluktuk
Coronation Gulf
Nunavut
Napaktulik Lake
Hottah Lake
Contwoyto Lake
Lac de Gras
Lac la Martre
Wrigley
Gamètì
Wekweètì
Whatì
Behchokò
Edzo
Northwest Territories

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