



Back River Project

2019 Pre-Construction Wildlife Mitigation and Monitoring Program Report

March 2020

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GLOSSARY AND ABBREVIATIONS

CESSC	Canadian Endangered Species Conservation Council
CWS	Canadian Wildlife Service, a division of ECCC
ECCC	Environment and Climate Change Canada
FEIS	Final Environmental Impact Statement
GN DOE	Government of Nunavut Department of Environment
GNWT ENR	Government of Northwest Territories Department of Environment and Natural Resources
Goose Site	The planned mine location; currently houses the Goose camp and airstrip used for advanced exploration.
INAC	Indigenous and Northern Affairs Canada (renamed Crown-Indigenous Relations and Northern Affairs Canada in July 2019)
KIA	Kitikmeot Inuit Association
MLA	Marine Laydown Area; located on the west coast of Bathurst Inlet.
NIRB	Nunavut Impact Review Board
NWB	Nunavut Water Board
the Project	Back River Project
PDA	Project Development Area; the area approved for development by the NIRB.
Q3	Third quarter
Sabina	Sabina Gold & Silver Corp.
WIR	Winter Ice Road connecting the MLA and Goose Site
WMMP Plan	Wildlife Mitigation and Monitoring Program Plan

1. INTRODUCTION

1.1 Project Overview

The Back River Project (the Project) is a gold mining project owned by Sabina Gold and Silver Corp. (Sabina), located in the Kitikmeot Region of Nunavut (Figure 1.1-1). The Project is largely located on Inuit Owned Land (IOL) and has two centres of activity that are connected by a Winter Ice Road. The two centres of activity are a Marine Laydown Area (MLA) located in Bathurst Inlet and the Goose Property Area (Goose site) about 160 km south of the MLA where the mine will be located.

The Project holds Project Certificate No. 007 from the Nunavut Impact Review Board (NIRB) and a Type A Water License from the Nunavut Water Board (NWB). Currently, the Project is in the pre-construction phase, with a camp and infrastructure at the Goose site and MLA.

1.2 2019 Project Activities

During 2019, pre-construction and exploration activities occurred at the Goose site and the MLA.

The Goose site previously included a camp and facilities that were used during the exploration phase of the Project from the early-2000s to 2018, and continued to be used in 2019. This includes administration, accommodations and kitchen buildings, workshops and storage buildings, a fuel depot, heli-pads, a 900 m all-season airstrip, an all-season road connecting the camp and airstrip, and a quarry.

No new earthworks were constructed at the Goose site in 2019. During 2019, the Goose site supported a mineral exploration program in the areas surrounding the Goose site, and the George exploration camp to the north-west of the Goose site. Pre-construction also progressed by making use of the existing exploration infrastructure and resources and a winter airstrip.

No new earthworks or camp construction occurred at the MLA during 2019. During the spring and summer of 2018, the Marine Laydown Area (MLA) at Bathurst Inlet was expanded from a 10-person starter-camp to including the addition of: a 1,500 metre ice airstrip, a 45-person all season camp, 730,000 liter fuel storage depot, desalination water plant, waste management infrastructure, satellite communications, power generation, heavy equipment roads, a barge offloading shore ramp, 6 hectare storage/laydown pads and a portion of an on-site road was upgraded to function as a 1,200 metre all-season gravel airstrip capable of Dash 7-sized aircraft landings.

During the fall of 2018, the first sea-lift of equipment and fuel for the Goose site was delivered to the MLA. Between mid-December of 2018 and mid-April of 2019, a Winter Ice Road (WIR) was constructed between the MLA and the Goose Site. From the MLA, the WIR was constructed on the sea ice to the southern end of Bathurst Inlet, where it crossed to Bathurst Lake. From the southern tip of Bathurst Lake, the WIR followed the route outlined in the water license permit to the Goose site, traversing lakes wherever possible and land-based portages between lakes. Construction occurred from a mobile camp towed on skis on the road route ("Forward Camp"). Approximately 60 loads of equipment and fuel were transported using standard A-train trucks between April 19 and May 10, 2019. Ancillary maintenance equipment and wildlife observation vehicles traversed the route daily. In August and September 2019 one 10 ML fuel tank was constructed at the MLA.

Aircrafts (including Dash-7, Twin Otter, Hercules, etc.) were used at the site, including 83 fixed wing flights to the Goose site and 105 flights to the MLA during the winter and spring of 2019 to bring in crews, equipment, and fuel. Smaller planes, Dash-7 or similar, were used each week for crew changes and equipment. A helicopter was on site to support ongoing exploration and environmental studies from May to early August, 2019, and again in September 2019.

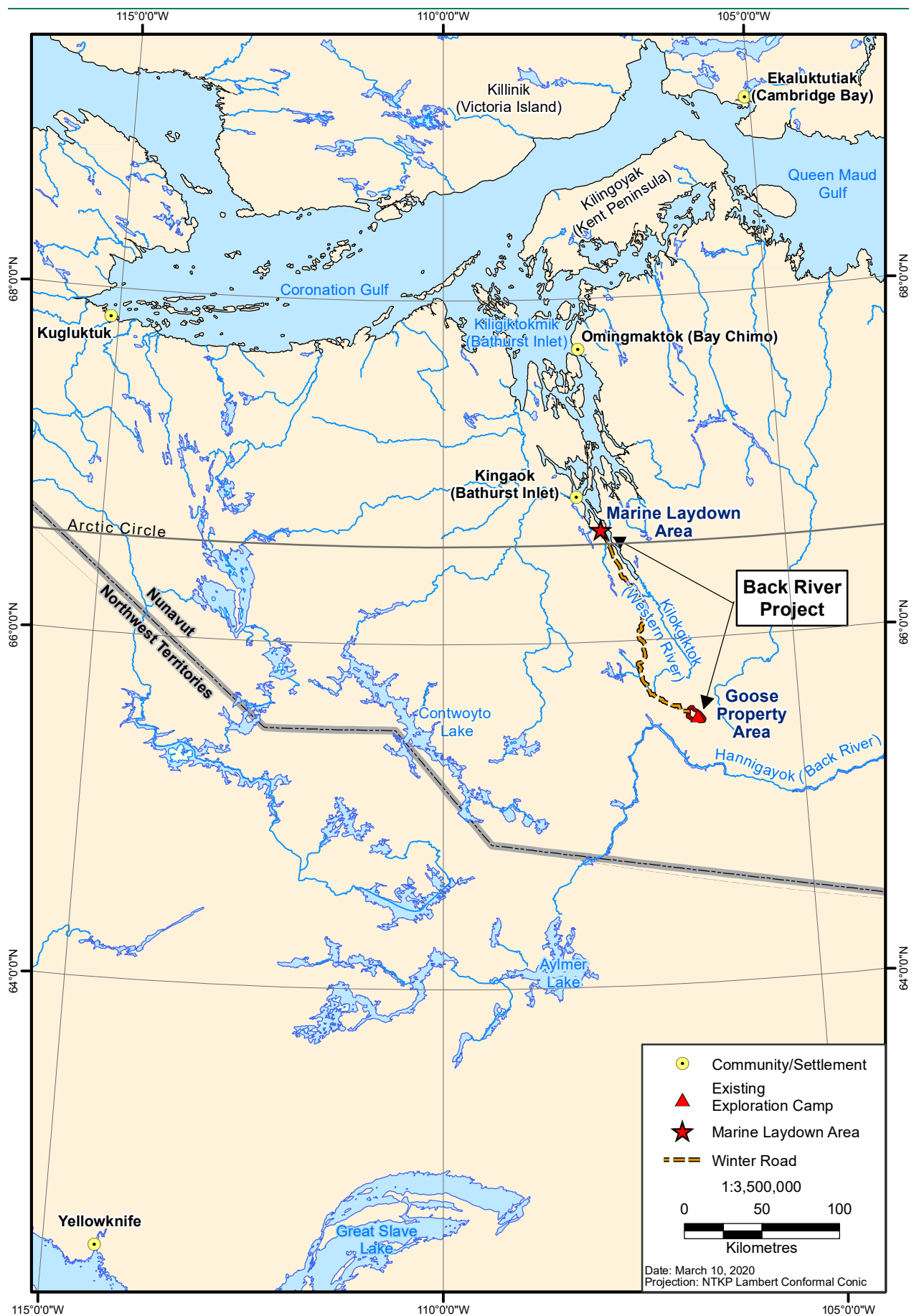


Figure 1.1-1: Back River Project Location

2. OVERVIEW OF PRE-CONSTRUCTION WILDLIFE MITIGATION AND MONITORING PROGRAM

In 2019, the Back River Project was in the pre-construction phase of the Project. Reporting requirements outlined in the WMMP Plan, Chapter 19 (ERM 2019), state that the WMMP compliance reporting will occur during construction, operation, care and maintenance, and closure (excluding periods of temporary closure and post-closure).

This Pre-Construction WMMP Report presents the mitigation and incidental monitoring conducted during this phase, as per Table 6.2-1 in the WMMP Plan, and presented in Appendix 2A. For reference, Appendix 2A also outlines the various monitoring and mitigation that will occur during later phases of the project (construction, operation, care and maintenance, and closure).

2.1 The Wildlife Mitigation and Monitoring Program Plan

This document reports the results of the wildlife mitigation and monitoring program during pre-construction, as described in the Wildlife Mitigation and Monitoring Program (WMMP) Plan.

The WMMP Plan describes all of the mitigation and management activities conducted by Sabina to keep wildlife and wildlife habitat safe. The WMMP Plan also includes a description of two types of Project monitoring activities: 1) monitoring used to direct management activities (including incidental observations), and 2) monitoring of Project effects to confirm impact predictions made in the Final Environmental Impact Statement (FEIS). This document does not include the second type of monitoring (monitoring of Project effects), as the project is in the pre-construction phase. Monitoring of Project effects will begin during the construction phase of the Project.

The WMMP Plan was included in the FEIS and was updated several times following discussions with regulators including the Kitikmeot Inuit Association (KIA), Government of Nunavut Department of Environment (GN DOE), and Government of Northwest Territories Department of Environment and Natural Resources (GNWT ENR).

During 2019, the WMMP Plan was updated to Version 10 to include commitments made by Sabina in response to comments and suggestions made by the Kitikmeot Inuit Association (KIA). The WMMP Plan will be updated as needed during the life of the Project in conjunction with the KIA, GN, GNWT, and community members and groups.

NIRB Project Condition 51 describes a collaborative Caribou Technical Advisory Group (CTAG) that reviews and provides comments on the WMMP Plan. The CTAG is composed of representatives from Sabina, the KIA, the GN DOE and other experts requested by the representatives to address particular issues. Version 9 of the WMMP Plan was updated in 2018 and was delivered to the NIRB in May 2019 as part of Sabina's annual NIRB Report. During 2019, the WMMP Plan was updated to Version 10 to include a commitment made by Sabina in response to comments and suggestions made by the Kitikmeot Inuit Association regarding contact telephone numbers in case of fuel spills.

The CTAG met on December 10, 2019 and discussed the following: pre-development work activities and planned activities for 2020; the CTAG Terms of Reference; the 2018 WMMP Report; a report on caribou crossing the 2019 winter ice road during spring migration; and an update on developments in high powered cameras for the Project.

In addition to the WMMP Plan, Sabina has also produced detailed memos to discuss particular aspects of management with the CTAG. Sabina has also produced detailed Standard Operation Procedures (SOPs) to operationalize aspects of the WMMP Plan, the SOPs communicate requirements to subcontractors such as shipping and aircraft companies. These memos and SOPs are included in the NIRB Report (Sabina 2019) where they are relevant for meeting a NIRB Certificate Condition.

2.2 NIRB Conditions

The NIRB Project Certificate (No. 007) includes 28 Conditions for wildlife. Compliance with these Conditions is described in the 2019 NIRB Compliance Report.

2.3 Monitoring in 2019

The primary component of the pre-construction monitoring program in 2019 was recording incidental observations of wildlife by Project personnel to determine whether wildlife Valued Ecosystem Components (VECs) or other species of interest such as fox are interacting with Project personnel or infrastructure and remaining safe.

The purpose of documenting wildlife incidental observations is to reduce the potential for wildlife-related safety concerns for employees, and to minimize potential effects of mine activities on wildlife. Natural wildlife activity and ecological processes are left undisturbed unless there is risk of harm to on-site personnel. As part of the wildlife monitoring, all wildlife sightings are recorded and reviewed to develop mitigation measures and adaptive management procedures for re-occurring incidents, if they occur.

Wildlife effects monitoring (monitoring wildlife populations to confirm predictions made in the Project FEIS) will begin with construction and continue during operation.

In 2019, the following components of the WMMP Plan and associated Project Conditions were carried out as part of pre-construction:

- Section 3: Tracking Habitat Loss (Section 7.2.2.1 of WMMP Plan)
- Sections 5.1 and 6.1: Fixed Wing Aircraft and Helicopter Management (Section 7.1 of WMMP Plan, Conditions 60 and 61)
- Section 5.2: Traffic/Vehicle Management (Section 7.1 WMMP Plan)
- Section 5.3: Winter Ice Road Management (Section 7.1.6 of WMMP Plan)
- Section 5.4: Blasting Management (Section 7.1 of WMMP Plan)
- Section 5.5: Waste Management Monitoring/Bear Safety (Section 6 of WMMP Plan, Table 6.2-1, Condition 48)
- Sections 5.6, 6.3 and 7.3: Incidental Wildlife Reporting (Section 6 of WMMP Plan, Table 6.2-1)
- Section 6.2: Construction Timing Windows (Section 11.1.3.2 of WMMP Plan)
- Section 7.1: Shipping Management (Section 13, 14, and 15 of WMMP Plan, Conditions 58, 64, and 65)
- Section 7.2: Seal Lair Management (Section 14 of WMMP Plan, Condition 63)
- Section 8: Species at Risk Table Update (Section 4.1 of WMMP Plan, Condition 55)
- Section 9: Mortality Reporting (Section 7.1 of WMMP Plan, Conditions 46 and 59)

3. HABITAT LOSS

The FEIS described the wildlife habitat that will be lost within a permitted Project Development Area (PDA); composed of the Project footprint and a 1-1.5 km buffer. The WMMP Plan includes monitoring and reporting of the area of habitat loss in each year of construction and operation of the Project. Habitat loss is reported here to provide a measure of habitat loss due to exploration activities prior to 2018 and due to pre-construction activities in 2019.

Direct loss of wildlife habitat may occur through site clearing, infrastructure construction, and facility expansion. Habitat loss is evaluated as the direct loss of vegetation communities due to the Project footprint.

3.1 Methods

During the pre-construction phase of the project, the amount of habitat loss is expressed as proportion of the Project Development Area (PDA). The total area constructed in 2019 was calculated and compared to the total area of the PDA using GIS analysis.

For each wildlife VEC, a GIS analysis was conducted by overlaying the existing footprint of camps and other facilities with the habitat suitability mapping for caribou (summer and fall), muskox (summer/fall and winter/early spring), grizzly bear (spring, summer, fall, and denning), wolverine (denning), wolf (denning), upland breeding birds (dry upland/moist-wet lowland), waterbirds (waterbodies/wetlands), and raptors (cliff-nesting including a 1 km foraging buffer, and ground-nesting).

3.2 Results and Discussion

There was no new earthworks that occurred at the MLA or at the Goose site in 2019. Therefore, the amount of lost habitat remains the same as in 2018. Collectively, the Project footprint covers 35.9 ha to date (Table 3.2-1; Figure 3.2-1).

Table 3.2-1: Footprint Development within the Project Development Areas as of 2019

Project Area	Pre-2019 (ha)	2019 (ha)	Total (ha)
Goose Site	17.9	0	17.9
MLA	18.0	0	18.0
Total	35.9	0	35.9

The Goose PDA is approximately 5,427 ha; therefore, a total of 17.9 ha of the Goose PDA has been constructed (0.3% of the Goose PDA), as of 2019.

The MLA PDA is approximately 653 ha; therefore, as of 2019, 18 ha of the MLA PDA has been constructed (2.7% of the total MLA PDA).

The Back River FEIS (2015) assessed the impacts of predicted habitat loss on VEC species or group. Table 3.2-2 summarizes the amount of habitat lost for each wildlife species as of 2019, with no changes occurring between 2018 and 2019.

The magnitude of predicted habitat loss was classified as low for caribou, grizzly bear, wolverine, grey wolf, muskox, upland breeding birds, waterbirds, and raptors. The predictions of the Back River FEIS on the VECs remain valid with respect to the Project footprint.

Table 3.2-2: Area of Suitable Habitat Lost for Wildlife VECs

Species	Season or Habitat Type	Total FEIS Predicted Loss in the PDA (ha) ¹	FEIS Predicted Loss in the MLA PDA (ha)	FEIS Predicted Loss in the Goose PDA (ha)	Pre-2019 Habitat Loss (ha)	2019 Habitat Loss (ha)	Total Habitat Loss to Date (ha)	% of Predicted Loss
Caribou	Summer	5,389	542	4,847	34	0	34	0.6
	Fall	4,592	532	4,060	35	0	35	0.8
Muskox	Summer/Fall	2,302	491	1,811	16	0	16	0.7
	Winter/Early Spring	882	29	853	2	0	2	0.2
Grizzly Bear	Spring	4,324	296	4,029	31	0	31	0.7
	Summer	4,545	616	3,929	32	0	32	0.7
	Fall	4,032	516	3,517	32	0	32	0.8
	Denning	23	23	0	1	0	1	4.3
Wolverine	Denning	2,866	299	2,567	20	0	20	0.7
Wolf	Denning	67	37	31	1	0	1	1.5
Upland Breeding Birds	Dry upland/ Moist-Wet Lowland	4,905	532	4,372	35	0	35	0.7
Waterbirds	Waterbodies/ Wetlands	2,489	337	2,152	12	0	12	0.5
Raptors	Cliff-nesting/ Foraging habitat ²	633	5	629	9	0	9	1.4
	Ground-nesting	2,806	363	2,443	12	0	12	0.4

Notes:

¹ Potential Development Area without Winter Roads

² Suitable cliff-nesting habitat was defined as 1) areas within a 1 km radius from known raptor cliff nests, and 2) south-facing rock faces taller than 10 m and within 1 km of water. No cliffs were lost during construction. The 9 ha are within the 1 km buffer.

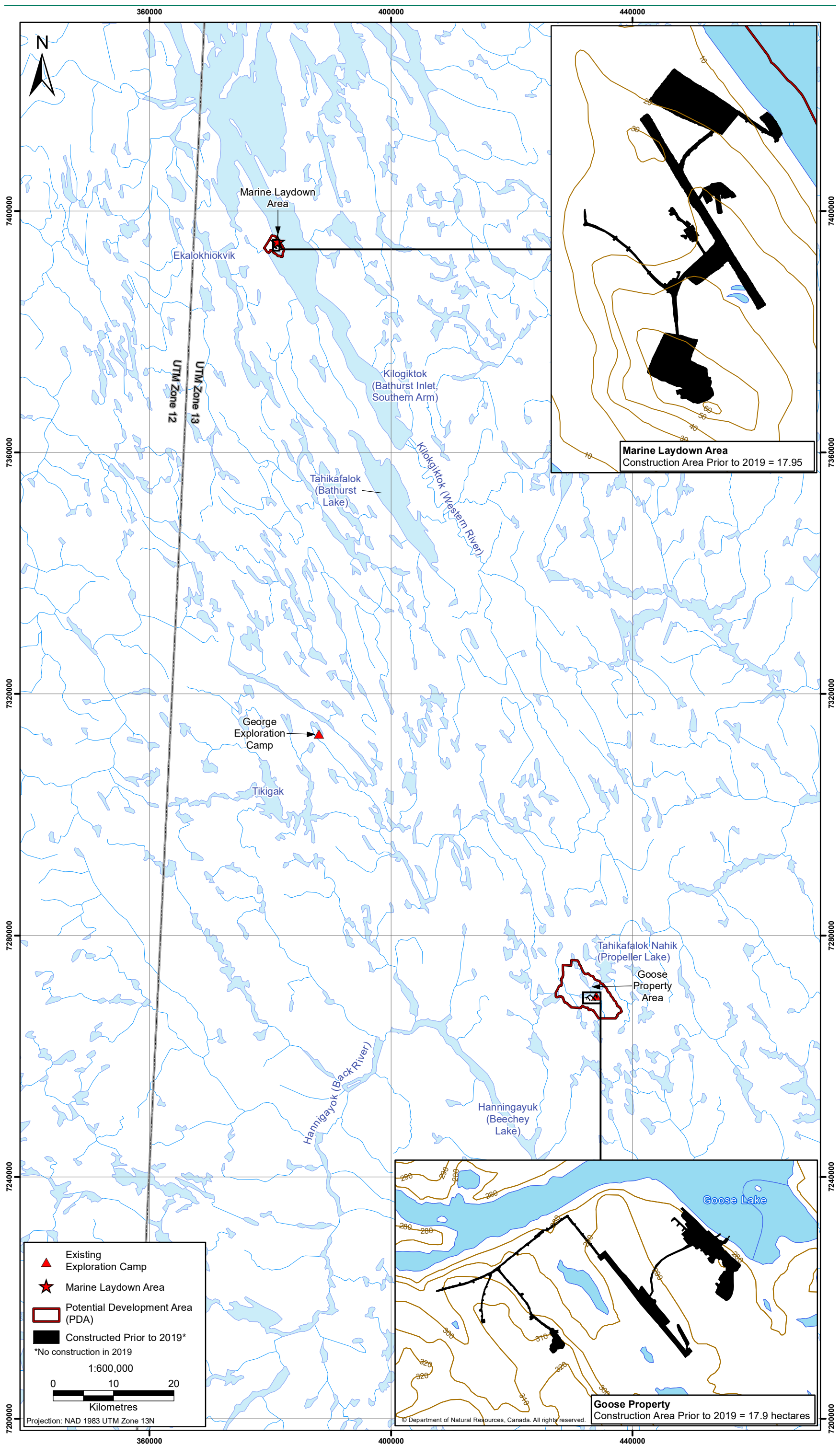


Figure 3.2-1: Infrastructure Development at the Back River Project as of 2019

4. CARIBOU MITIGATION AND MONITORING SUMMARY

This section summarizes caribou mitigation and management during 2019. Details of mitigation and management for all terrestrial mammals, including caribou, are provided in Section 5.

The WMMP Plan describes the mitigation program for caribou, and the monitoring programs designed to detect caribou and inform mitigation, and to monitor for Project effects.

In 2019, the Project was in the pre-construction phase, with activities similar to an exploration camp, including two active camps (Goose and the MLA) for periods of the year, an active drilling program at Goose, cargo aircraft, aircraft conducting crew changes and a helicopter supporting the drilling program and environmental work. One 10 ML fuel tank was also constructed at the MLA. The full construction and mine operation activities have not yet begun, including open pit activities such as blasting, hauling of ore and waste rock and operation of the mill.

The majority of mitigation activities and monitoring described in the WMMP Plan is intended for the construction and operation phases of the Project.

Monitoring and mitigation for caribou during pre-construction in 2019, as well as a summary of the outcomes of the mitigation, included the following:

- Monitoring for caribou prior to blasting in quarries and delaying quarry blasts if groups of caribou were present.
 - Outcome: No blasting was conducted in 2019.
- Monitoring by drivers of heavy vehicles (excavators and dump trucks) on the roads within the camps (on-site) for caribou and pausing if groups of caribou were on or near the road (Section 5.2).
 - Outcome: No caribou were reported by drivers of heavy vehicles in 2019.
- Monitoring by drivers of light vehicles on the on-site roads for caribou and pausing if individual caribou were on or near the road (Section 5.2).
 - Outcome: Caribou were incidentally observed along the WIR in 2019 (Section 5.3.3.1 and Section 5.6.1). Caribou were given the right of way and no caribou incidents occurred along the WIR or site roads in 2019.
- Monitoring by helicopter pilots for caribou and avoidance of any animals by 1 km horizontal or 610 m vertically (larger distances during calving and post calving; see Section 5.1 for flight tracks).
 - Outcome: No caribou were reported by pilots in 2019.
- Pre-flight inspections of airstrips for caribou and delaying flights if caribou were on or near the airstrip.
 - Outcome: No caribou were observed on airstrips during pre-flight inspections in 2019 (Section 5.1.1).
- Because the winter ice road remained open after April 15, 2019, a “Caribou Winter Ice Road Crossing Analysis” was completed. The objective of this analysis was to explore the movement of barren-ground caribou in relation to the construction of a winter ice road (WIR) in 2019 to determine if the road altered caribou movement.
 - Outcome: The analyses of the caribou collar data did not identify any significant changes in caribou movement patterns following WIR construction in 2019, either from hesitation or from changes in direction in response to the presence of the road (Section 5.3.5; Appendix 5C).

In addition, standard mitigation measures were carried out to protect the general environment, including caribou. These, as well as a summary of the outcomes of the mitigation, included the following:

- Keeping the Goose and MLA sites clean so animals would not encounter garbage or become trapped or entangled in materials.
 - Outcome: No caribou were observed in 2019 interacting with attractants (see Section 5.5).
- Managing waste materials so animals were not attracted and cannot access the waste management facility.
 - Outcome: No caribou were observed in 2019 near waste (Section 5.5).
- Managing fuels and hazardous substances and reporting and cleaning up any spills.
 - Outcome: There were 22 minor spills at the Project in 2019. No caribou or other wildlife interacted with the spills and all spills were managed following the Fuel and Spill Management Plans (Section 6.1.3 of the WMMP Plan). No incidents involving caribou and spills occurred in 2019.
- Speed limits on vehicles.
 - Outcome: Speed limits were followed and no encounters between caribou and vehicles occurred in 2019 (Section 5.2).
- Directions for pilots to keep minimum flight elevations when caribou were observed (Section 5.1).
 - Outcome: No caribou were reported by pilots in 2019.

During 2019, there were 36 separate incidental observations of caribou of approximately 14,979 animals (Appendix 4A; Section 5.5.1). This does not indicate that 14,979 individual animals were observed, as animals likely were observed on more than one occasion. Twenty-two of the 36 incidental observations of caribou, accounting for over 98% of observed animals (estimate of approximately 14,710 animals), occurred during the spring migration or calving periods (April 15 to June 15). Caribou were observed in all project areas (Goose, MLA, WIR, and Forward Camp) during this period.

5. TERRESTRIAL MAMMALS

During 2019, mitigation and monitoring focused on the reduced list of activities conducted during pre-construction. This section describes the mitigation and monitoring results conducted for terrestrial mammals (including caribou) during 2019.

Mitigation included:

- Aircraft management;
- Vehicle management;
- Winter ice road management;
- Pre-blast management and monitoring; and
- Bear safety and waste management (managing attractants).

Monitoring included:

- Incidental observations.

5.1 Aircraft

Fixed wing and helicopter aircraft operation guidelines were developed and provided to pilots to guide aircraft operation at the Project. These guidelines met the Back River Project NIRB Project Certificate (No. 007) Conditions #60 and #61.

The SOP for aircraft was included as an Appendix of the Back River Project 2018 NIRB Annual Report.

Management of aircraft discussed in the SOP for aircraft is summarized below in Section 5.1.1, following NIRB Condition #60. Monitoring of helicopters is summarized in Section 5.1.2, following NIRB Condition #61.

5.1.1 *Mitigation for Aircraft*

The following list describes the mitigation actions applied to fixed-wing aircraft during pre-construction in 2019 to limit disturbance to caribou and other terrestrial mammals, as well as a summary of the outcomes of the mitigation:

- Fixed-wing aircraft remained above 610 m local ground level at all times, except when landing or taking off from the MLA or the Goose airstrips or ice airstrips.
 - Outcome: No low-level fixed wing flights were conducted in 2019.
- If large groups of caribou were near the airstrip during calving or post calving, flights were suspended or delayed.
 - Outcome: No large groups of caribou were observed at airstrips during 2019.
- Prior to aircraft landing on the airstrip, a visual inspection was conducted to identify the presence of any wildlife on the airstrip.
 - Outcome: No wildlife were observed during pre-landing inspections in 2019.

The following mitigation actions were applicable to helicopters during pre-construction in 2019 to limit disturbance to caribou and other terrestrial mammals:

- As part of pilot induction, pilots were informed of the seasons when caribou are more sensitive to disturbance (e.g., calving and post-calving) and their responsibilities to monitor, report, and avoid

caribou. Maps were provided to pilots that identify important habitat areas for wildlife to be avoided, such as caribou water crossings.

- Pilots were instructed to report all incidental sightings of caribou to other pilots and the Environment Department.
- During calving, post-calving, and early summer (June 5 to July 31), helicopter pilots were instructed to avoid groups of 25 or more caribou either vertically (610 m) or horizontally (2 km).
- During all seasons, pilots avoided groups of less than 25 caribou vertically (610 m) or horizontally (1 km).
- During calving, post-calving, and early summer (June 5 to July 31), large groups of caribou (more than 250) were avoided by 610 m vertically or 4 km horizontally.
- These buffers applied to engine start-up, take-off, landing, and in-flight.
 - Outcome: No caribou were reported by helicopter pilots and as such, no management actions were reported.

5.1.2 *Monitoring Aircraft*

NIRB Condition #61 indicates that aircraft should be monitored.

5.1.2.1 *Methods*

Fixed wing flights were recorded on pilot's logs.

The tracks of helicopters were recorded using a Global Positioning System (GPS), which recorded the track, including the time, latitude, longitude and elevation. Helicopter GPS tracks were analyzed using GIS by counting the number of helicopter flight lines with an elevation below 610 m. The WMMP Plan indicates 610 m vertical flying altitude for avoiding caribou disturbance; therefore, this threshold was used to illustrate flights below this altitude during pre-construction activities in 2019.

5.1.2.2 *Results and Discussion*

Fixed Wing Aircraft

Pilots followed flying guidelines during the 2019 season for both fixed wing and helicopters.

Fixed wing aircraft typically cruised at approximately 3,000 - 7,000 metres, depending on whether or not they were pressurized. Descents and ascents to and from landing were conducted following standard procedures to maintain safe approach angles and minimum elevations. No fixed-wing pilots reported any emergencies or weather conditions which required low-level flight (below 610 m).

Prior to all aircraft take-off and landing at the airstrip, a survey for wildlife was conducted to ensure safe departure and/or arrival for aircrafts and for wildlife. No interactions with wildlife occurred.

Helicopters

Helicopter pilots did not report any incidental sightings of caribou or other wildlife. Therefore, no management actions were triggered and helicopter use was in compliance with the WMMP Plan and NIRB Conditions.

Although no incidental wildlife sightings were reported by pilots, pilots avoided flying close to the ground even when wildlife were absent, except when doing short-distance drill moves or approaching/leaving landing sites. Figure 5.1-1 shows the frequency of helicopter flights at the project between May and August, 2019, while a helicopter was on site. Dark green indicates one flight over the season, and red indicates the highest frequency of flights.

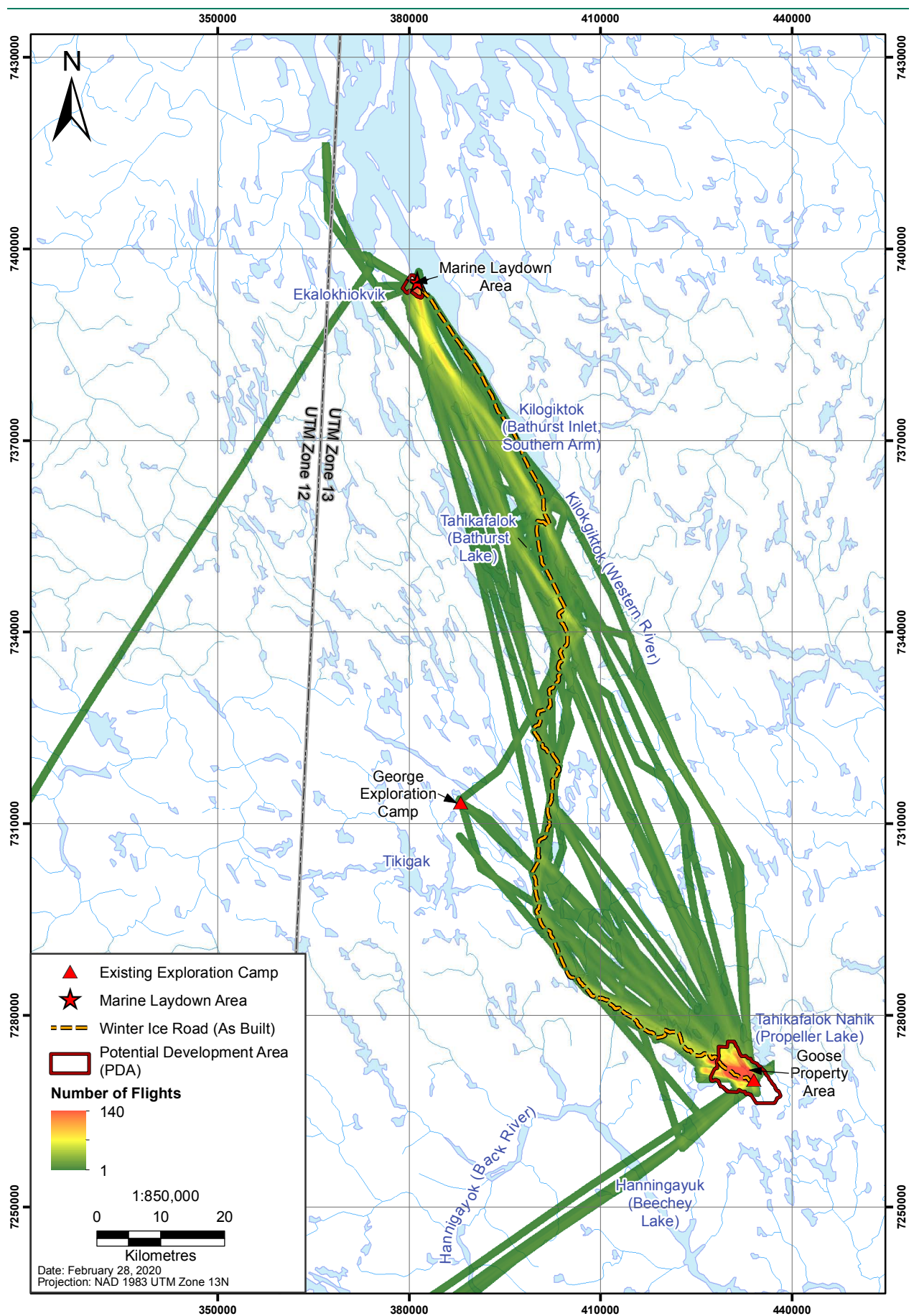


Figure 5.1-1: Frequency of Helicopter Flights Below 610 m, May to August, 2019

This figure shows that the vast majority of helicopter flights were localized to the area surrounding the Goose site where drilling activities occurred. Each drill move requires approximately 20 return flights. Drill moves were only conducted when caribou were not within the disturbance buffers described above and in the WMMP Plan.

Shuttle flights were also carried out between the Goose and George sites and between Goose and the MLA.

5.2 Vehicles along On-Site Roads

The Back River Project is committed to ensuring wildlife safe passage near Project roads. Mitigation and management for disruption of movement of caribou and other wildlife focuses on management of the on-site Project roads. Mitigation for vehicles on-site is summarized below in Section 5.2.1. Management is the same for drivers on-site and on the WIR; however, the WIR mitigation is presented separately in Section 5.3.1.

5.2.1 Mitigation for Vehicles

Vehicle traffic is managed to ensure caribou and other wildlife can travel safely through the area and to minimize vehicle-related wildlife mortality and injury.

The following list describes the responsibilities of all drivers to mitigate effects on wildlife, as well as a summary of the outcomes of the mitigation:

- Drivers must follow 60 km/h speed limits on all on-site roads.
 - Outcome: No speeding violations were reported in 2019.
- Wildlife have right-of-way on all roads.
 - Outcome: Drivers yielded the right-of-way to wildlife.
- Drivers will report all wildlife observations to the Environment Department.
 - Outcome: Drivers reported all wildlife observations to the Environment Department. One muskox was observed on July 24, 2019 from the road to the treatment plant (Appendix 5A).
- Drivers will report any wildlife injury or mortality to the Environment Department.
 - Outcome: No wildlife injuries or mortalities occurred along the roads in 2019.
- If drivers see wildlife on or along the road, they refer to Figure 5.2-1 for specific actions.
 - Outcome: Drivers referred to Figure 5.2-1 and followed management guidelines for specific actions when the muskox was observed along the road.

5.2.2 Monitoring Wildlife from Vehicles

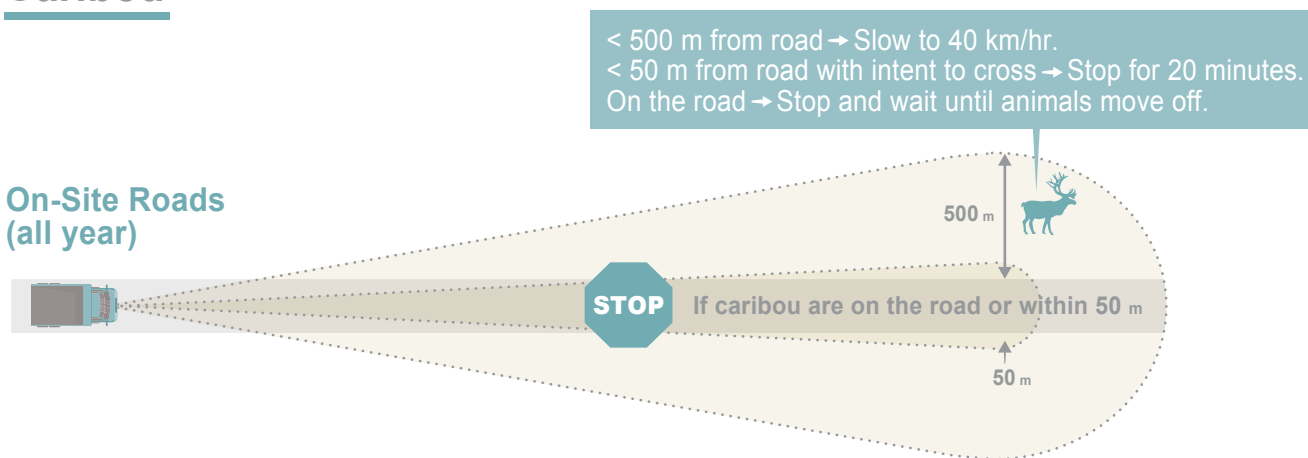
During 2019, no wildlife interactions on the road were reported, as all mitigation measures were followed by drivers on Project roads. No wildlife injuries or mortalities occurred in 2019 as a result of vehicle interactions.

5.3 Winter Ice Road

The Back River Project is committed to ensuring wildlife safe passage near the WIR. Mitigation and management for disruption of movement of caribou and other wildlife focuses on management of the WIR, as per Section 7.1.6 of the WMMP Plan (Sabina 2019). Mitigation for vehicles is summarized below in Section 5.3.2.

Caribou

On-Site Roads (all year)



Muskox, Grizzly Bear, Wolverine, Wolves, and Foxes

On-Site Roads (all year)

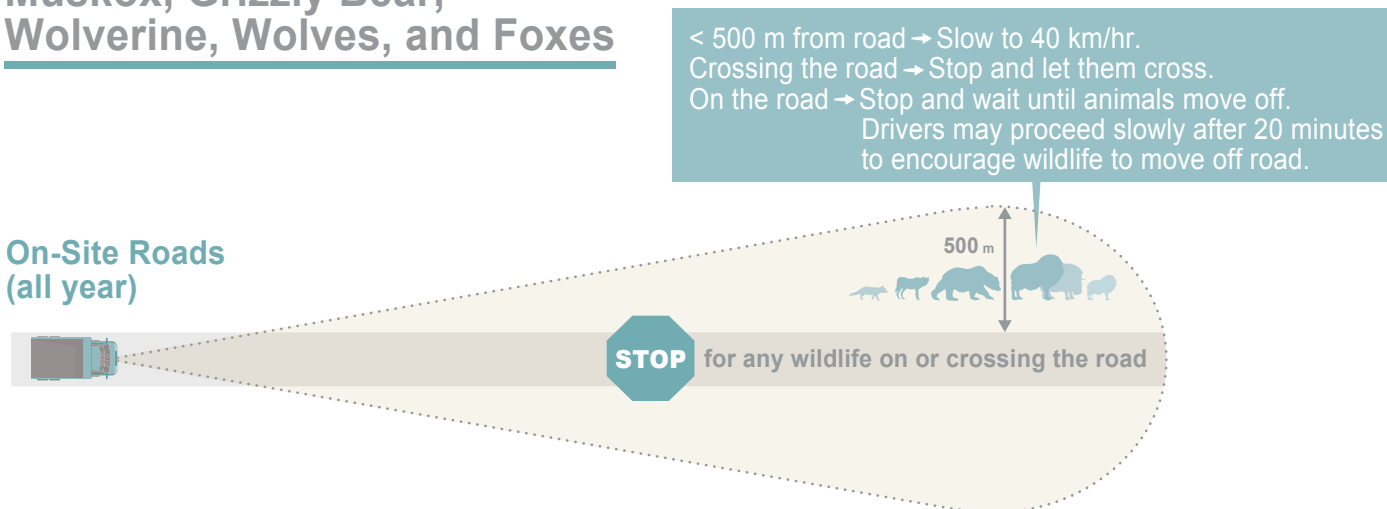


Figure 5.2-1: Management of Vehicles when Wildlife are Observed on or along On-Site Roads

The WIR was designed in accordance with Back River Project Wildlife Mitigation Measures for the WIR (Appendix 5B). Construction of the WIR was completed between mid-December, 2018 and April 19, 2019. Construction activities were based out of a mobile camp ("Forward Camp") towed on skis on the road route ("Forward Camp"), as well as the MLA and Goose camps. In 2019, the WIR operated between April 19 and May 10, 2019. Approximately 60 loads were hauled down the WIR during the operating period, with additional daily ancillary maintenance equipment and wildlife observation vehicles traversing the route.

In a typical year, the WIR is designed to be closed by April 15 to minimize disturbance to caribou during spring migration. Construction of the WIR for the 2019 season commenced in mid-December 2018, but due to reasons including delayed equipment delivery to the MLA, construction from only one WIR front (MLA-side), inaugural WIR routing, severe weather conditions, and equipment limitations, operation of the WIR extended beyond April 15 and occurred until May 10, 2019. The KIA and GN were notified of the extension of road use via a memo on March 29, 2019, and additional mitigation for caribou was implemented (Section 5.3.1.3)

5.3.1 *Winter Ice Road Mitigation*

The WIR is restricted to project personnel only. In addition to the mitigation measures in place for construction and vehicles described below, the following measures are in place to ensure hunting does not occur near the project as a result of the winter ice road:

- The WIR is closed to the public.
- The WIR will be monitored. Should people be observed hunting or using the winter ice road, this information will be reported in this Report.
 - Outcome: A wildlife monitor surveyed the WIR daily between April 15 and May 10, 2019. No members of the public were observed hunting or using the winter ice road.

Construction of the WIR is managed to avoid disruption of movement to caribou and other wildlife, and to avoid disturbance to bear dens. The following summarizes construction mitigation for the WIR and a summary of the outcomes of the mitigation:

- Limit the height of snowbanks to a maximum of approximately 1 m and conduct snow plowing to limit the angle and vertical height of the snowbank edge.
 - Outcome: The WIR was designed and maintained regularly to meet the above requirements. On March 7, 2019, Sabina submitted a technical memo to the KIA to describe the rationale for the anticipated use of up to 5 km of snow fencing and describe proposed mitigation and monitoring; however, no snow fences were required to be installed on the WIR in 2019.
- Design the WIR to avoid identified grizzly bear denning habitat. If grizzly bear denning habitat cannot be avoided, conduct a pre-construction survey. If the survey identifies an active bear den, the road route will be designed to avoid the den by 1 km.
 - Outcome: The majority of denning habitat was avoided during design of the WIR. Grizzly bear den surveys were conducted in February 2019 where it was not possible to avoid potential denning habitat (Section 5.3.3). No active bear dens were observed.

5.3.2 *Mitigation for Vehicles along the WIR*

Vehicle traffic on the WIR is managed to ensure caribou and other wildlife can travel safely through the area and to minimize vehicle-related wildlife mortality and injury.

Management is the same along the WIR as it is for drivers on-site (Section 5.2.1).

The following list describes the responsibilities of all drivers to mitigate effects on wildlife, as well as a summary of the outcomes of the mitigation (Appendix 5B):

- Drivers must follow 60 km/h speed limits on the WIR.
 - Outcome: No speeding violations were reported in 2019.
- Wildlife have right-of-way on the WIR.
 - Outcome: Drivers yielded the right-of-way to wildlife.
- Drivers report all wildlife observations to the Environment Department.
 - Outcome: Drivers reported wildlife observations to the Environment Department. Observations of caribou from the WIR or Forward Camp are summarized in Section 5.3.4.1. Incidental observations of other wildlife from the WIR or the Forward Camp included the following: two observations of a grizzly bears (March 5 and April 30, 2019); three observations of wolves (single wolves on April 5 and April 21, 2019; group of three wolves on April 18, 2019); one observation of a fox (April 20, 2019); one observation of a wolverine (April 27, 2019); and an observation of a group of 15 muskox on May 20, 2019; Appendix 5A).
- Drivers report any wildlife injury or mortality to the Environment Department.
 - Outcome: No wildlife injuries or mortalities occurred along the WIR in 2019.
- If drivers see wildlife on or along the WIR prior to April 15, they refer to Figure 5.3-1a for specific actions.
 - Outcome: Drivers referred to Figure 5.3-1a and followed management guidelines.
- After April 15, if drivers see wildlife on or along the WIR, they refer to Figure 5.3-1b for specific actions.
 - Outcome: Drivers referred to Figure 5.3-1b and followed management guidelines.

5.3.3 *Pre-Clearing Surveys for Grizzly Bear Dens*

Pre-construction surveys were conducted in winter 2019 prior to construction of the WIR in an area identified by habitat suitability modeling as an esker where grizzly bears could den, as per Section 9.1.3.7 of the WMMP Plan (Sabina 2019).

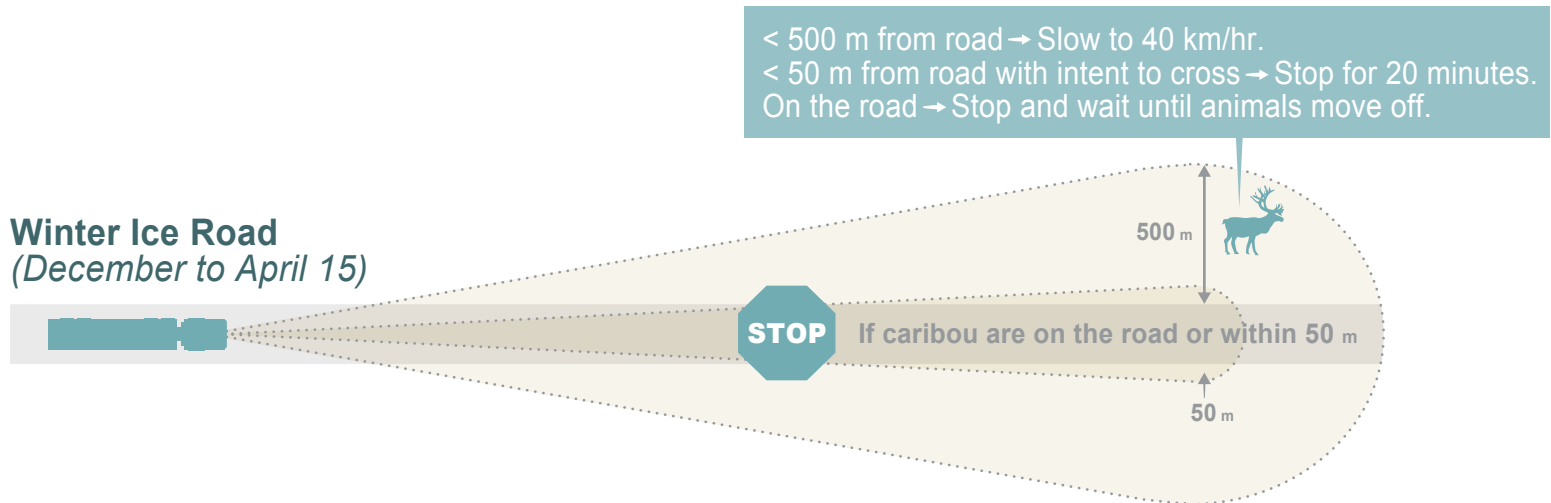
5.3.3.1 *Methods*

Pre-construction surveys were completed in an area identified from habitat capability maps as capable grizzly bear denning habitat in the FEIS.

Surveys were completed on the ground, supported with an infrared camera (FLIR T1020 unit; FLIR Commercial Systems, Inc. Nashua, NH, USA). The infrared camera was used to identify “hot spots” that would indicate potential dens based on the heat signature of hibernating bears released from occupied dens. The infrared imagery was reviewed by a wildlife biologist and sites that reflected “hot spots” were evaluated on the ground to determine the potential for denning.

Ten capable habitat polygons were surveyed, including three that crossed the proposed winter ice road alignment, and seven that were near the alignment (Figure 5.3-2). The three polygons crossing the proposed alignment were traversed by foot within 50 m of the proposed alignment in addition to the infrared camera survey. The seven polygons further from the proposed alignment were surveyed using the infrared camera, focusing on the areas identified as being potentially disturbed by vehicle activity.

a) Winter Ice Road
(December to April 15)



b) Winter Ice Road
(After April 15)

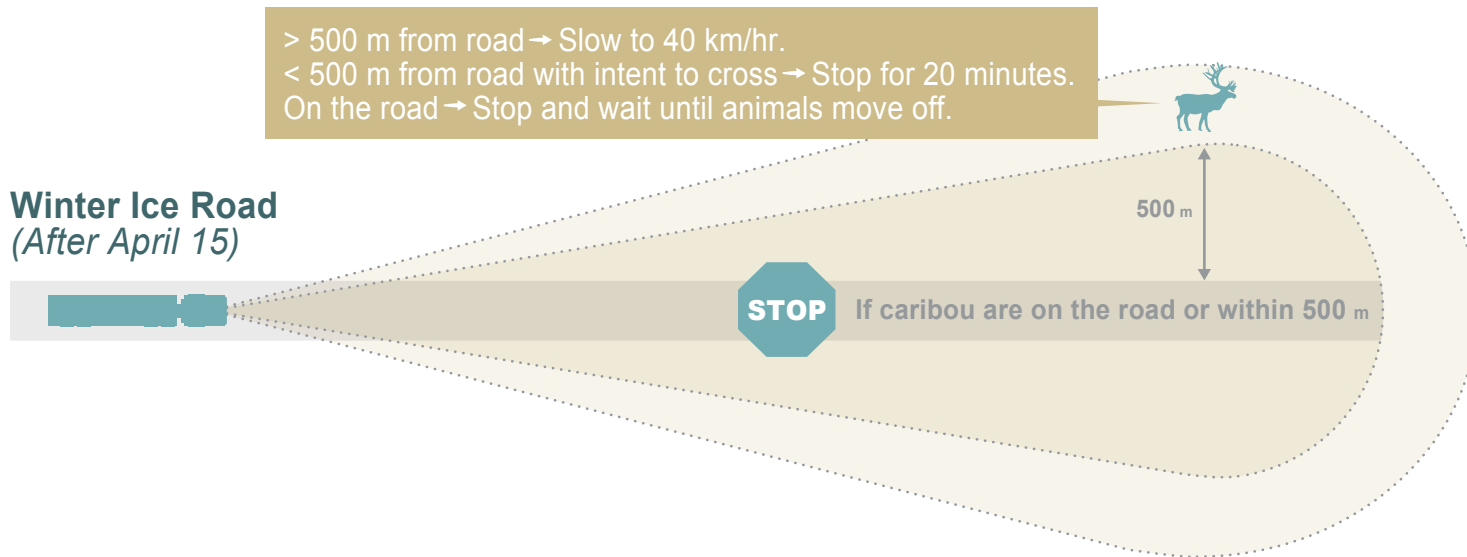


Figure 5.3-1: Management of Vehicles when Wildlife are Observed on or along the Winter Ice Road

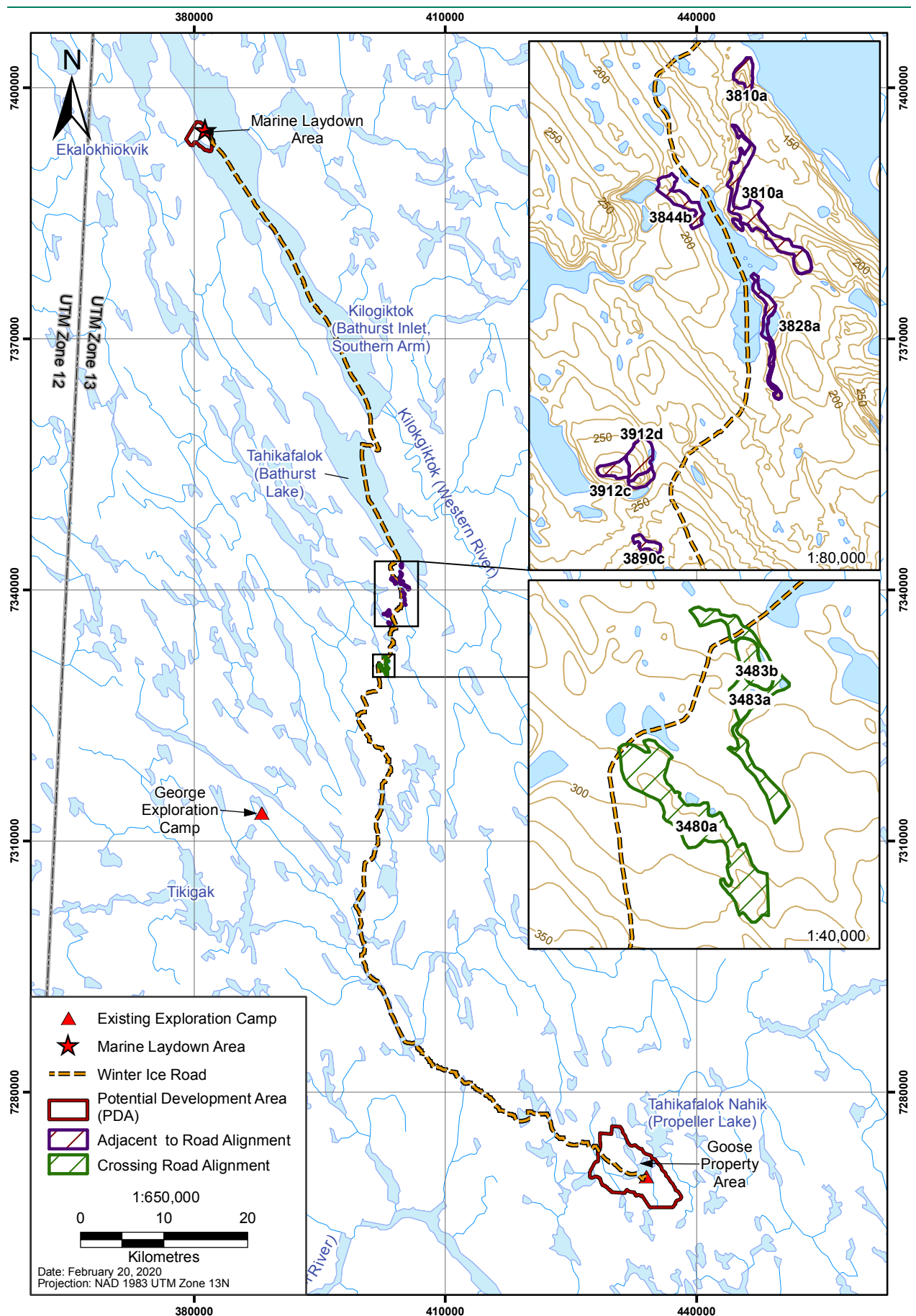


Figure 5.3-2: Grizzly Bear Habitat Polygons along the Winter Ice Road Surveyed in 2019

5.3.3.2 Results

Pre-construction surveys for potential grizzly bear den sites were conducted on February 7, 2019, along approximately 12 km of proposed winter ice road south of Bathurst Inlet.

No evidence of dens was observed in any surveyed polygon. Overall, snow conditions in the polygons surveyed were shallow, with exposed soil on some areas of the proposed alignment. Accumulations of snow of up to 1 m did occur along the bases of landforms, such as eskers, that faced prevailing winds (Photo 5.3-1). The tops of these landforms supported less than 10 cm of snow; therefore den entrances were unlikely to be covered. The three polygons that crossed the proposed alignment were relatively flat and windswept with little snow cover. Habitat capability for grizzly bear denning was marginal in these polygons, given the low profile and gentle slopes of the landforms (Photo 5.3-2).

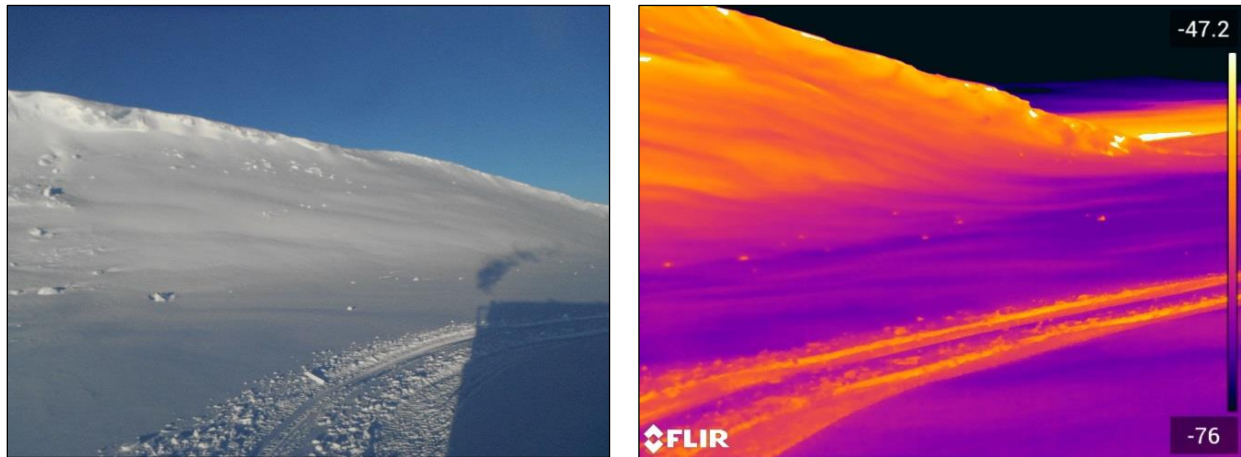


Photo 5.3-1: Digital and infrared images of deeper snow conditions at Polygon 3912B, away from the proposed winter ice road alignment. Note the spectrum temperature range on the FLIR image of -76 to -47.2 °F.



Photo 5.3-2: Low snow pack and flat topography at Polygon 3483A and B road crossing.

Following completion of the WIR, as-built surveys indicated that the WIR crossed 25 m into a polygon identified as being capable denning habitat for grizzly bears in the FEIS. The polygon includes areas of esker and tussock hummock vegetation and was classified as possible bear denning habitat because of the areas of esker. On review, it was determined that the area of the polygon traversed by the WIR was tussock hummock vegetation that was unlikely to provide suitable denning habitat.

5.3.4 Caribou Observations along the Winter Ice Road

5.3.4.1 Incidental Observations and Mitigation

Incidental observations of caribou along the WIR are summarized here, and are also included in Section 5.6.1.

During normal WIR construction and operations from mid-December to April 15, mitigation for vehicles followed the management outlined in Section 5.3.1.2. During this period, there were no incidental observations of caribou reported along the WIR or from the Forward Camp (Appendix 4A).

After April 15 and until the closure of the WIR, mitigation for vehicles was more conservative, as outlined in Section 5.3.1.2 (Figure 5.3-1b). In addition, a wildlife monitor surveyed along the road daily between April 15 and May 10. Fourteen incidental observations of caribou were reported along the WIR or at the Forward Camp during the spring migration period, between April 18 and May 9, 2019 (Appendix 4A). All observations were of groups of caribou with approximately 10 to 5,000 individuals observed in a group. When caribou were observed, drivers referred to Figure 5.3-1b and followed management guidelines.

5.3.5 Caribou Road Crossing Study

The WMMP Plan indicates that the WIR will be designed to be closed by April 15, prior to caribou spring migration. Sabina notified the KIA and GN that the road would be operated after April 15, and the GN requested that an analysis be conducted to examine whether collared caribou hesitated to cross the WIR compared to previous years prior to WIR construction.

Caribou may respond to the construction of the WIR through changes in behavior during spring migration. These behavioural changes may be related to changes in noise or vibrations, or the physical barrier of the road itself (D'Amico et al. 2016), and may include avoidance (where individuals change direction in response to the road), or hesitation (where individuals spend more time near the road prior to crossing it).

To identify potential changes to caribou movement during spring migration in 2019 when the WIR was active, caribou collar data from the pre-construction and post-construction periods were analyzed from the region around the WIR. The full caribou road crossing report is presented in Appendix 5C and is summarized below.

Between 2017 and 2019, caribou appeared to be more active in the region of the WIR than in previous years, in particular, the Bathurst caribou herd. Prior to 2017, Bathurst caribou did not pass through the region of the WIR during their migration to their calving grounds. However, in 2017, 2018, and 2019, 26% of collared individuals crossed to the east side of Bathurst Inlet before turning west to return to their calving grounds. Because of the recent changes in movement patterns, the analyses focused only on caribou movement behavior between 2017 and 2019.

5.3.5.1 *Caribou Road Crossing Report – Summary of Methods*

Two separate analyses were conducted in which caribou movements were compared before and after the construction of the WIR: a multinomial mixed-effects model was used to test the hypothesis that caribou were hesitating before crossing the road; and a step-selection model was used to test the hypothesis that caribou were changing direction in response to the road (i.e., deflecting away from the road). To isolate the potential effect of the road from the influence of habitat on caribou movement, both analyses accounted for key habitat variables that influence migratory behavior, including topography, land cover, and primary productivity.

5.3.5.2 *Caribou Road Crossing Report – Summary of Results*

The analyses of the caribou collar data did not identify any significant changes in caribou movement patterns following WIR construction in 2019, either from hesitation or from changes in direction in response to the presence of the road. Additional caribou movement data in future years when the WIR is constructed will improve the power of the statistical analyses to detect any potential effects of the WIR on caribou movement.

5.4 **Blasting**

NIRB Conditions #41, #43, and #44 require Sabina to manage blasting activities to avoid disturbance to caribou and other wildlife. No blasting was conducted in 2019.

5.5 **Camp and Waste Management**

NIRB Condition #48 requires Sabina to limit the attractiveness of the site to wildlife. The WMMP Plan includes design mitigation and management to reduce the attractiveness of the Goose and MLA camps and infrastructure to wildlife. This is an important safety issue because grizzly bears and wolverine can be attracted to camps. To accomplish this, Sabina conducted the following:

- Managed the camp to reduce attractiveness (Section 5.5.1.1).
- Reviewed waste management during regulatory inspections and a site inspection completed by the KIA (Section 5.5.1.2).
- Conducted monitoring for grizzly bears and wolverine in the vicinity of the camp (Section 5.5.2).

5.5.1 **Mitigation for Attractants**

5.5.1.1 *Mitigating Attractants*

Section 9.1.7 of the WMMP Plan lists the mitigation to be conducted on site starting during construction of the project. During the pre-construction phase, Sabina used mitigation measures appropriate to the activities being conducted at the Goose site and the MLA, including the following:

- Design mitigation – constructing buildings to exclude wildlife and skirting buildings.
- Mitigating attractants – storing wastes in bear-proof containers, keeping the camp clean, incinerating wastes and disposing non-wildlife attracting wastes in approved landfills.

Photos of the Goose Camp, the MLA, and Forward Camp are provided in Photos 5.5-1, 5.5-2, and 5.5-3, respectively, to illustrate that the camps were kept clean and free of attractants for wildlife.



Photo 5.5-1: Goose Camp.



Photo 5.5-2: MLA Camp.

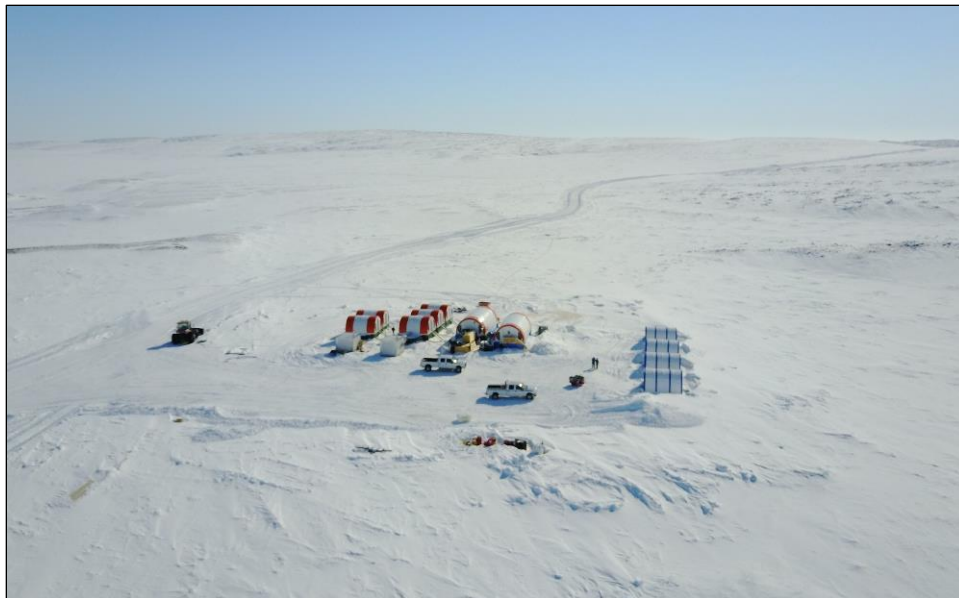


Photo 5.5-3: Forward Camp.

5.5.1.2 Review of Camp Management and Adaptive Management

Camp management was reviewed during regulatory inspections and a site inspection completed by the KIA:

- On January 30, 2019, Crown-Indigenous Relations and Northern Affairs Canada conducted a Water License Inspection that included a review of waste management. No waste management concerns were noted.
- On May 9, 2019, Crown-Indigenous Relations and Northern Affairs Canada completed a Crown Lands Surface Lease Inspection that included a review of the permit requirement to ensure that the land use area is kept clean and tidy at all times (Land Use Permit N2018F0017). No concerns with wildlife attractants were noted.
- On July 24, 2019, KIA completed a site inspection. At the Goose Lake Camp, the incinerator was observed to be operating in good condition. The kitchen and dry building were observed to be neat and organized, with grey water passing through a grease trap and waste stored inside until it was moved to the incinerator. No concerns related to wildlife attractants were noted.

Two Standard Operating Procedures relating to waste management were developed or reviewed and updated in 2019:

- The Back River Project; Waste Management SOP (#0008) defines the management and operational processes for waste management to reduce the risks associated with the various safety hazards to people and environmental aspects identified at the Back River Project as they relate to regional wildlife (last revision: March 20, 2019; Appendix 5D).
- The Back River Project: Waste Management – No Littering SOP (#0010) defines the processes for waste management with respect to the prevention of littering on the project site (last revision: March 25, 2019; Appendix 5E).

5.5.2 Monitoring for Grizzly Bears and Wolverine

5.5.2.1 Methods

Camp personnel reported incidental observations of grizzly bears and wolverine whenever personnel were on site.

5.5.2.2 Results and Discussion

Twelve grizzly bears and three wolverine were observed incidentally during 2019 (Section 5.5); however, there was only one observation inside the camp perimeter in the area of the MLA quarry and camp. On August 28, 2019 a sow grizzly bear and two cubs were observed on the west side of the quarry. On-site personnel followed the “Back River Project: Wildlife Interactions and Deterrents SOP” and deterred the bears away from the area using bear bangers. The bears returned from the south approximately an hour later in the area of the desalination shack. Again, the bears were deterred away from the area by on-site personnel. There were no reports of the bears returning again to the area and it was determined that the deterrence of the bears was successful.

There were no reports of repeated sightings of animals over multiple days, animals accessing wastes, or other signs of grizzly bears or wolverine being attracted to the camp or habituated near the camp. Therefore, it is concluded that the measures taken to keep the camp clean and free of attractants were successful. Sabina continues to ensure safety of personnel and wildlife by meeting all waste management requirements and minimizing attractants on site.

5.6 Incidental Observations

All personnel are responsible to record wildlife sightings in the camp’s wildlife logs. These logs provide an indication of the wildlife species that occur in proximity to and interact with Project infrastructure (Appendices 4A and 5A). Caribou are discussed separately in Section 5.6.1, and all other terrestrial mammals are summarized in Section 5.6.2.

Personnel were on site at the Goose Camp from March to September, at the MLA from January to September, and at the Forward Camp from February to May in 2019 (Table 5.6-1). Incidental observations are restricted to those periods.

Table 5.6-1: Summary of On-Site Personnel in 2019

Month	Number of Personnel on Site		
	MLA	Goose	Forward Camp
January	77	-	-
February	74	-	24
March	77	23	26
April	70	77	46
May	32	76	17
June	13	30	-
July	25	26	-
August	21	13	-
September	11	6	-

5.6.1 Caribou Observations

Caribou recorded in the camp wildlife logs for 2019 are summarized in Table 5.6-2. Overall, there was a total of 36 separate incidental caribou observations of approximately 14,979 animals (Appendix 4A; Section 5.5.1). This does not indicate that 14,979 individual animals were observed, as animals likely were observed on more than one occasion.

Table 5.6-2: Summary of Incidental Observations of Caribou during each Season in 2019

Season	Locations	Number of Observations	Total Number of Individuals Observed
Winter (November 1, 2018 – April 14, 2019)	Goose	4	252
Spring Migration (April 15 – June 4, 2019)	Goose, MLA, WIR, Forward Camp	18	13,310
Calving (June 5 – June 15, 2019)	Goose	4	1,400
Post-Calving (June 16 – July 20, 2019)	MLA	4	7
Summer (July 21 – August 31, 2019)	Goose, MLA	5	7
Fall Migration (September 1 – October 31, 2019)	-	-	-
Specific dates were not provided	MLA	1	3

Twenty-two of the total 36 incidental observations of caribou, accounting for over 98% of observed animals (approximately 14,656 animals), occurred during the spring migration or calving periods (April 15 to June 15). During this spring migration period (April 15 to June 4), most observations were of large groups of caribou (100 to 5,000 individuals) and were observed from the WIR or Forward Camp (note that sightings along the WIR were also summarized in Section 5.3.4). This is consistent with the collar data from 2019 (Section 5.3.5). All sightings during the spring migration period were of large groups travelling or feeding, and were all observed between 2 km and 170 km from Goose or MLA camps.

During the calving season (June 5 to June 15), all of the caribou observations (four separate sightings) occurred on June 8 between 2 and 4 km from Goose Camp. Three of the observations were of greater than 100 animals, and one observations was of greater than 1,000 animals. All of the animals were recorded as travelling. These sightings, although were during the calving period, confirm that the Project does not overlap with the calving grounds, as the sightings were of large groups of animals travelling past the area. No females with calves were observed.

Caribou were observed near camp infrastructure at the MLA on five occasions between July and August, 2019. On July 10, 2019, one caribou was observed by the shop. On July 16, 2019, two caribou were observed near camp infrastructure. On July 29, 2019, a single caribou was observed at the camp landing strip, and one caribou was observed at the quarry. On August 16, two caribou were observed in camp; this group was noted to be bulls escaping from insects.

An additional incidental sighting of two caribou was recorded by ERM field biologists on July 23, 2019, when two caribou were observed approximately 500 m from the Goose Camp landing strip.

5.6.2 Other Terrestrial Mammal Observations

In addition to caribou, eight other terrestrial mammal species were observed in 2019, including fox, Arctic hare, grizzly bear, wolverine, moose, muskox, wolf, and weasel, on 39 separate occasions (Table 5.6-3; Appendix 5D).

Most observations of terrestrial mammals were made at the MLA or Goose sites (31 of 39), where the majority of on-site personnel were located throughout the year (Table 5.6-1). The most commonly observed mammals were wolf (21 individuals recorded over 10 separate sightings), fox (10 animals recorded over 10 separate sightings), and grizzly bear (12 animals recorded over nine sightings). The largest group of animals observed was a group of 15 muskox near the winter ice road on May 20, 2019. One of the muskox incidental sightings (of one individual) was made by ERM field biologists on July 20, 2019, approximately 3.5 km northwest of Goose Camp.

Table 5.6-3: Summary of Incidental Observations of Terrestrial Mammals in 2019

Mammal	General Locations	Number of Observations	Total Number of Individuals Observed ¹
Red Fox	MLA	3	3
Unknown Fox	Goose, MLA, Forward Camp	7	7
Arctic Hare	MLA	1	1
Grizzly Bear	Goose, MLA, Forward Camp	9	12
Moose	MLA	2 ²	4
Muskox	MLA, WIR, Goose	3	17
Weasel	Goose	1	1
Wolf	Goose, MLA, Forward Camp	10	21
Wolverine	Goose, MLA	3	3

Notes:

¹ Note that it is not possible to identify individuals and it is likely that some of the same animals observed were observed on multiple occasions.

² One of the moose sightings was of a cow and two calves, observed on April 15, 2019, approximately 20 km from the MLA. The other moose observation was of a bull on June 22, 2019, approximately 7 km from the MLA.

Grizzly bear and wolverine are both assessed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and are listed as such on Schedule 1 of the *Species at Risk Act* (SARA; Government of Canada 2019). They are also both territorially ranked as vulnerable (CESCC 2015). There were nine observations of grizzly bears in 2019. Most (78%) observations were of single animals. Two sightings involved more than one animal: on June 5, 2019, two bears were observed at Goose, approximately 1.5 km east of camp; and on August 28, 2019, a sow and two cubs were observed at the MLA tank site (Section 5.5.2.2).

There were three sightings of wolverine, each of only one individual, in April and June, 2019, near Goose and the MLA.

6. TERRESTRIAL BIRDS, WATERBIRDS, AND RAPTORS

During 2019, mitigation and monitoring for birds was appropriate for the activities conducted during the pre-construction phase of the project. Specific mitigation and monitoring activities for avian species that occurred in 2019 during the pre-construction phase of the project included the following:

- Aircraft management.
- Incidental observations.

6.1 Aircraft Management

As per the Back River Project's NIRB Project Certificate (No. 007) Condition #60 and #61, fixed wing and helicopter aircraft operation guidelines were developed and provided to pilots to guide aircraft operation at the Project. Details regarding general aircraft management methods are described in Section 5.1.

Additional aircraft mitigation for waterbirds as well as a summary of the outcomes of the mitigation includes the following:

- As part of pilot induction, pilots were informed of their responsibilities to monitor, report, and avoid waterbirds.
 - Outcome: An aircraft SOP with maps was provided to pilots that identifies areas with concentrations of waterbirds during certain seasons, including areas such as lakes used for staging by waterbirds.
- Disturbance to colony-nesting birds and important staging areas was reduced during sensitive periods by maintaining an aircraft flight altitude of at least 650 m during horizontal (point to point) flights. The three waterbird staging areas closest to the Project are on Beechey Lake, approximately 35 km south/southwest of the Goose site, at an unnamed lake approximately 15 km north of the George site and in the cove south of the MLA.
 - Outcome: No fixed wing flights and a low frequency of helicopter flights (approximately one) occurred near these area in 2019 (Figure 5.1-1), and helicopter flights occurred outside of the staging season (June to August).
- Pilots reported all incidental sightings of significant aggregations of waterbirds to the Environment Department.
 - Outcome: No incidental observations of birds were reported by pilots in 2019.

6.2 Mitigation for Birds

Two forms of mitigation are generally required for birds: 1) timing ground-clearing outside of the bird breeding season, and 2) management of incidentally observed birds nesting on infrastructure. There were no birds observed nesting on infrastructure in 2019.

The WMMP Plan, Section 11.1.3.2, includes a commitment to plan ground clearing/construction of new pads on the tundra outside of the bird breeding season. There were no ground clearing activities in 2019 (Section 3).

6.3 Incidental Observations of Birds

In 2019, there were two incidental observations of birds recorded. On May 17, 2019, a flock of 200 geese was observed flying overhead at Goose. The species of geese was not determined. On July 24, 2019, an unidentified falcon was observed near the road to the treatment plant at the MLA (Appendix 6A).

7. MARINE MAMMALS AND SEABIRDS

Management and monitoring activities for marine mammals and seabirds that occurred in 2019 during the pre-construction phase of the Project included incidental observations of marine mammals and marine birds. Marine shipping monitoring and pre-construction surveys and management for seal lairs are also discussed below.

7.1 Marine Shipping Mitigation and Monitoring

NIRB Conditions #58 and #64 require Sabina to mitigation impacts and disturbance to seabirds and marine mammals during marine shipping.

The objectives of the marine mammal and seabird monitoring program during shipping included the following:

- Recording incidental observations of seabirds and marine mammals in the Northwest Passage made by bridge staff.
- Documenting and reporting measures taken to mitigate impacts to marine mammals and large groups of seabirds.
- Documenting and report ship strikes of marine mammals or seabirds, if they occurred.

7.1.1 Methods

Prior to the 2019 shipping season, Sabina provided an SOP to the shipping contractor which describes the management and monitoring requirements for the Project.

During 2019, there was one sailing to the MLA on board the MV Kelly Ovayuak in late August. The vessel sailed from Tuktoyaktuk on August 25 and arrived at the MLA on September 1, and departed the MLA on September 4, returning to Hay River on September 14 (Figure 7.1-1). No surveys were conducted during the sailing in 2019.

7.1.2 Results and Discussion

During the sailing from Tuktoyaktuk and the MLA on the *MTS Vessel* between August 25 and September 1, and between the MLA and Hay River from September 4 to 14, 2019, no surveys were conducted, and no ship strikes were reported.

7.1.3 Seal Lair Mitigation and Monitoring

As part of the operation of the MLA, Sabina may construct an on-ice landing strip for aircraft on the sea ice in front of the MLA and may construct a winter ice road (WIR) to transport equipment and supplies from the MLA to the Goose site. The WIR travels south on sea ice from the MLA to the mouth of the Western River before heading inland. Construction of both pieces of on-ice infrastructure are planned for December and January of each year, prior to the seal pupping season, starting approximately February 15.

NIRB Condition #63 and the WMMP Plan Section 14.1.3 indicate that if construction of the on-ice landing strip or the WIR occurs during the seal pupping period, then pre-construction surveys will be conducted and construction will be altered to avoid any identified seal lairs. Sabina produced a SOP to guide pre-construction surveys and mitigation for seal lair.

In 2019, Sabina completed the construction of the on-ice airstrip at the MLA prior to February 15, 2019, so no pre-construction surveys were required.



Figure 7.1-1: The MV Kelly Ovayuak Vessel Shipping Route between Hay River and the Marine Laydown Area, August and September 2019

Construction of the WIR between the MLA and the Western River was also completed prior to February 15, 2019, so no pre-construction surveys were required.

7.2 Incidental Observations

There were four incidental observations of single seals recorded by site personnel at the MLA (Appendix 7A). On June 7, 2019 a seal was observed on the MLA ice strip. On April 12, 2019, a seal calf was observed approximately 30 km from the MLA Camp. The two remaining observations of seals at the MLA occurred on April 11 and June 23, 2019.

8. SPECIES OF CONSERVATION CONCERN

NIRB Condition #55 requires Sabina to ensure mitigation and monitoring is updated regularly to maintain consistency with changes to species at risk listings. Table 8-1 is an updated version based originally on Table 4.1-1 from the WMMP Plan (Version 9; September 2018, conservation status' in the WMMP are consistent with the 2013 FEIS), and updated annually as part of the WMMP report. This table summarizes the species of conservation concern known to occur or potentially occurring in the Project area, updated annually with any new species additions or status changes as of February 2020.

Table 8-1: Species of Conservation Concern Known or Potentially Occurring at the Project, 2019

VEC or VEC Group	Species	Scientific Name	Federal Designation		Territorial Status ¹
			COSEWIC Status	Species at Risk Act Schedule 1	
Species Confirmed to Occur in the Project Terrestrial or Marine Regional Study Areas					
Caribou (Beverly/Ahiak herd and Bathurst herd)	n/a	<i>Rangifer tarandus groenlandicus</i>	Threatened	No	Apparently Secure
Grizzly Bear	n/a	<i>Ursus arctos horribilis</i>	Special Concern	Yes	Vulnerable
Wolverine	n/a	<i>Gulo gulo</i>	Special Concern	Yes	Vulnerable
Upland Birds	American Golden-plover	<i>Pluvialis dominica</i>		No	Vulnerable
	Harris’s Sparrow	<i>Zonotrichia querula</i>	Special Concern	No	Unrankable
	Hoary Redpoll	<i>Carduelis hornemanni</i>		No	Vulnerable
	Least Sandpiper	<i>Calidris minutilla</i>		No	Vulnerable
	Red-necked Phalarope	<i>Phalaropus lobatus</i>	Special Concern	Yes	Vulnerable
	Semipalmated Sandpiper	<i>Calidris pusilla</i>		No	Vulnerable
Raptors	Golden Eagle	<i>Aquila chrysaetos</i>	Not at Risk	No	Vulnerable
	Peregrine Falcon	<i>Falco peregrinus anatum/tundrius</i>	Not at Risk	Yes	Apparently Secure
	Short-eared Owl	<i>Asio flammeus</i>	Special Concern	Yes	Vulnerable
Seabirds and Seaducks	Common Eider ²	<i>Somateria mollissima</i>		No	Vulnerable

VEC or VEC Group	Species	Scientific Name	Federal Designation		Territorial Status ¹
			COSEWIC Status	Species at Risk Act Schedule 1	
Species that Could Occur in the Project Terrestrial or Marine Regional Study Areas					
Caribou (Bathurst herd)	n/a	<i>Rangifer tarandus groenlandicus</i>	Threatened	No	Apparently Secure
Upland Birds	Black-bellied Plover ²	<i>Pluvialis squatarola</i>		No	Vulnerable
	Buff-breasted Sandpiper	<i>Tryngites subruficollis</i>	Special Concern	Yes	Vulnerable
	Hoary Redpoll ²	<i>Acanthis hornemanni</i>		No	Vulnerable
	Ruddy Turnstone	<i>Arenaria interpres</i>		No	Vulnerable
	Red Knot	<i>Calidris canutus rufa/islandica</i>	Endangered/ Special Concern	Yes	Imperiled
	Sanderling	<i>Calidris alba</i>		No	Vulnerable
	Snow Bunting	<i>Plectrophenax nivalis</i>		No	Vulnerable
Species that Could Be Encountered along the Project Shipping Route					
Caribou (Dolphin and Union herd)	n/a	<i>Rangifer tarandus groenlandicus</i>	Endangered	Yes	Apparently Secure
Caribou (Peary caribou)	n/a	<i>Rangifer tarandus pearyi</i>	Threatened	Yes	Apparently Secure
Waterbirds	Horned Grebe	<i>Podiceps auritus</i>	Special Concern	Yes	Unrankable
Upland Birds	Hudsonian Godwit	<i>Limosa haemastica</i>	Threatened	No	Vulnerable
	Lesser Yellowlegs	<i>Tringa flavipes</i>		No	Vulnerable
Seabirds and Seaducks	King Eider	<i>Somateria spectabilis</i>		No	Vulnerable
	Ivory Gull	<i>Pagophila eburnea</i>	Endangered	Yes	Critically Imperiled
	Ross's Gull	<i>Rhodostethia rosea</i>	Threatened	Yes	Critically Imperiled
Marine Mammals	Bowhead Whale ³ (Eastern Canada - West Greenland population)	<i>Balaena mysticetus</i>	Special Concern	No	Secure
	Beluga (Eastern High Arctic - Baffin Bay population)	<i>Delphinapterus leucas</i>	Special Concern	No	Secure

VEC or VEC Group	Species	Scientific Name	Federal Designation		Territorial Status ¹
			COSEWIC Status	Species at Risk Act Schedule 1	
Marine Mammals (cont'd)	Narwhal ³	<i>Monodon monoceros</i>	Special Concern	No	Apparently Secure
	Walrus	<i>Odobenus rosmarus rosmarus</i>	Special Concern	No	Vulnerable
	Polar Bear	<i>Ursus maritimus</i>	Special Concern	Yes	Vulnerable

Notes:

Gray cells refer to species' statuses that have changed or been added since the 2018 WMMP Report.

¹ Territorial status is current to 2015 and are presented in the 2015 Wild Species Report (CESCC 2015).

² Species are also likely to be encountered along the Project shipping routes.

³ In the 2018 WMMP report, it was reported that COSEWIC had recommended that bowhead whale (Eastern Canada-West Greenland population) and narwhal both be changed from Special Concern to being no longer at risk. However, these species are both currently still listed as Special Concern by COSEWIC.

Species of conservation concern include those listed in Nunavut by the Canadian Endangered Species Conservation Council (CESCC 2015), or those listed as Endangered, Threatened, or Special Concern on Schedule 1 of the SARA (2002; Government of Canada 2019). The federal or territorial conservation status of one bird species changed since the species at risk table was updated for the 2018 WMMP Report. No updated recovery strategies, action plans, or management plans for any of the listed species have been made available since 2013.

Since 2018, there was a change in the status of the Hudsonian godwit (*Limosa haemastica*), which was designated as Threatened by COSEWIC in May, 2019 (Table 8-1).

The WMMP Plan (Version 10, October 2019) includes mitigation, management and monitoring activities for each of the species at risk groups listed in Table 8-1. No additional mitigation, management or monitoring is required due to the change in status listed above.

9. WILDLIFE MORTALITIES

One grizzly bear mortality occurred near the Project in 2019. On July 29, 2019, a grizzly bear was observed by an archaeology field crew conducting field surveys away from camp. The field crew reported that the bear was acting in a predatory manner, approaching the crew while conducting their work. The dedicated wildlife monitor accompanying the crew attempted to deter the bear using bear bangers and a warning shot; assistance was also requested from a helicopter in the area. Attempted deterrence measures were ineffective, and the bear charged the group. The wildlife monitor determined that shooting the bear was required to ensure the safety of the group. The bear was believed to have been hit by the shot, and it turned away and moved off from the group. Shortly after, a helicopter observed the bear continuing to move away from the group.

Notification of the incident was provided to the KIA and the community of Bathurst Inlet, and the GN was informed in writing on July 30, 2019. No specific direction was received from the GN.

The KIA agreed with Sabina that the bear should be euthanized if it was hit in the leg. On July 31, 2019, a helicopter deployed two Inuit wildlife monitors, who euthanized the bear. The bear was moved to camp in the basket of the helicopter. The bear was a female, described as young and skinny, measuring 62" long.

The GN agreed that the bear be given to the community of Bathurst Inlet, and the bear hide was salvaged by a community member in Bathurst Inlet. The bears' head was delivered to GN Department of Environment on August 9, 2019, as directed by the GN.

No other wildlife mortalities were reported at the Project sites in 2019.

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APPENDIX 2A OVERVIEW OF WILDLIFE MITIGATION AND MONITORING PROGRAMS DURING PHASES OF THE BACK RIVER PROJECT

Appendix 2A: Overview of Wildlife Mitigation and Monitoring Programs during Phases of the Back River Project

Monitoring Programs that Trigger Management (section of the document where they are described)	Baseline/ Pre-Construction	Mobilization and Construction	Operations	Temporary Closure	Care and Maintenance	Reclamation/ Closure	Post- Closure
Caribou (Section 7.2)							
1) Monitor Seasonal Caribou Ranges <i>Use collar data to track during which seasons caribou are likely to interact with the Project</i>	--	Yearly	Yearly	Yearly	Yearly	Yearly	--
2) Near Real-time Collar Monitoring <i>Use collar data to track near real-time location of caribou herds</i>	--	Ongoing	Ongoing	--	--	Ongoing	--
3) Active Caribou Monitoring <i>Wildlife monitors will survey for caribou from raised platforms or using cameras</i>	--	Ongoing	Ongoing	--	--	Ongoing	--
4) Incidental Wildlife Reporting <i>Incidental observations of wildlife and incidents</i>	Ongoing	Ongoing	Ongoing	--	Ongoing	Ongoing	--
5) On-site Camera Monitoring <i>Use motion-trigger cameras to track caribou interactions with Project infrastructure</i>	Ongoing	Ongoing	Ongoing	--	Ongoing	Ongoing	--
6) Over the Horizon Monitoring <i>If ZOI monitoring indicates that management must be conducted for caribou when they are over the horizon (greater than can be observed from site)</i>	--	If triggered	If triggered	--	--	If triggered	--
7) Human Activity Monitoring <i>Reporting hunting and fishing on the Project site</i>	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing	--
8) Noise Monitoring <i>Monitor noise levels outside the footprint</i>	One time	One time	Every three years	--	--	One time	--
Muskox (Section 8.2)							
1) On-site Camera Monitoring <i>Use motion-trigger cameras to track muskox interactions with Project infrastructure</i>	Ongoing	Ongoing	Ongoing	--	Ongoing	Ongoing	--
2) Incidental Wildlife Reporting <i>Incidental observations of wildlife and incidents</i>	Ongoing	Ongoing	Ongoing	--	Ongoing	Ongoing	--

APPENDIX 4A INCIDENTAL CARIBOU OBSERVATIONS, 2019

Appendix 4A: Incidental Caribou Observations, 2019

Date	Location	Distance from Camp	Direction Travelling	Number	Comments (# of calves, etc.)	Name of Observer
27-Mar-19	Goose	2 km	E	6	Crossing Lake	RmD
28-Mar-19	Goose	2 km	E	6		RmD
11-Apr-19	Goose	Llama Lake?		40		-
12-Apr-19	Goose	1-2 km	N	200+	By icestrip	-
18-Apr-19	Forward Camp	130 km	28 km S heading W	300		Frank M.
	Forward Camp	103 km	Heading E	300		Brock Steen
	MLA	80	S	~100		Kevz/Stamley
	MLA	102	S	~100		Kim/Stamley
	WIR	80 km		200	Perimeter survey to Goose Lake, feeding	Stanley Carpenter
	WIR	102 km		100	Feeding	Stanley Carpenter
20-Apr-19	Forward Camp	101 km	E	150		Scott Taylor
21-Apr-19	Forward Camp	112 km	S	150	Only last year's calves	Michael Marchildon
22-Apr-19	Forward Camp	100 km	N	300	Bulls, cows, calves	Brock Steen
	WIR	100 km		2000	Feeding	Stanley Carpenter
25-Apr-19	Goose	1.5-5 km	SW-S	3000+	From West of gravel strip to 3-4 km S	Gerry
26-Apr-19	WIR	104-170 km	multitude of herds between Goose and FC	>1000 total		Andrew S
	WIR	150 km		5000	Perimeter survey to Goose Lake and back to MLA, feeding	Stanley Carpenter
29-Apr-19	Forward Camp	165 km	N Goosecamp	500	Bulls, cows, calves	Michael Marchildon
3-May-19	Forward Camp	82 km		<10	On hills	Jim Stevens
4-May-19	Forward Camp	95 km		50		Jim Stevens
5-May-19	Goose	2 km		50		RmD
8-Jun-19	Goose	2 km	E of camp	1000+		-
	Goose	2 km	SE camp	100-200		-
	Goose	4 km	N camp	100+		-
	Goose	.	N camp	100+		-
22-Jun-19	MLA	5 km	SW	3		Michael Marchildon
1-Jul-19	MLA	0.6 km	NW	1	Running	Colin
10-Jul-19	MLA	by shop		1		Colin
16-Jul-19	MLA	by farm		2		-
22-Jul-19	MLA	50 m from S		1	Bedded bull	-
29-Jul-19	MLA	camp landing strip		1		-
	MLA	quarry		1		-
16-Aug-19	MLA	in camp		2	Bulls getting away from bugs	Michael
5-Sep-19	WIR	100 km		Not reported	Seen from vehicle during Site Inspection	Merle Keefe
Not reported	MLA	2 miles	NW	3	Laying in the rain	Colin

* An additional incidental sighting of two caribou was made by ERM field biologists on July 23, 2019, approximately 500 m from the Goose camp airstrip.

APPENDIX 5A INCIDENTAL TERRESTRIAL MAMMAL OBSERVATIONS, 2019

Appendix 5A: Incidental Terrestrial Mammal Observations, 2019

Date	Location	Distance from Camp	Direction Travelling	Number	Mammal	Comments (# of calves, etc.)	Name of Observer
5-Apr-19	Goose	Behind Kit		1	Weasel		RMD
5-Apr-19	Forward Camp	99 km	N	1	Wolf	Mostly white in colour	Michael Marchildon
14-Apr-19	Goose	~5-6 km	E	1	Wolf	Near Umwelt Lake	Marc L (Reflex)
15-Apr-19	MLA	20 km	S	3	Moose	1 cow, 2 calves	Jim Bob Firth
16-Apr-19	MLA	35	S	1	Wolverine		Jim Bob Firth
18-Apr-19	MLA	55		6	wolves	Westbound	Gerald/Stanley
18-Apr-19	Forward Camp	104 km	W	3	Wolf		
20-Apr-19	Goose	1.5 km	NE	1	Fox	Near/North Side of Goose Neck	Stacie
20-Apr-19	Forward Camp	105 km	S	1	Fox		Scott Taylor
21-Apr-19	Forward Camp	168 km	N	1	Wolf	Black male	Brock Steen
27-Apr-19	WIR	140 km	near road sign	1	Wolverine		radio call
30-Apr-19	Forward Camp	116 km		1	Bear	On the hill to East by road	-
3-May-19	Forward Camp	132 km	S	1	Bear	Grizzly rolling in snow	Arcie Erkatuk
17-May-19	Goose	Cabin 17		1	Fox		RMD
20-May-19	WIR	148 km		15	Muskox		RMD
5-Jun-19	Goose	1.5 km	S-N	2	Bear	East of Camp	Jim
8-Jun-19	Goose	1 km		3	Wolf		RMD
8-Jun-19	Goose	300 km	E	1	Wolf		-
8-Jun-19	Goose	on ice strip		2	Wolf		-
8-Jun-19	Goose	1 km	E of ice strip	2	Wolf		-
8-Jun-19	Goose	0.5 km	E camp	1	Fox		SK
8-Jun-19	Goose	11 km	N	1	Bear	Young bear	-
8-Jun-19	Goose	behind kitchen		1	Fox		-
8-Jun-19	Goose	S of incinerator		1	Wolf		RMD
21-Jun-19	MLA	5 km	SW	1	Bear	Grizzly	Jared Smyth
22-Jun-19	MLA	7 km	W	1	Moose Bull		Colin Fraser
24-Jun-19	MLA	5 km	NW	1	Bear	Grizzly	Colin Fraser
27-Jun-19	MLA	by ice strip		1	Wolverine		Marlowe
27-Jun-19	MLA	2.5 km, middle of inlet		1	Bear	Grizzly	Jon Yak.
30-Jun-19	MLA	400 yards at lower laydown		1	Fox	Dark brown	Jonah K
12-Jul-19	MLA	by strip		1	Fox		Jonah
24-Jul-19	MLA	Road to treatment plant		1	Muskox	1 falcon	JPK
1-Aug-19	MLA	airstrip		1	Red Fox	red fox	-
14-Aug-19	MLA	on airstrip 200 m	S of camp	1	Red Fox	healthy red	Michael
28-Aug-19	MLA	Tank site		3	Bear	Sow and two cubs	Jesse
2-Sep-19	MLA	Tank site		1	Rabbit		Michael
2-Sep-19	MLA	Lower laydown		1	Red Fox	red	Brandon
No specific date provided	MLA	1 mile	E	1	Bear		Jonah

**An additional incidental observation was made by ERM field biologists on July 20, 2019, of one muskox north of Goose camp. It was observed travelling to the north.*

APPENDIX 5B WILDLIFE MITIGATION DURING PRE-CONSTRUCTION: WINTER ICE ROAD

Appendix 5B: 2018 Wildlife Mitigation during Pre-Construction – Winter Ice Road

The following tables describe the wildlife mitigation, and management for construction and operation of the Back River Project Winter Ice Road.

Table 1 describes mitigation prior to construction of the road to avoid disruption of movement to caribou and disturbance to bear dens. Table 2 describes mitigation of light vehicle use of the winter road during operation of the winter ice road.

Table 1: Pre-Construction Mitigation of the Winter Ice Road

Species	Active Timing Window	Notes
Caribou	October to April 15. After April 15, additional monitoring and mitigation would be required.	<ol style="list-style-type: none"> 1. Approximately 2% of the Beverly/Ahiak caribou cross the winter road route on their spring migration (according to collar data). Therefore, the winter ice road will be designed to be closed by April 15. 2. Construct and operate the winter ice road to ensure that it is not a barrier to movement for caribou by: <ul style="list-style-type: none"> ■ Limiting the height of snowbanks to a maximum of approximately 1 m; and ■ Conducting snow plowing to limit the angle and vertical height of the snowbank edge.
Bear Dens	Oct 15-May 7	<ol style="list-style-type: none"> 3. Grizzly bears den in well-known habitats (eskers, river banks) during the fall and sleep through the winter in these dens. These habitats have been mapped from terrain and vegetation mapping (Figure 1). Design the road to avoid these areas where possible. 4. If these areas cannot be avoided through design, then conduct a pre-construction survey (planned by ERM for Dec 15, 2018). If this survey discovers an active bear den, then the road route will avoid this den by 1 km. 5. Under special circumstances, an exception to the 1 km buffer may be provided for logistical reasons through consultation with the GN DOE.

The winter ice road is restricted to project personnel only. In addition to the mitigation in the tables below, the following is in place to ensure hunting does not occur near the project as a result of the winter ice road:

- The winter ice road will be closed to the public.
- The winter ice road will be monitored and should people be observed hunting or using the winter ice road this information will be recorded and presented in the annual WMMP Report.
- Should more than five groups of hunters be observed using the winter ice road, then enhanced management will be conducted to limit use of the winter ice road. If triggered, Sabina will liaise with the relevant HTOs to discuss possible options for enhanced management to limit hunter use of the winter ice road.

Table 2: Vehicle Management on the Winter Ice Road When Wildlife are Observed on the Winter Ice Road During Pre-Construction (Dec 1-April 15)

Species	How Identified	Notes
Caribou	Drivers	<ol style="list-style-type: none"> 1. Traffic on all roads will be managed and monitored through a central dispatch. 2. To reduce frequency of traffic on the winter ice road that may deter caribou from crossing, trucks may be grouped into convoys. 3. Speed limits will be monitored and enforced, and set at 60 km/h. 4. If a driver observes a caribou (or other large mammal) <500 m away, slow to 40 km/h, alert other drivers and proceed with caution. 5. If a driver observes that caribou <50 m of the road and moving towards the road, stop the vehicle, and proceed after the animals have crossed the road and moved off; alternatively, after 20 minutes proceed slowly if animals have not made their road crossing. 6. If caribou are resting on the road, stop the vehicle and wait until the animals have moved off on their own. 7. Record all wildlife observations.
Muskox, grizzly bear or wolverine	Drivers	<ol style="list-style-type: none"> 8. On road – stop for 20 minutes and let them leave; drivers may proceed slowly after 20 minutes. 9. Animals are crossing the road – stop and let them cross. 10. Grizzly bear, wolverine or >10 muskox, <500 m from road, slow to 40 km/h and proceed with caution. 11. Animals at >500 m from the road do not trigger mitigation – report to Environment Team. 12. Record all wildlife observations.

Note:

A small proportion (approximately 2%) of the Beverly/Ahiak caribou spend the winter to the west of the proposed winter ice road, and may cross the winter ice road while it is still in operation. Specific mitigation is proposed for the period of April 15 to the end of the winter ice road season to reduce any disruption of movement to these caribou.

APPENDIX 5C CARIBOU ROAD CROSSING ANALYSIS

Appendix 5C: Back River Winter Ice Road Caribou Crossing Analysis

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EXECUTIVE SUMMARY

The Back River Project (the Project) includes two centres of activity, the Marine Laydown Area (MLA) on Bathurst Inlet and the Goose site, 160 km to the south. The two sites were connected by a winter ice road (WIR) during the winter of 2019. The WIR was constructed in January through March, with a planned end date of April 15th, prior to spring migration for caribou. Due to delays in construction, Sabina informed the Kitikmeot Inuit Association (KIA) and Government of Nunavut (GN) that they would operate the WIR after the planned April 15 closure date. The GN requested that Sabina investigate whether the movement of collared caribou were affected by WIR during spring migration. This report explores the movement of barren-ground caribou in relation to the operation of the winter ice road (WIR) in 2019 compared to movements in previous years. This analysis examines collared caribou from the Beverly/Ahiak and Bathurst herds that crossed the WIR during spring migration to their respective calving grounds.

Exploratory analyses indicated that caribou were more active in the region from 2017-2019 than in previous years, particularly Bathurst caribou, which previously did not pass through the region on their annual migration to their calving grounds on the West side of Bathurst Inlet. However, in 2017, 2018, and 2019, 26% of collared Bathurst individuals crossed to the east side of Bathurst Inlet before turning west to return to their calving grounds.

Caribou collar data were analysed from the region around the Back River WIR to test for changes to caribou movement during spring migration in 2019, when the ice road was active. Several analyses were used to examine for caribou hesitating to cross the road, including: two qualitative analyses, a brownian bridge movement model and histograms of movement rate and step length with distance to the WIR route. A tortuosity mixed-effects modelling analysis and a step-selection analysis were also conducted to address this question.

A rigorous statistical analysis was unable to detect any significant change in caribou movement behaviour following the construction of the WIR. Caribou responded strongly to terrain, but there was no indication of caribou hesitating or slowing down due to the WIR. Results Included:

- A brownian bridge movement model was used to examine caribou movement paths for areas where caribou are slowing down or concentrating on the landscape; there was no indication that caribou were hesitating or “clumping” prior to crossing the WIR during 2019 compared to previous years.
- Histograms of caribou movement rate and step length were constructed at increasing distance before and after crossing the road to examine whether there is any indication that caribou movement rate declined prior to crossing the road and speeding up after crossing. These histograms showed no hesitation by caribou when crossing the WIR during 2019 compared to previous years.
- A multinomial mixed-effects analysis was constructed to explain the tortuosity of movement paths. If caribou were hesitating before crossing the road, then their movement pattern would change from linear to tortuous (wandering). Topographic variables such as elevation and terrain roughness had a notably consistent effect on tortuosity, where step length was shorter as elevation and terrain roughness increased. However, tortuosity did not increase before crossing the road.
- A step-selection analysis was conducted to test whether the step length or angle of caribou movement changed near the road when the WIR was active. The hypothesis that individuals were deflecting away from the road. As with the tortuosity modelling, topography was a major determining variable in step selection probability.

These four analyses all produce that same result – there is no detectable effect of the WIR on caribou movement during spring migration in 2019. Each of these analyses relies on different assumptions and analysis methods, but reaches the same conclusion.

1. INTRODUCTION

The Back River Project (the Project) includes two centres of activity, the Marine Laydown Area (MLA) on Bathurst Inlet and the Goose site. The MLA receives sealifts of equipment and fuel during the open water season (generally August to October). The Goose site is approximately 100 km south of Bathurst Inlet, supports a camp and drilling program, and is the area intended for the construction of the Back River mine site. Equipment and fuel are shipped from the MLA to the Goose site on an annual winter ice road (WIR) constructed during December and January. The Wildlife Mitigation and Monitoring Program Plan (WMMP Plan; Version 10) indicates that truck transport on the WIR was scheduled to be complete by April 15, prior to the spring migration of caribou.

During 2019, Sabina constructed the WIR for the first time. Construction began in January and completed in March. Due to delays in construction, Sabina informed the KIA and GN that they would operate the WIR after the planned April 15 closure date. The GN requested that Sabina investigate whether the movement of collared caribou were affected by WIR during spring migration.

This report explores the movement of barren-ground caribou in relation to the operation of the winter ice road (WIR) in 2019 compared to movements in previous years. This analysis examines collared caribou from the Beverly/Ahiak and Bathurst herds that crossed the WIR during spring migration to their respective calving grounds.

Beverly/Ahiak caribou typically winter northeast of Yellowknife, north of the treeline and generally travel straight northeast during spring migration to the calving grounds in the Queen Maud Gulf Migratory Bird Sanctuary (Ekati WEMP, ERM 2018).

Bathurst caribou winter at or below the tree line in a band north of Yellowknife and they generally travel straight north via Contwoyto Lake to the calving grounds west of Bathurst Inlet, between the Hood and Burnside rivers (Ekati WEMP, ERM 2018). Since 2017, approximately 10-25% of the collared Bathurst caribou follow the Beverly caribou northeast, crossing the WIR route and then turn left and proceed northwest and cross through the rocky area south of Bathurst Inlet to the Bathurst calving area. This is a new development in the last three years.

In order to understand if the construction of the winter ice road altered caribou movement in any way, factors related to the underlying landscape must be accounted for. Caribou choose migration routes based on a number of factors including food availability, ease-of-travel, avoidance of threats, and social group dynamics (Johnson et al. 2002; Torney et al. 2018). Using spatial datasets on habitat, models like those used here can be used to explain changes in movement rate observed in caribou around the WIR, and in doing so parse apart the effect of the road from the effect of the underlying habitat.

No direct mortality was reported at or near the site of the WIR in 2019 (WMMP Plan; Version 10), and thus the effect of the road on caribou was expected to be purely behavioural. A behavioural response to a road may be related to noise, vibrations, light, or dust produced by vehicles, or a response to the physical barrier of the road itself (D'Amico et al. 2016). Three types of behavioural responses may be expected from animals encountering a road: 1) avoidance, where individuals are deflected off a straight path; 2) hesitation, where individuals spend more time near the road prior to crossing it; and 3) no detectable response (Forman and Alexander 1998). Changes in the way caribou move near the road are important because they can lead to a delayed arrival to the calving grounds, and female caribou must already contend with a short time frame to give birth and raise their offspring (Panzacchi et al. 2011).

It was hypothesized that should caribou be hesitating to cross the road, their speed would drop prior to crossing the road, followed by an increase in speed following crossing the road (Figure 1-1; Panel 1). The number of collar locations (the frequency of occurrence) would follow the opposite trend, with more locations near the road prior to crossing as the animal slows down and lingers, and fewer locations after crossing the road as they are moving quickly away (Figure 1-1, Panel 2).

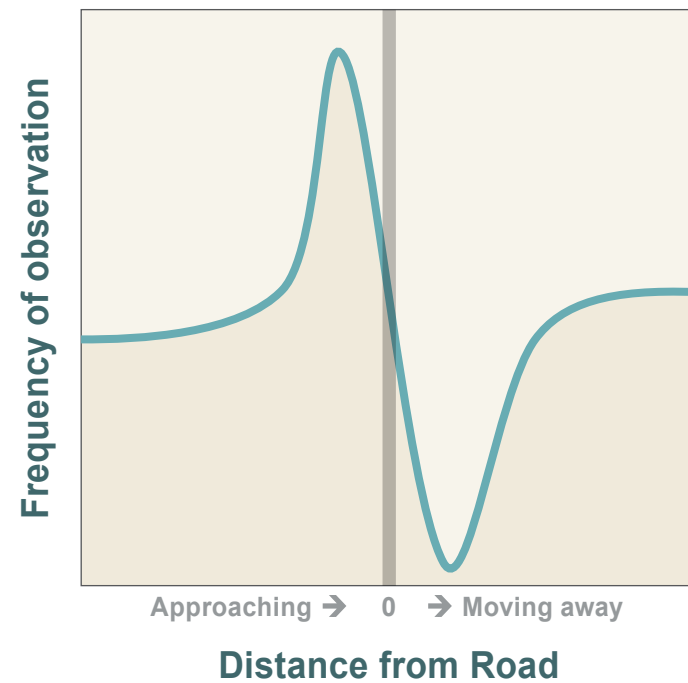
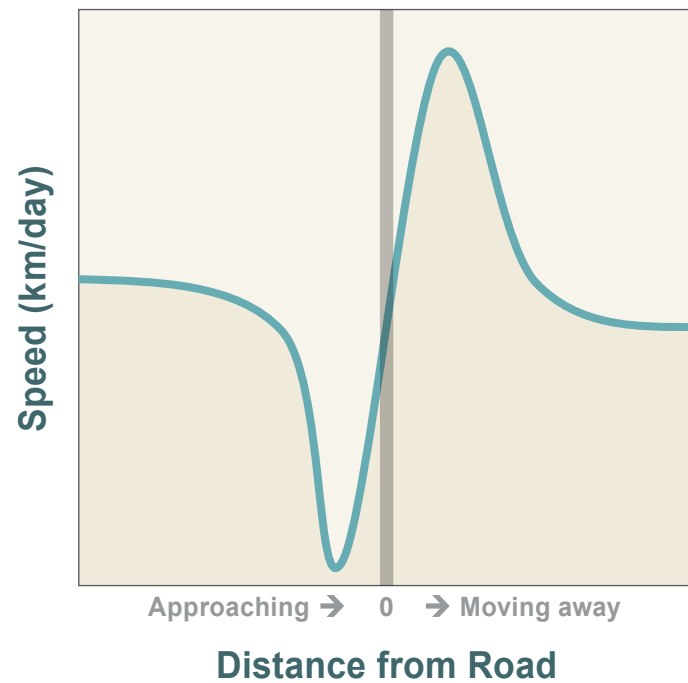


Figure 1-1: Management of Vehicles when Wildlife are Observed on or along the Winter Ice Road

Several analyses were used to examine for the behaviours listed above, two qualitative methods and two analyses using statistical models, including:

- A brownian bridge movement model was used to examine caribou movement paths for obvious areas where caribou are concentrating on the landscape.
- Histograms of caribou movement rate and step length were constructed at increasing distance before and after crossing the road to examine whether there is any indication that caribou movement rate is declining prior to crossing the road and speeding up after crossing.
- A multinomial mixed-effects analysis was constructed to explain the tortuosity of movement paths and to test the hypothesis that individuals were hesitating before crossing the road. If caribou were stopping at the road, then their movement pattern would change from the kind of straight path typically seen during migration to a path with shorter distances and frequent changes in direction. This is referred to as an increase in tortuosity. A multinomial mixed-effects model assesses the tortuosity of a typical movement path using multiple factors such as habitat, and then compares the kinds of paths seen between years and near or far from the road.
- A step-selection analysis was conducted to test the hypothesis that individuals were deflecting away from the road. If caribou were deflecting away from the road, then as they approach the road their movement pattern would change from a straight path to a path where movement away from the road was increasingly likely. A step-selection analysis quantifies the degree to which caribou choose habitat in a straight path or habitat away from a straight path, and then compares the kinds of paths seen between years and near or far from the road.

2. METHODS

In this analysis, two exploratory analyses are explored;

- A Brownian bridge movement model, and
- A multinomial mixed-effects analysis was constructed to explain the tortuosity of movement paths and to test the hypothesis that individuals were hesitating before crossing the road.

And two key model types are explored:

- A multinomial mixed-effects analysis was constructed to explain the tortuosity of movement paths and to test the hypothesis that individuals were hesitating before crossing the road.
- A step selection analysis was conducted to test the hypothesis that individuals were deflecting away from the road.

All analyses were carried out using the freely available program, R version 3.6.1 (R Core Team, 2017). Key R packages used for statistical analysis included {lme4} and {MuMIn} for mixed-effects modelling, and {mclogit} for step-selection analysis. For graphing and working with spatial data, {ggplot2}, {tidyverse}, {raster}, and {rgeos} were used.

The following section describes the data management and exploratory analyses of the collar data and preparation of habitat data for use in the tortuosity and step-selection analyses. The exploratory analysis was conducted to determine the strength of the data and the types of statistical analyses that would be best for addressing the hypotheses about how the road might affect caribou movement.

2.1 Data Management and Exploratory Analyses

An analysis of caribou movement in the area of the WIR before and after its construction was performed using caribou collar data supplied by the Government of Northwest Territories (GNWT) Department of Environment and Natural Resources (ENR) for both the current year (2019) as well as a compilation of historical years (2001 to 2018). The source data contained location data from each of the collars and corresponding unique ID, herd, and sex for the individual.

The raw dataset was cleaned to remove errors in collar locations, including mislabelled records and outlier locations. Movement rates (km per day) were calculated as the distance travelled from one collar observation to the next divided by the number of days between consecutive observations. Only individuals with daily locations were included in the analyses; data from before 2008 were excluded because these years lacked daily location data.

Prior to conducting the main analyses, a series of exploratory analyses were conducted to determine the data quality, determine which variables to use in the analysis and look for auto-correlations and other data dependencies that could bias the analyses.

For an exploratory analysis, collar data were summarised from the Bathurst herd between 2008 and 2019 and for the Beverly/Ahiak herd between 2012 and 2019.

A preliminary step was to plot out key response and predictor variables to detect any obvious trends or outliers. Observations were subset into those occurring before an individual had crossed through the winter ice road area (denoted by negative values on the x-axis) and those occurring after an individual crossed through the winter ice road area (positive values), irrespective of whether the road existed or not.

Between 2016 and 2017 there was a notable shift in migratory routes for both the Bathurst and Beverly/Ahiak herds evidenced by the collar tracks. Therefore, the analysis included only the years 2017 through 2019. To control for effort and to focus on a temporal scale applicable to management decisions, data

were filtered to one observation per day. Data were further refined so that only observations from spring migration were included (March 1 to June 15).

For both statistical analyses, predictor variables were tabulated for each step across all years, and calculated as the average value of the habitat raster intersecting each step. Predictor variables were selected based on both a review of literature on caribou movement and the best available data. Of the many habitat variables considered for inclusion, only a few were available for the area at the scale required for statistical modelling. For the focus of this analysis, three broad categories of predictor variables were selected that best summarized the habitat requirements of migrating caribou:

- Primary productivity, which relates to food availability (Figure 2.1-1);
- Habitat type, which relates to the types of vegetation cover available (Figure 2.1-2);
- Topography, which relates to the roughness of terrain and ease of travel (Figure 2.1-3).

For primary productivity, an enhanced vegetation index (EVI; derived from Landsat and USGS) was used. For habitat type, the dominant land cover classes were used, which included sparse vegetation cover (<10% vegetated), graminoid dominated cover (>50% graminoid), and shrub-dominated cover (>25% shrub). Non-water land cover variables comprising less than 25% of the landscape cumulatively were not included. Land cover was derived from the Northern Land Cover of Canada dataset by grouping together similar land cover classes (Olthof et al. 2000).

Topography variables were extracted from a digital elevation model and included slope and a terrain roughness index (TRI; Natural Resources Canada 2015). The distance to roads variable was calculated as the nearest Euclidean distance to the WIR from the location at the start of the day for that “step”, where a step is defined as the line connecting two successive radio collar locations.

A correlation test was conducted to test for habitat variables that were too closely related to include in the same models. Slope and TRI were closely related (Pearson’s correlation coefficient >0.7) and slope was dropped from further analysis, as TRI provided a better fit to the data when compared with a t-test using two models with only TRI or slope as predictors.

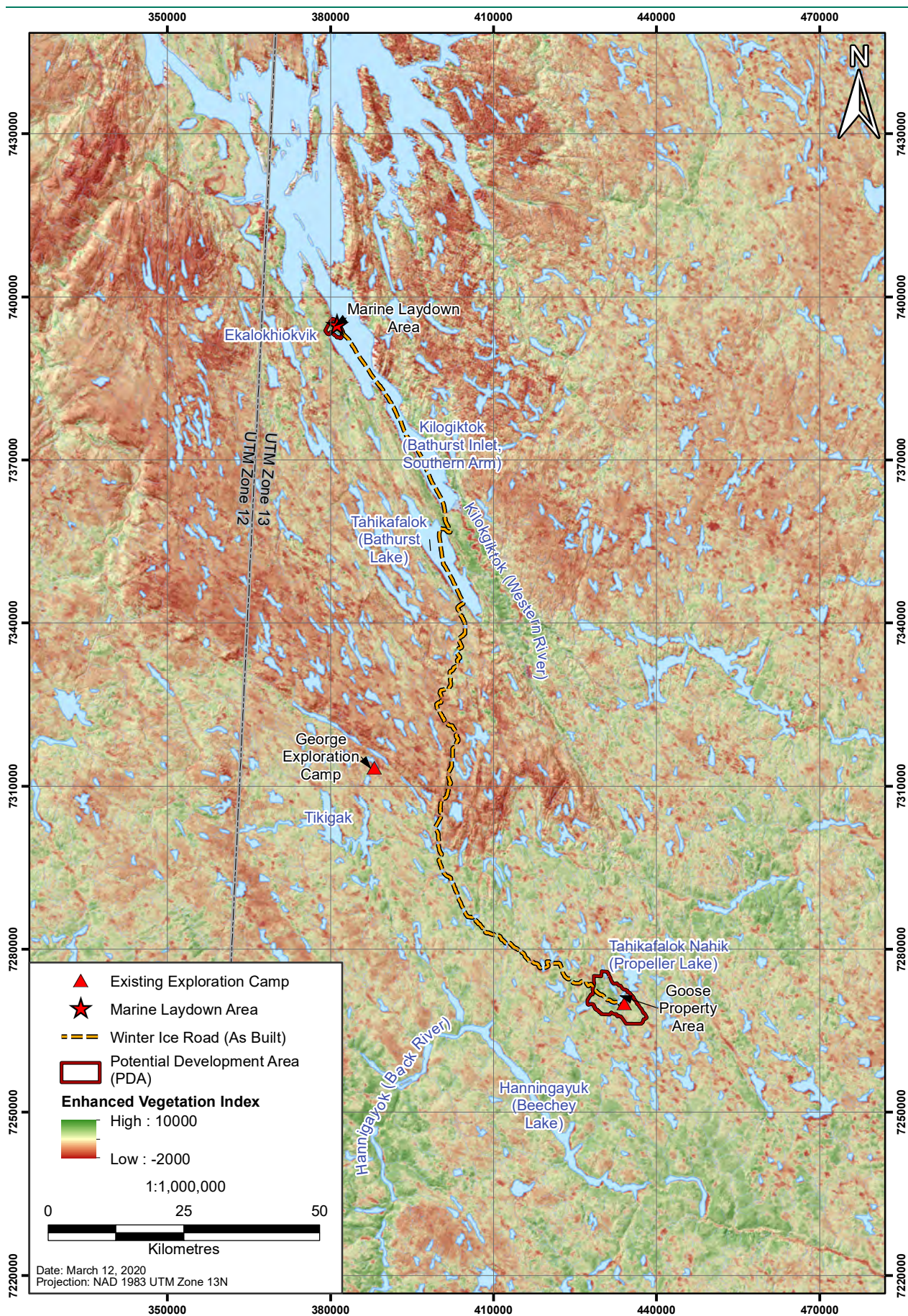
2.2 Brownian Bridge Movement Model

An additional exploratory step was to map high traffic routes by collared caribou. This was done in order to provide an estimate of areas where caribou were more likely to interact with the road, and to help identify which habitat variables were likely to be important for further statistical modelling. The presence of “high traffic” routes indicated that the underlying habitat was conducive to migration, and so helped justify the inclusion of habitat variables that were found there.

Improvements in radio collar technology have increased the frequency of and accuracy of location points, but the nature of satellite data and the fact that you cannot collar every individual means that some uncertainty will always exist. One way to map occurrence from an incomplete sample is to use a Brownian Bridge movement model (BBMM), which can provide a probabilistic estimate of migration routes given the locations known to contain individuals from the sampled population (Horne et al. 2007). Because the Bathurst herd and Beverly/Ahiak herd have different calving grounds, migratory routes were expected to be different and BBMMs for the two populations were analysed separately.

2.3 Histogram of Distance to Road

Histograms of the daily step length and the frequency of occurrence both Beverly/Ahiak and Bathurst caribou were plotted versus the distance before and after crossing the road route during spring migration both before the construction of the WIR and during 2019 when the WIR was operational.



**Figure 2.1-1: Habitat Variables Underlying the WIR Area:
Enhanced Vegetation Index (EVI)**

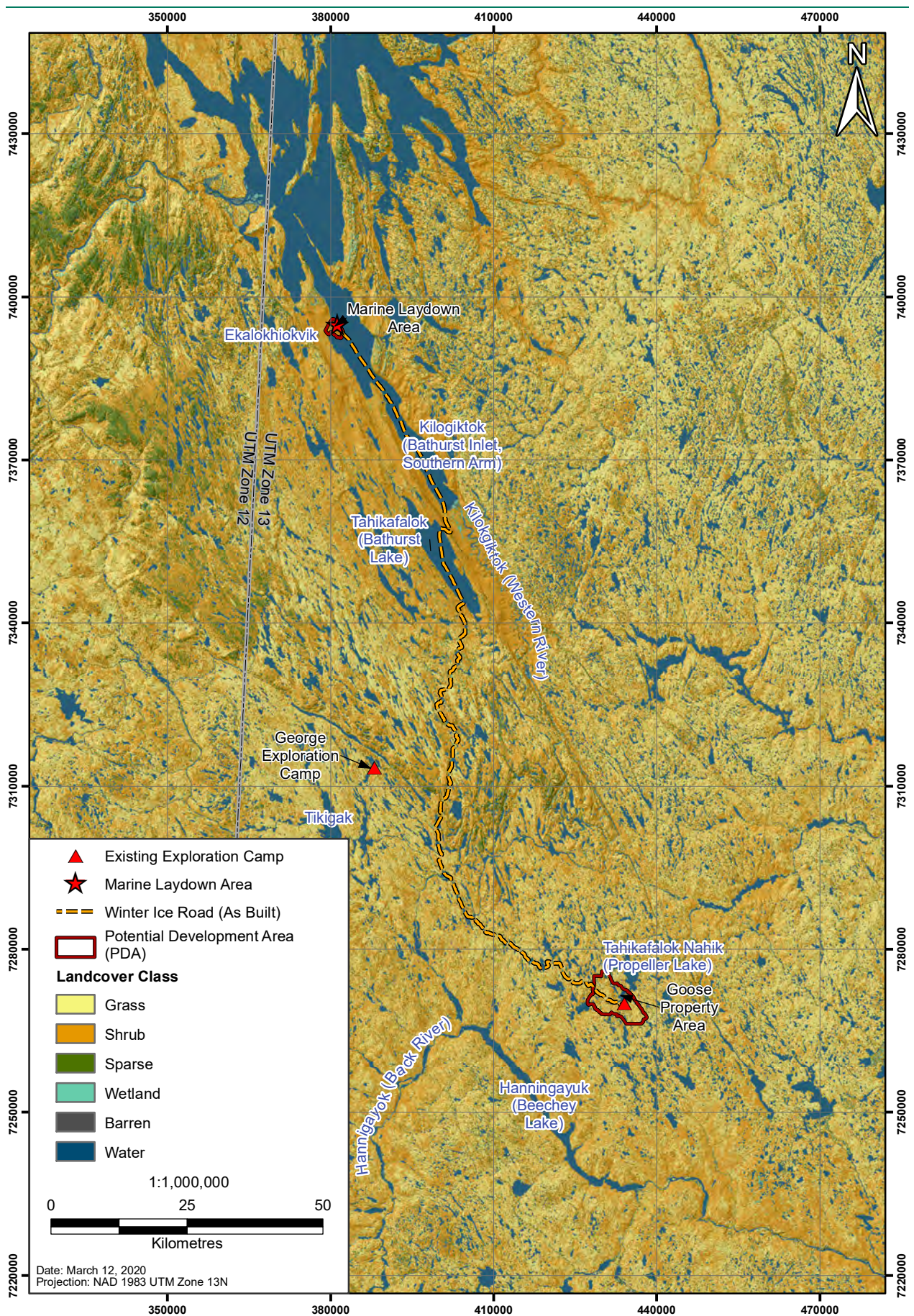


Figure 2.1-2: Habitat Variables Underlying the WIR Area: Northern Land Cover

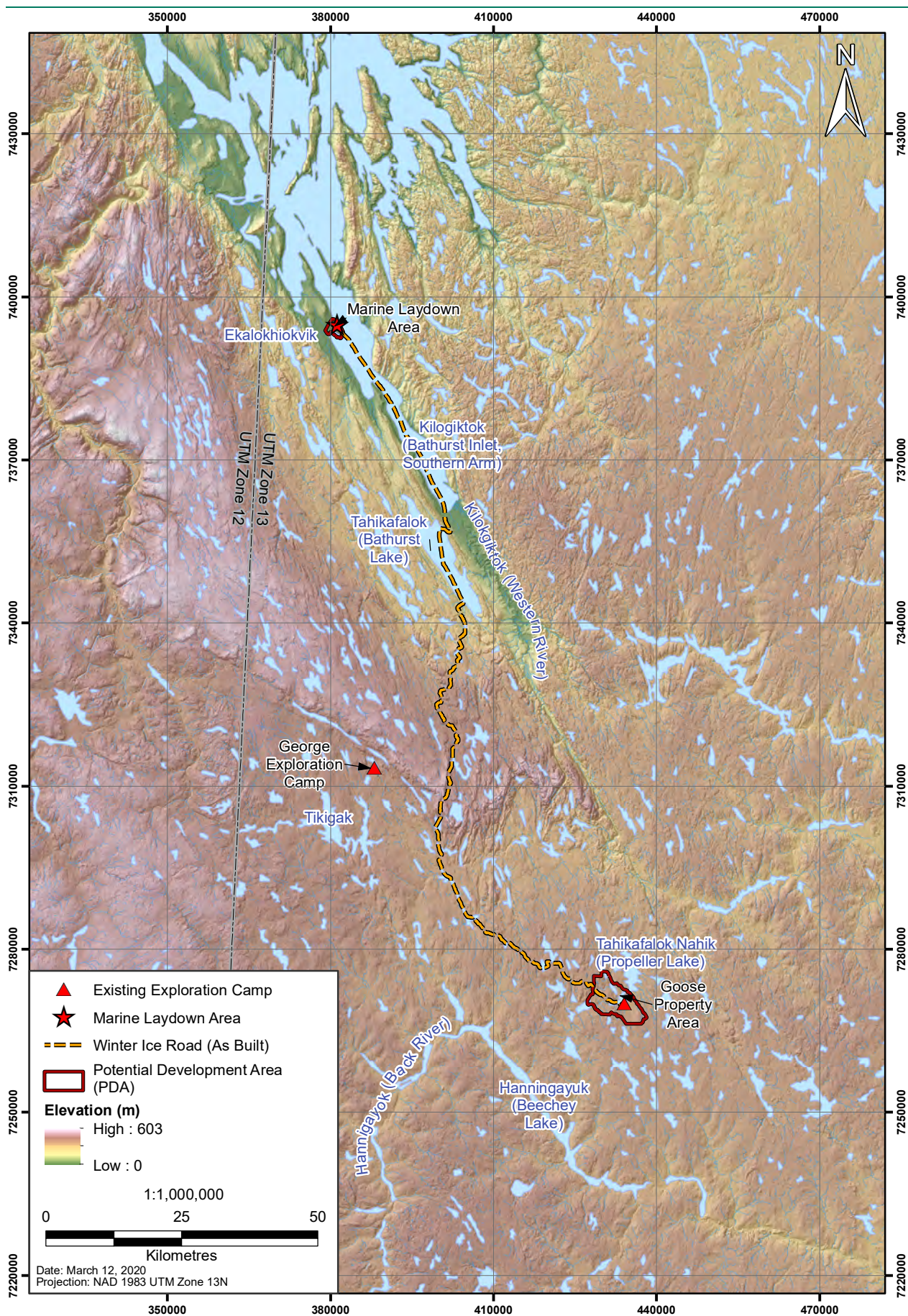


Figure 2.1-3: Habitat Variables Underlying the WIR Area: Topography

2.4 Tortuosity Mixed-Effects Modelling

It was hypothesized that individuals may hesitate before crossing the active WIR compared to animals migrating in the years without a WIR. A common method to evaluate changes in animal movement paths is to assess the tortuosity of the path as a response to habitat. The term tortuosity describes the straightness of a movement path, where a more tortuous path may indicate that an individual is moving slowly or cautiously in response to external factors (Benhamou 2004). It is a combination of both the turning angle and distance travelled in successive collar locations. High tortuosity can be indicative of foraging behaviour, in spring it may also mean a delay in getting to the calving grounds.

For this analysis, tortuosity mixed-effects models were used to investigate the differences in turning angle and step length in response to various habitat variables and distances to the WIR in control years (2017 and 2018) and in treatment years (2019).

Turning angle was defined as the deviation in radians from a straight path given the previous day's location. Step length was defined as the distance travelled from one collar observation and the next. Only observations within 25 km of the WIR were included. This buffer was selected based on previous studies of the zone of influence of industrial activities on caribou, and was considered sufficiently large to capture any behavioural effects of the road, while at the same time excluding caribou that did not migrate near the road. All predictor and response variables were scaled to standard "z-scores" using the mean and standard deviation to ensure all variables were on a similar scale.

A Before-After-Control-Impact (BACI) approach was used to test for a change in step length or turning angle in the potential effect region of 25 km around the WIR during potential effect years compared to non-effect years. The models included two covariates to account for this: 1) observations from a range of distances from the potential effect region (the winter ice road) and 2) observations within or outside of the potential effect year of 2019. An interaction between potential effect years and potential effect region (potential effect year term \times potential effect region term) was included as the BACI term, which indicates a change in step length or turning angle over time within and outside of the potential effect region. Thus, project related effects (i.e., change in step length or turning angle in the potential effect region during potential effect years) may be indicated by a significant p-value of <0.05 of the potential effect years and potential effect region interaction term.

A multinomial mixed effects model was constructed with all habitat variables and the BACI term included, as well as individual ID as a random effect. An iterative model selection process was conducted to test all combinations of parameters and rank them by model fit, as evidenced by the Akaike Information Criteria (AIC). Top models were identified as having a low AIC and within a delta AIC ≤ 2 of the top-ranked model (Burnham & Anderson 2004). Models with a $\Delta AIC \leq 2$ from the top model were considered as 'well-supported'; those with a ΔAIC from 2 to 4 to have 'limited support'. Effect sizes and standard errors were averaged by model weight and parameter estimates reported for all models with a cumulative weight of 0.95 (Burnham and Anderson 2004). The model selection process was repeated for subsets of data for which differing group effects may be expected, including by herd, and again by whether or not the observation occurred before or after the individual first encountered the road.

2.5 Step-Selection Analysis

It was also hypothesised that caribou may approach the active WIR and then deflect away from it to avoid it altogether, a response which would be uncharacteristic for individuals that typically travel straight, direct routes during migration. In order to test for this, a step-selection analysis was carried out to determine whether the existence of the WIR in 2019 affected the probability that caribou would move in the direction of the WIR.

A step selection analysis is a type of conditional logistic regression that assumes that the route taken by individuals is a function of the underlying habitat, and compares the route taken by the individual to the routes available to the individual, and what habitats are underlying these routes (Avgar et al. 2016). The logic of this test is that individuals make decisions every day to choose a direction in which to go, which is largely dependent on the type of habitat available around them. If something other than habitat, like the WIR, is affecting this choice, then the expectation is that this difference would be detectable through a statistical test.

Movement routes were divided up into “steps”, or the difference in location of the collared caribou each 24 hours. A series of random alternative steps were generated from the distribution of step distances and step directions in the dataset, given the actual starting point for each step. Here, for each step that a caribou actually took, three hypothetical steps were generated that the caribou could have taken, but did not. These four steps were considered one cluster. Habitat variables were extracted for each real and hypothetical step, and an identifier variable denoted the actual steps as 1's and the alternative steps as 0's. Logistic regression was then used to assess the relationship between the probability that the step was taken and the habitat variables. This was conducted independently for each cluster of steps and coefficients were combined together across all individuals to get an average coefficient across all steps.

As with the tortuosity analysis, a BACI design was employed to test for a change in the probability of a move towards the road in the potential effect region during potential effect years compared to non-effect years. The models included two covariates to account for this: 1) observations from a range of distances from the potential effect region (the winter ice road) and 2) observations within or outside of the potential effect year of 2019. An interaction between potential effect years and potential effect region (potential effect year term \times potential effect region term) was included as the BACI term, which indicates a change in probability of moving towards the road over time within and outside of the potential effect region. Thus, project related effects (i.e., change in probability of moving towards the winter ice road in the potential effect region during potential effect years) may be indicated by a significant p-value of < 0.05 of the potential effect years and potential effect region interaction term. The data were subset into observations within 5 km, 10 km, 20 km, 30 km, 40 km, and 50 km from the WIR, to test whether models with observations closer to the road were more likely to detect an effect.

3. RESULTS

The following sections describe the results of the analyses, starting with the exploratory analysis. This includes a description of the data, high-traffic routes used during migration, and visualizations of the data and Brownian Bridge movement model results. The sections following the exploratory results provide a detailed description of the results of the two statistical tests – the tortuosity mixed-effects modelling and the step selection analysis.

3.1 Exploratory Analysis

Once processed for errors, the complete dataset from GNWT included 166 unique Bathurst caribou and 135 unique Beverly/Ahiak caribou over the course of 11 years. The number of days per year and the number of years each caribou was monitored differed greatly. The number of collared caribou passing through a 20 km zone around the future WIR varied year to year and by herd. In the years before 2017, few or no Bathurst caribou passed within 20 km of the WIR, but since 2017 the number of Bathurst caribou in the zone has increased to 10-20%, and the number of collared caribou from both herds in the zone are now comparable.

During spring 2019, 11 collared Bathurst caribou and 9 collared Beverly/Ahiak caribou have passed within 20 km of the WIR, which accounts for 26% and 18% of collared individuals in these two herds, respectively (Table 3.1-1).

Tables 3.1-2 and 3.1-3 show that movement rates peak in May in all years, during spring migration, including 2019.

Table 3.1-1: Number of Collared Caribou by Herd and Proximity to the Winter Ice Road (WIR)

Year	Total Collared Bathurst	Collared Bathurst within 20 km of WIR, Spring	Total Collared Beverly/Ahiak	Collared Beverly/Ahiak within 20 km of WIR, Spring
2008	15	0	0	0
2009	16	0	0	0
2010	20	0	0	0
2011	18	0	0	0
2012	25	0	23	0
2013	18	1	17	0
2014	20	0	33	0
2015	48	1	50	0
2016	47	0	36	1
2017	54	9	55	14
2018	44	13	59	27
2019	42	11	50	9

Table 3.1-2: Caribou Movement Distances by Month, All Years (2008-2019)

Time Periods	Total Occurrences	Min	Max	Mean	Median	Std. Dev.
March	12546	0.00	58.19	3.48	1.77	4.82
April	15520	0.01	78.28	4.80	2.23	6.61
May	16727	0.00	85.06	12.08	9.07	10.69
June	15189	0.00	89.36	7.84	5.47	8.00

Table 3.1-3: Caribou Movement Distances by Month, 2019 Only

Time Periods	Total Occurrences	Min	Max	Mean	Median	Std. Dev.
March	1669	0.00	41.24	4.10	1.85	5.56
April	1496	0.01	63.43	5.23	2.54	6.85
May	1689	0.01	74.52	10.53	7.62	10.25
June	1040	0.00	60.47	7.40	4.89	8.01

3.2 Brownian Bridge Movement Model

If caribou were hesitating before crossing the road or deflecting off it, then the expectation is that data visualizing maps and graphs would show a higher frequency of data points on the pre-crossing side of the road vs. the post-crossing side of the road. Figures 3.2-1 through 3.2-4 show the outcome of a Brownian bridge movement model (BBMM), where darker colours denote high probability values and therefore a greater likelihood of use for migration routes.

These results indicate a high coincidence with topographic features on the landscape, as well as strong fidelity to migratory routes. For example, both herds have high frequency routes that follow the edge of the topographic ridgeline visible in Figure 2.1-3.

Bathurst caribou are thought to be less frequent in the area of the road because their historic calving grounds are on the West side of Bathurst Inlet directly north of their overwintering grounds. However, the Bathurst BBMM showed a high frequency of observations on both sides of Bathurst Inlet and thus the winter ice road, which may be indicative of a shift in movement patterns. The Beverly/Ahiak BBMM showed a strong northeast oriented pattern of high frequency areas consistent with their migration from their overwintering grounds to their calving grounds in the Queen Maud Gulf region.

These BBMM graphics suggest that patterns observed in 2017 and 2018 were mirrored in 2019, when the WIR was active. No obvious difference is visible in hotspots or key routes travelled in 2019.

3.3 Histogram of Distance to Road

Should caribou be hesitating to cross the road, it was hypothesized that step length (speed of travel) would decline before crossing the road, and speed up again after crossing the road, as illustrated in (Figure 1-1). Histograms of caribou step length (speed) and frequency of occurrence were plotted against the distance to the WIR route. Plots were produced for 2017-2018, before the WIR was constructed, and 2019 when the WIR was active during spring migration.

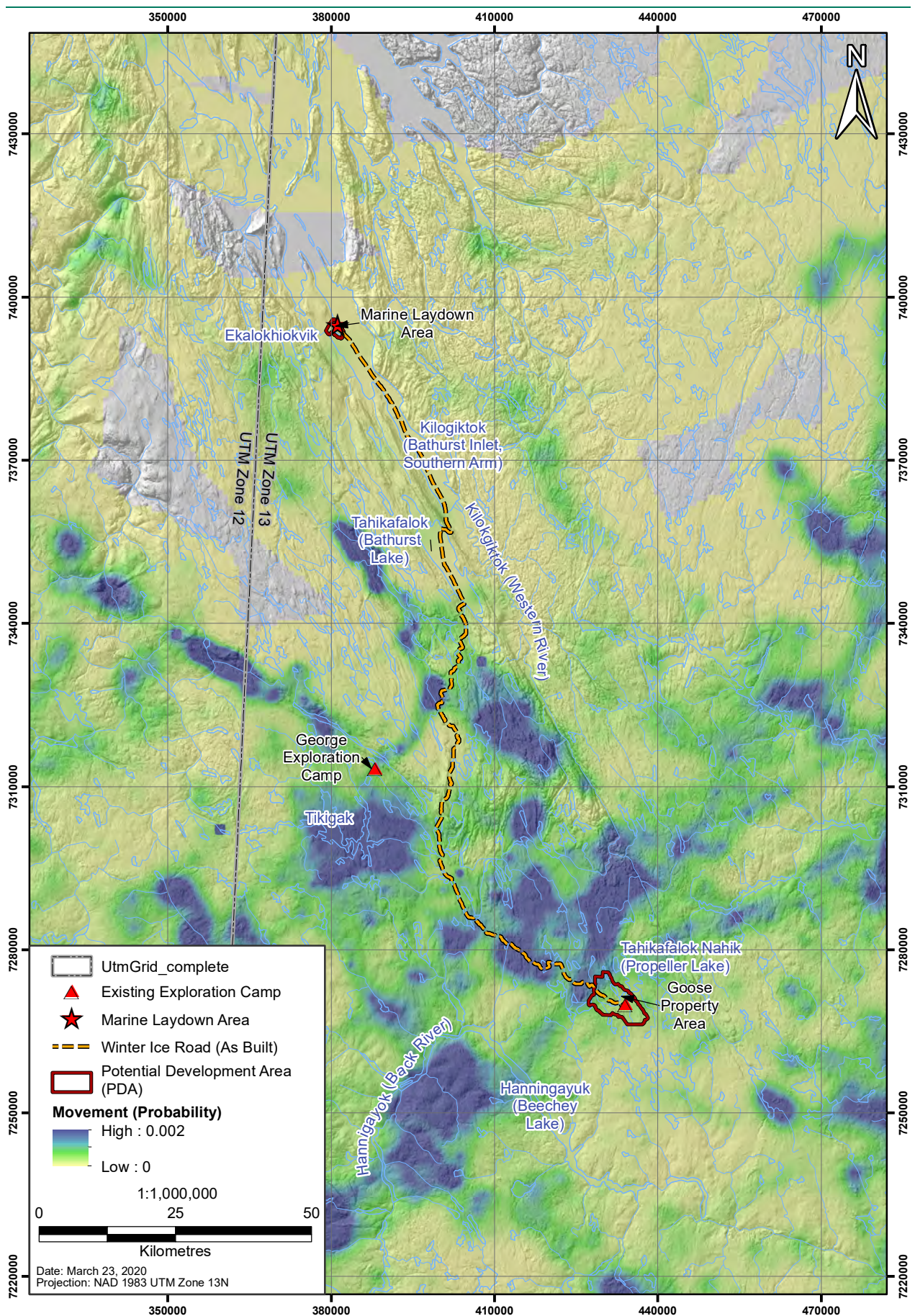


Figure 3.2-1: Brownian Bridge Movement Model for Beverly/Ahiak Herd Spring Data 2017-2018

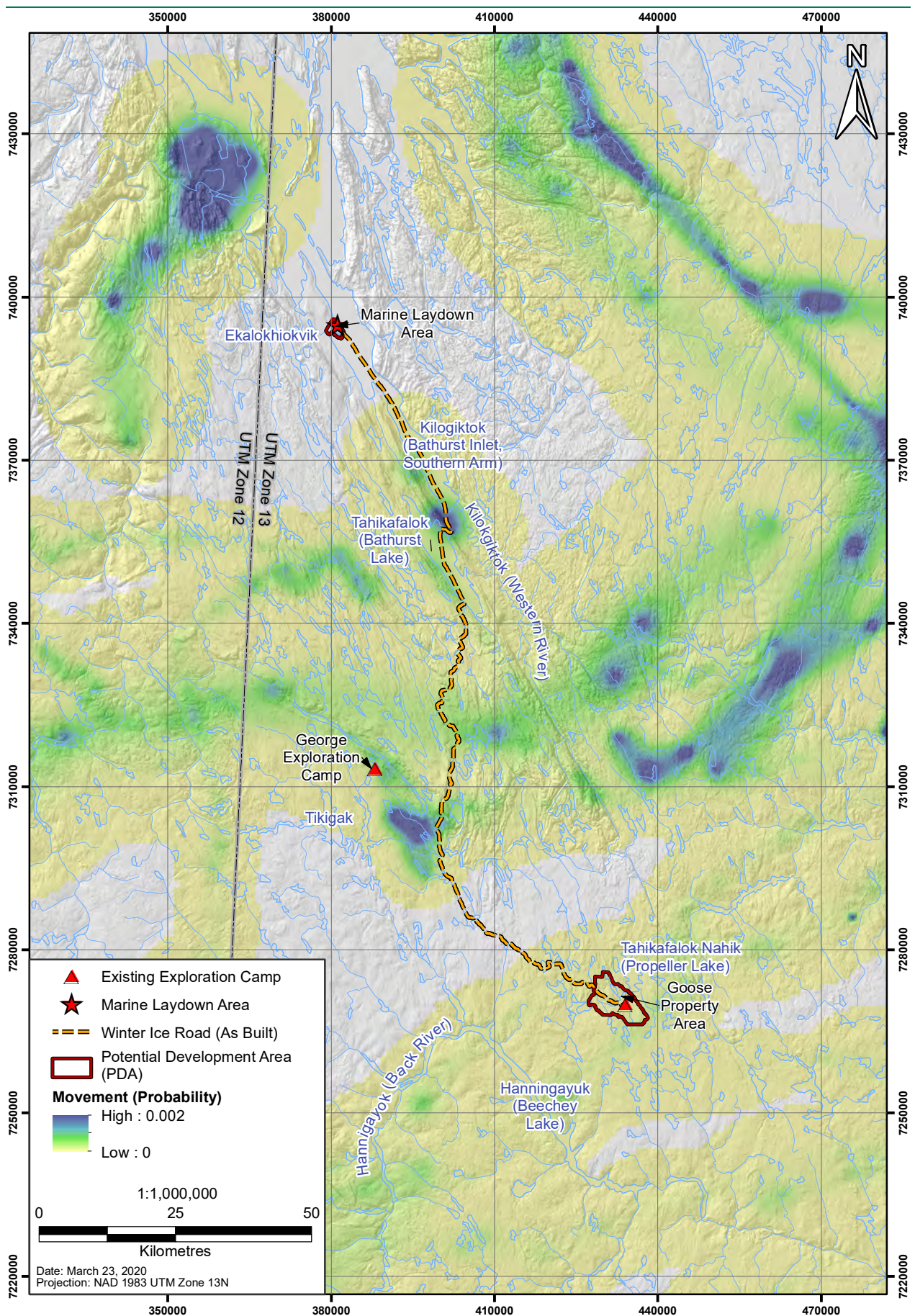
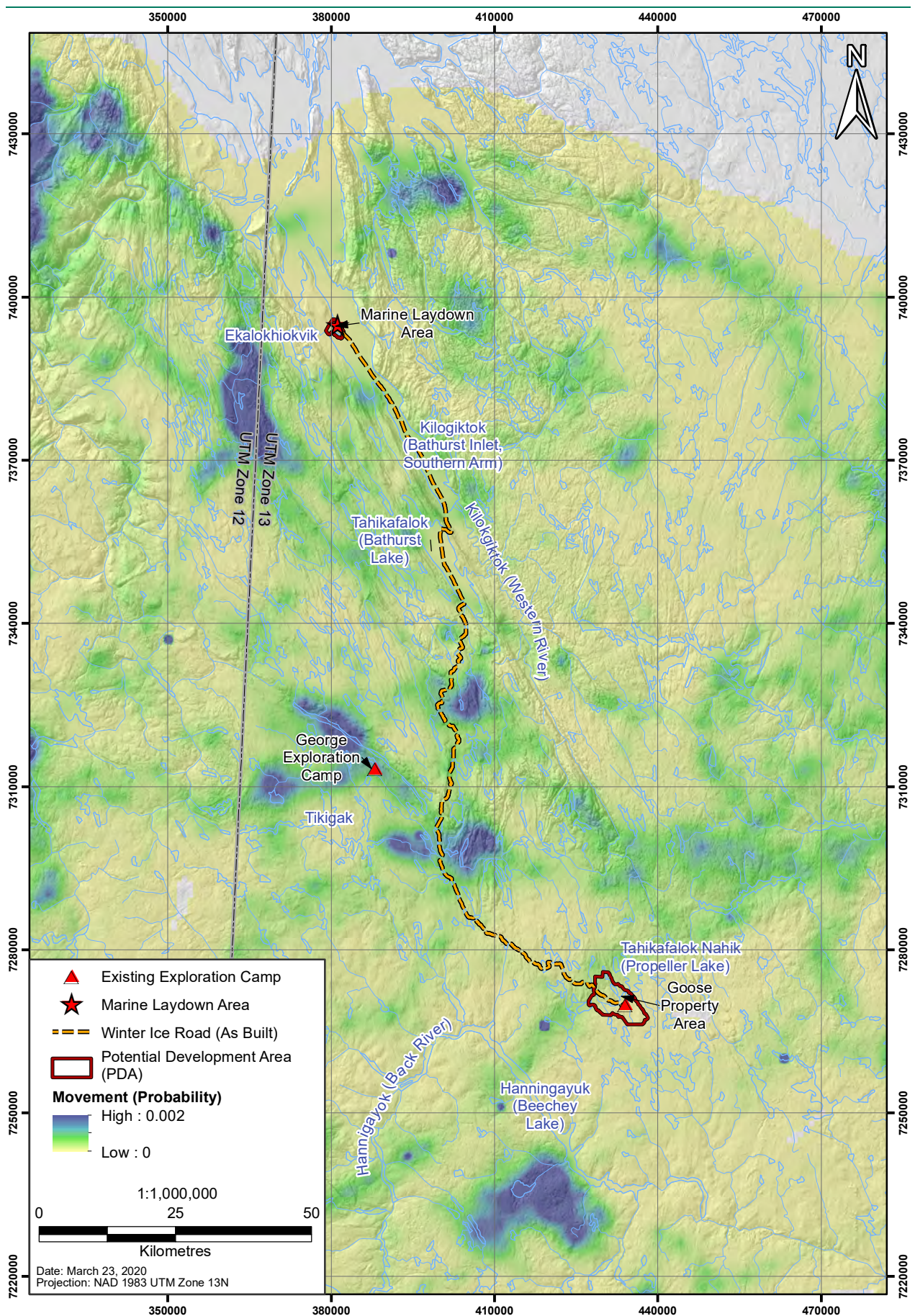


Figure 3.2-2: Brownian Bridge Movement Model for Beverly/Ahiak Herd Spring Data 2019 Only



**Figure 3.2-3: Brownian Bridge Movement Model for Bathurst Herd
Spring Data 2017-2018**

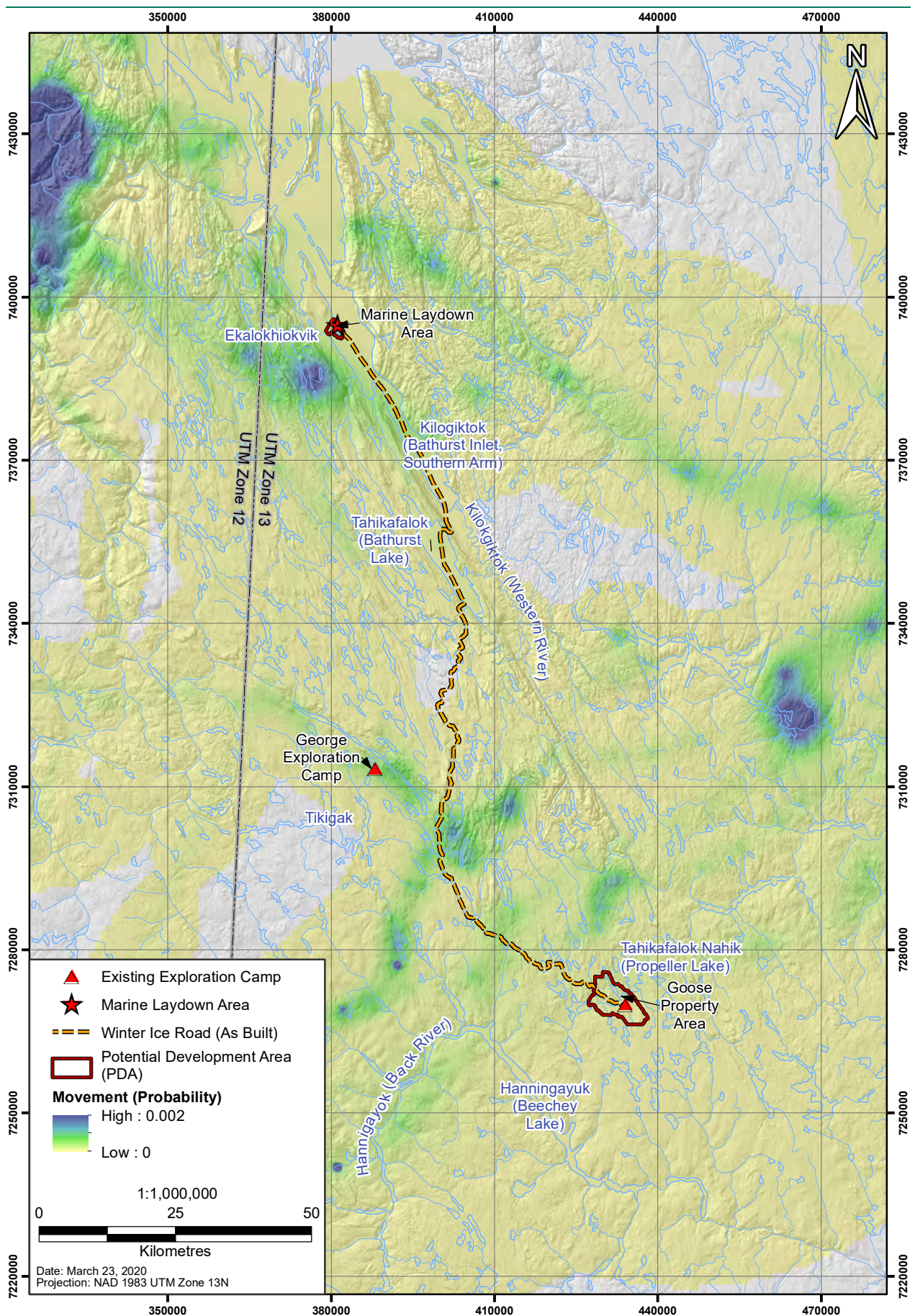


Figure 3.2-4: Brownian Bridge Movement Model for Bathurst Herd Spring Data 2019 Only

The histograms of step length and frequency of occurrence did not support the hypothesis that caribou hesitated to cross the active WIR in 2019, compared to other years. Instead, the histogram of distance to the WIR route at the start of each day showed a distinct bi-modal distribution with peak frequency of observations within 20 km of the ice road both before and after crossing, and dipping around 0 km from the winter ice road, particularly in the Bathurst herd (Figure 3.3-1). It is important to note that the bimodal distribution is apparent in years before the winter ice road existed, and may be a product of the calculation, of underlying habitat features, or of movement patterns that cause the Bathurst herd to spend more time in the area of the road after crossing through it.

A scatter plot of step length as a function of distance to the winter ice road shows a similar gap in the frequency of observations close to 0 km, but the large range of values make it difficult to easily detect other trends (Figure 3.3-1). These plots suggest that some variation in model predictions may be expected for observations occurring near the road, and these could be examined in closer detail. The statistical analyses in the following sections work to address this uncertainty.

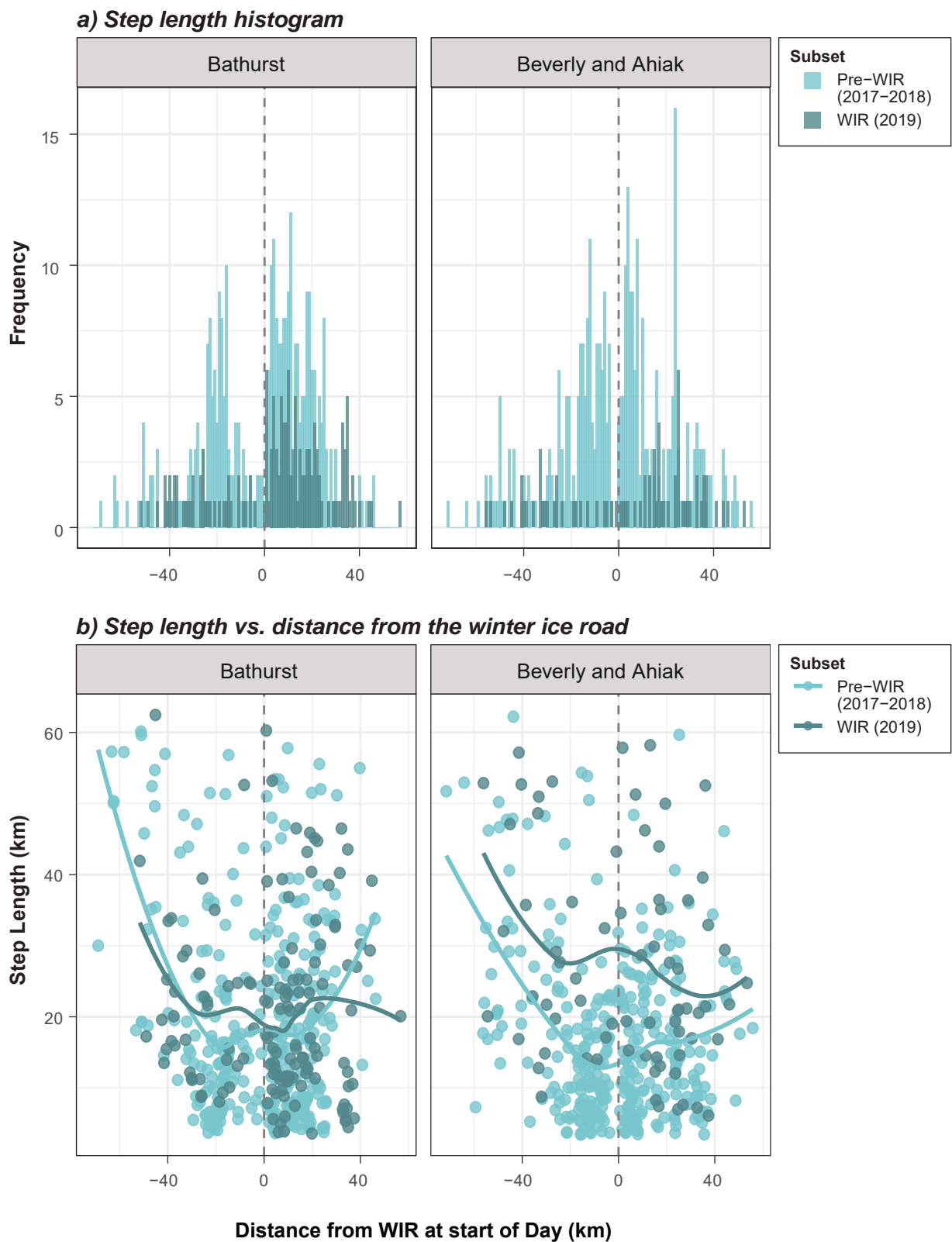
However, the overall takeaway of this analysis is that there is no obvious block of histogram observations on the pre-crossing side of the road, which is what would be expected if the caribou were hesitating or deflecting off the road on their west to east migration. The results also highlight the natural level of noise in the data.

3.4 Tortuosity Mixed-Effects Modelling

The tortuosity analysis examined whether caribou altered their movement patterns with distance to the WIR route, habitat (terrain roughness, elevation and land cover) and between years (when the WIR was active or not). The analysis indicated that caribou respond strongly to habitat variables. In all years, the movement rate of caribou was slightly higher near the WIR route – whether it was active or not. Importantly, there was no indication that caribou movement changed near the WIR route during 2019, when the WIR was active, compared to the previous years. This indicates that caribou did not respond to the WIR when it was active.

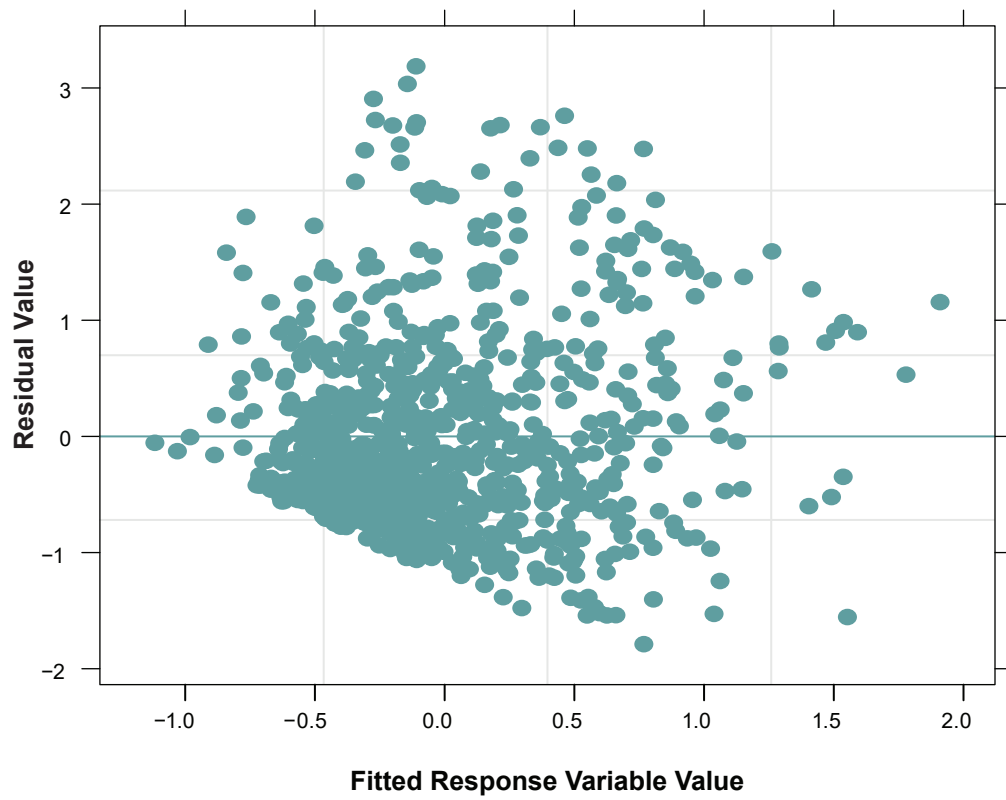
Of the two response variables tested to represent tortuosity – step length and turning angle – only step length resulted in viable models. Model selection for turning angle as a response variable produced no model that performed better than a null model with no parameters, and as such turning angle was excluded from additional analyses. The model selection process for step length as a response variable returned similar top models and model-averaged effects regardless of the subset of data used. All top model sets, whether they used a herd subset or a before or after crossing subset, returned a significant negative effect of distance to road as a predictor of step length. No top model set returned a significant effect of road interaction with effect year.

The topographic variables elevation and terrain roughness were consistently included in top model sets as negative predictors of step length, but their significance varied. Habitat variables for land cover and EVI were not included in any top model set, regardless of subset, because the inclusion of these predictors resulted in models that performed more poorly than the null model with no predictors. As a result, these variables are not included in model selection tables. Residual plots for the top model were similar across all subsets of data and suggest a slight skew to the data (Figure 3.4-1). However, a test using a log transformed response variable only slightly resolved the issue and was more difficult to interpret, so the response variable was left untransformed.



Notes: Two subsets displayed: 1. before the WIR existed and 2. during operation of the WIR.
 Negative distance values denote steps approaching the road, and positive values denote steps after crossing the road.
 A loess line is fit to each of two subsets; 1) before the WIR existed and 2) during operation of the WIR.

Figure 3.3-1: Step Length Data Exploration



*Notes: Full dataset comprising all observations within 25km of the winter ice road.
Pearson residuals.*

Figure 3.4-1: Residual Plot for Top Model Response Variable

3.4.1 Overall Dataset

The model results are shown in Table 3.4-1 in which each row represents a model, and the terms included in the model and their associated coefficients are shown in the first five columns. If the cell is empty, that predictor was not included in the model. The remaining columns indicate model fit, with AICc being the key indicator, and delta AIC (ΔAIC or just delta) being the difference in AIC value from the top model. The two top models ($\Delta AIC \leq 2$) from a pooled dataset across both herds included distance to road as a predictor of step length, but did not include the BACI interaction term of effect year (Table 3.4-1). Model averaged effect sizes showed a significant positive effect of distance from the road on step length (0.286 ± 0.039), and a significant negative effect of elevation on step length (-0.136 ± 0.038 ; Table 3.4-2). Terrain roughness and the BACI interaction term occurred in models within a cumulative weight cut-off of >0.95 , but their effects were not significant (Table 3.4-2). No other parameters were included in models within a cumulative weight cut-off of >0.95 .

When the model-averaged effect-size for distance to road was used to predict step length across a range of hypothetical distance to road values, individuals in the effect year (2019) had slightly longer steps closer to the road than individuals in non-effect years, but confidence intervals overlapped (Figure 3.4-2).

Table 3.4-1: Top Model Set Using Full Dataset and All Observations within 25 km of the WIR

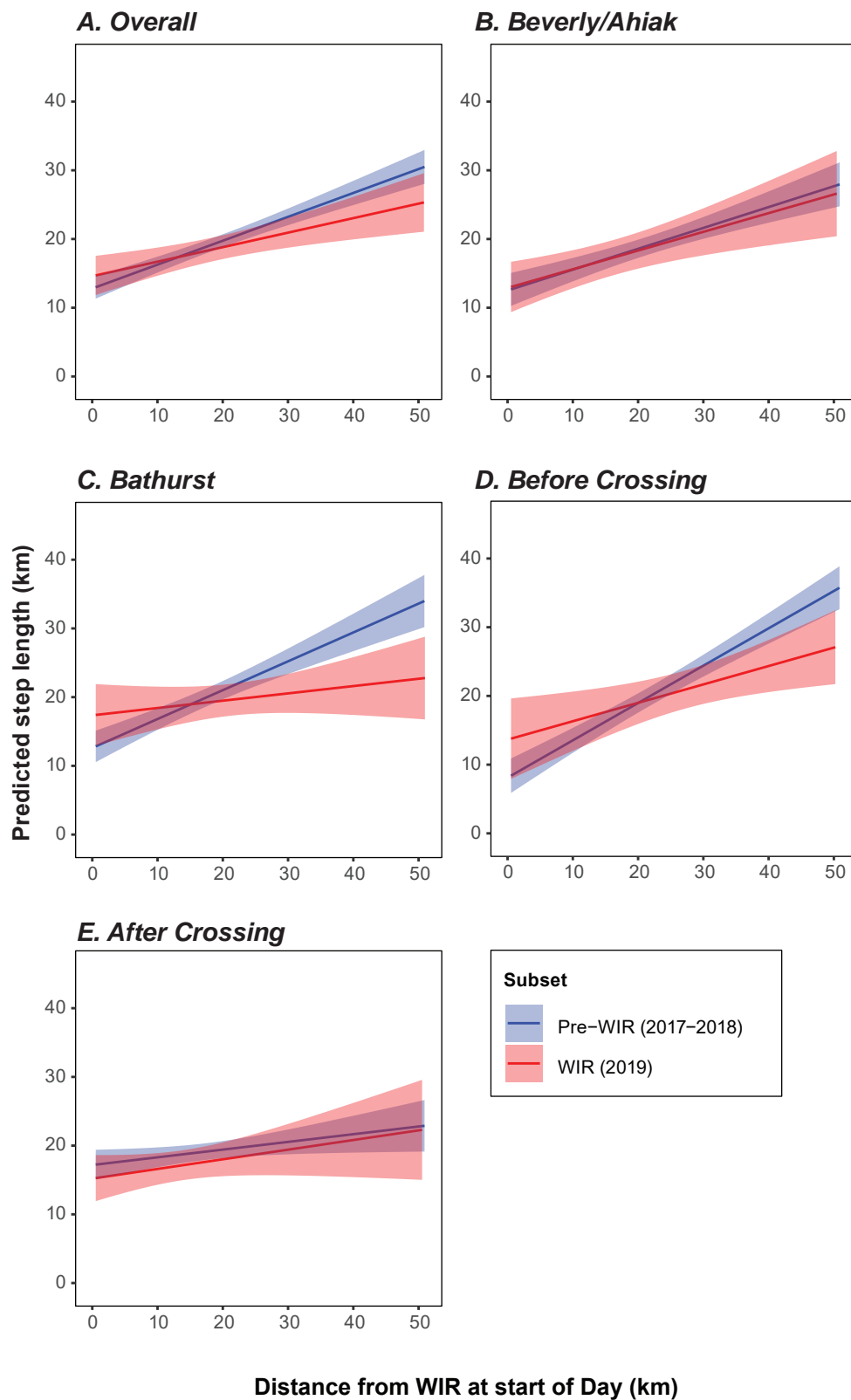
(Int)	elev	roaddist	TRI	roaddist × active	df	logLik	AICc	delta	weight ¹
0.13	-0.13	0.29			5	-1161.20	2332.47	0.00	0.491*
0.14	-0.15	0.27	-0.08		6	-1160.53	2333.16	0.69	0.348*
0.13	-0.13	0.31		-0.10	6	-1162.05	2336.20	3.73	0.076*
0.14	-0.15	0.30	-0.09	-0.12	7	-1161.12	2336.37	3.89	0.070*
0.16		0.26			4	-1166.05	2340.14	7.67	0.011
0.16		0.28		-0.10	5	-1166.95	2343.96	11.49	0.002
0.16		0.25	-0.06		5	-1166.97	2344.02	11.54	0.002

¹ Models included in the 0.95 cumulative weight cut-off for model averaging are indicated with an asterisk.

Table 3.4-2: Model Averaged Coefficients for Full Dataset and All Observations within 25 km of the WIR

	Estimate	Standard Error	Adjusted SE	z value	Pr(> z)
(Intercept)	0.135	0.081	0.082	1.652	0.099
Elevation	-0.136	0.038	0.039	3.531	0.000
Road distance	0.286	0.039	0.039	7.295	0.000
TRI	-0.035	0.046	0.046	0.756	0.450
Road distance × active year	-0.016	0.050	0.050	0.322	0.748

Note: Only variables in models with a cumulative weight $>95\%$, only observations within 25 km radius of WIR.



Notes: Derived from fitted coefficients from the best-fitting linear model to predict step distance, and using: a) the full dataset; b) only Beverly and Ahiak individuals; c) only Bathurst individuals; d) a subset of observations occurring prior to crossing the winter ice road and within 25km of the winter ice road; and e) a subset of observations occurring after crossing the winter ice road.

Figure 3.4-2: Predicted Step Length Given Distance from Road at Start of Day

3.4.2 Beverly and Ahiak Herd

The tortuosity analysis indicated that the Beverly/Ahiak caribou did not respond to the operation of the WIR in 2019.

The top model from a model subset of only Beverly/Ahiak individuals included distance to road as a predictor of step length, but did not include the BACI interaction term of effect year (Table 3.4-3). Model averaged effect sizes showed a significant positive effect of distance from the road on step length (0.286 ± 0.052 ; Table 3.4-4). Terrain roughness, elevation, and the BACI interaction term occurred in models within a cumulative weight cut-off of >0.95 , but their effects were not significant (Table 3.4-4). No other parameters were included in models within a cumulative weight cut-off of >0.95 . When the model-averaged effect-size for distance to road was used to predict step length across a range of hypothetical distance to road values, no difference is apparent between effect and non-effect years, and confidence intervals completely overlap (Figure 3.4-2).

Table 3.4-3: Top Model Set for Subset of Only Beverly and Ahiak Individuals

(Int)	elev	roaddist	TRI	roaddist × active	df	logLik	AICc	delta	weight ¹
0.02		0.28			4	-526.86	1061.82	0.00	0.787*
0.02		0.30		-0.09	5	-527.81	1065.78	3.96	0.109*
0.01		0.28	-0.04		5	-528.70	1067.55	5.73	0.045*
0.01	-0.02	0.29			5	-528.72	1067.59	5.77	0.044*
0.01		0.30	-0.04	-0.09	6	-529.64	1071.50	9.68	0.006
0.02	-0.02	0.30		-0.08	6	-529.70	1071.60	9.78	0.006
0.01	-0.04	0.28	-0.05		6	-530.40	1073.01	11.18	0.003

¹ Models included in the 0.95 cumulative weight cut-off for model averaging are indicated with an asterisk.

Table 3.4-4: Model Averaged Coefficients for Subset of Only Beverly and Ahiak Individuals

	Estimate	Standard Error	Adjusted SE	z value	Pr(> z)
(Intercept)	0.015	0.102	0.103	0.148	0.882
Road distance	0.286	0.052	0.052	5.500	0.000
Road distance × active year	-0.010	0.050	0.050	0.210	0.834
TRI	-0.002	0.014	0.014	0.144	0.885
Elevation	-0.001	0.014	0.014	0.090	0.928

Note: Only variables in models with a cumulative weight $>95\%$, only observations within 25 km radius of WIR.

3.4.3 Bathurst Herd

The tortuosity analysis indicated that the Bathurst caribou also did not respond to the operation of the WIR in 2019.

The top models ($\Delta AIC \leq 2$) from a model subset of only Bathurst individuals included distance to road as a predictor of step length, but did not include the BACI interaction term of effect year (Table 3.4-5). Model averaged effect sizes showed a significant positive effect of distance from the road on step length (0.298 ± 0.056 ; Table 3.4-6), and a significant negative effect of elevation on step length (-0.185 ± 0.045 ; Table 3.4-6). Terrain roughness and the BACI interaction term occurred in models within a cumulative weight cut-off of >0.95 , but their effects were not significant (Table 3.4-6). No other parameters were

included in models within a cumulative weight cut-off of >0.95. When the model-averaged effect-size for distance to road was used to predict step length across a range of hypothetical distance to road values, individuals in the effect year (2019) had slightly longer steps closer to the road than individuals in non-effect years, although the interaction term was not significant (Figure 3.4-2).

Table 3.4-5: Top Model Set for Subset of Only Bathurst Individuals

(Int)	elev	roaddist	TRI	roaddist × active	df	logLik	AICc	delta	weight ¹
0.25	-0.18	0.30			5	-632.09	1274.32	0.00	0.490*
0.28	-0.19	0.27	-0.10		6	-631.54	1275.26	0.93	0.307*
0.25	-0.18	0.34		-0.14	6	-632.67	1277.51	3.19	0.099*
0.28	-0.20	0.31	-0.11	-0.18	7	-631.64	1277.52	3.20	0.099*
0.32		0.25			4	-638.27	1284.62	10.30	0.003
0.35		0.23	-0.08		5	-638.76	1287.65	13.32	0.001

¹ Models included in the 0.95 cumulative weight cut-off for model averaging are indicated with an asterisk.

Table 3.4-6: Model Averaged Coefficients for Subset of Only Bathurst Individuals

	Estimate	Standard Error	Adjusted SE	z value	Pr(> z)
(Intercept)	0.264	0.129	0.129	2.043	0.041
Elevation	-0.185	0.045	0.045	4.072	0.000
Road distance	0.298	0.056	0.056	5.329	0.000
TRI	-0.043	0.060	0.060	0.728	0.467
Road distance × active year	-0.031	0.080	0.080	0.385	0.700

Note: Only variables in models with a cumulative weight >95%, only observations within 25 km radius of WIR.

3.4.4 Before Crossing

The collar data was analysed separately for the two herds before and after crossing the road. The analysis of collar data before crossing the road indicated that caribou are responding to elevation (low elevation areas are typically smooth heath tundra, whereas higher elevation areas in the study area tend to be rocky and rougher). Caribou in all years moved more quickly as they approached the road, which is the opposite of the hypothesis that they would slow down as they approached the road. Note that caribou speeding up as they approach the road may be an artefact of the fact that as caribou approach the road they are also getting closer to the calving ground and likely speeding up. Overall, caribou did not move differently in 2019 as they approached the road, when the WIR was active, compared to previous years.

The top model from a model subset of only observations occurring prior to the individual crossing the winter ice road included distance to road as a predictor of step length as well as the BACI interaction term of effect year (Table 3.4-7). However, a model without the BACI interaction term received similar levels of support ($\Delta AIC \leq 2$). Model averaged effect sizes showed a significant positive effect of distance from the road on step length (0.450 ± 0.063 ; Table 3.4-8), and a significant negative effect of elevation on step length (-0.250 ± 0.076 ; Table 3.4-8). Terrain roughness and the BACI interaction term occurred in models within a cumulative weight cut-off of >0.95, but their effects were not significant (Table 3.4-8).

Table 3.4-7: Top Model Set for Subset of Observations Occurring Prior to Crossing the WIR

(Int)	elev	roaddist	TRI	roaddist × active	df	logLik	AICc	delta	weight ¹
0.22	-0.25	0.48		-0.24	6	-481.42	975.06	0.00	0.481*
0.21	-0.26	0.42			5	-482.74	975.65	0.59	0.358*
0.22	-0.27	0.45	-0.09	-0.25	7	-482.13	978.57	3.51	0.083*
0.20	-0.27	0.40	-0.09		6	-483.50	979.24	4.18	0.060*
0.22		0.42		-0.26	5	-486.23	982.63	7.57	0.011
0.21		0.36			4	-487.77	983.66	8.59	0.007
0.22		0.40	-0.05	-0.26	6	-487.85	987.92	12.86	0.001

¹ Models included in the 0.95 cumulative weight cut-off for model averaging are indicated with an asterisk.

Table 3.4-8: Model Averaged Coefficients for Subset of Observations Occurring Prior to Crossing the WIR

	Estimate	Standard Error	Adjusted SE	z value	Pr(> z)
(Intercept)	0.214	0.106	0.106	2.011	0.044
Elevation	-0.250	0.076	0.077	3.259	0.001
Road distance	0.450	0.063	0.063	7.123	0.000
Road distance × active year	-0.141	0.145	0.145	0.972	0.331
TRI	-0.012	0.037	0.037	0.338	0.736

Note: Only variables in models with a cumulative weight >95%, only observations within 25 km radius of WIR.

No other parameters were included in models within a cumulative weight cut-off of >0.95. When the model-averaged effect-size for distance to road was used to predict step length across a range of hypothetical distance to road values, individuals in the effect year (2019) had slightly longer steps closer to the road than individuals in non-effect years, but confidence intervals overlapped (Figure 3.4-2).

3.4.5 After Crossing

After crossing the road, caribou responded to elevation (and indirectly to terrain roughness which tends to increase with elevation in the study area). However, once they crossed the WIR route, there was no effect of distance to the WIR route or to year. The hypothesis was that caribou would speed up after crossing the active road, but this was not supported – indicating that caribou did not respond to the active WIR in 2010.

The top model from a model subset of observations occurring after an individual crossed the road did not have any habitat parameters (Table 3.4-9). However, a model with just elevation received similar levels of support ($\Delta AIC \leq 2$). Terrain roughness, distance to roads, elevation, and the BACI interaction term occurred in models within a cumulative weight cut-off of >0.95, but their effects were not significant (Table 3.4-10).

No other parameters were included in models within a cumulative weight cut-off of >0.95. When the model-averaged effect-size for distance to road was used to predict step length across a range of hypothetical distance to road values, no difference is apparent between effect and non-effect years, and confidence intervals completely overlap (Figure 3.4-2).

Table 3.4-9: Top Model Set for Subset of Observations Occurring after Crossing the WIR

(Int)	elev	roaddist	TRI	roaddist × active	df	logLik	AICc	delta	weight ¹
0.09					3	-665.24	1336.52	0.00	0.346*
0.06	-0.10				4	-664.55	1337.18	0.66	0.249*
0.06	-0.11	0.12			5	-664.25	1338.63	2.11	0.121*
0.09		0.11			4	-665.40	1338.88	2.36	0.106*
0.07	-0.11		-0.08		5	-665.12	1340.35	3.84	0.051*
0.10			-0.07		4	-666.25	1340.57	4.05	0.046
0.08	-0.11	0.12	-0.08		6	-664.84	1341.85	5.34	0.024
0.10		0.08		0.13	5	-666.03	1342.17	5.65	0.020
0.07	-0.10	0.10		0.09	6	-665.14	1342.45	5.94	0.018
0.11		0.11	-0.07		5	-666.44	1343.00	6.49	0.014
0.08	-0.11	0.10	-0.08	0.07	7	-665.82	1345.86	9.34	0.003
0.11		0.08	-0.06	0.11	6	-667.17	1346.51	10.00	0.002

¹ Models included in the 0.95 cumulative weight cut-off for model averaging are indicated with an asterisk.

Table 3.4-10: Model Averaged Coefficients for Subset of Observations Occurring after Crossing the WIR

	Estimate	Standard Error	Adjusted SE	z value	Pr(> z)
(Intercept)	0.078	0.089	0.089	0.879	0.379
Elevation	-0.048	0.059	0.059	0.823	0.411
Road distance	0.034	0.060	0.060	0.565	0.572
TRI	-0.010	0.030	0.030	0.341	0.733
Road distance × active year	0.005	0.036	0.036	0.132	0.895

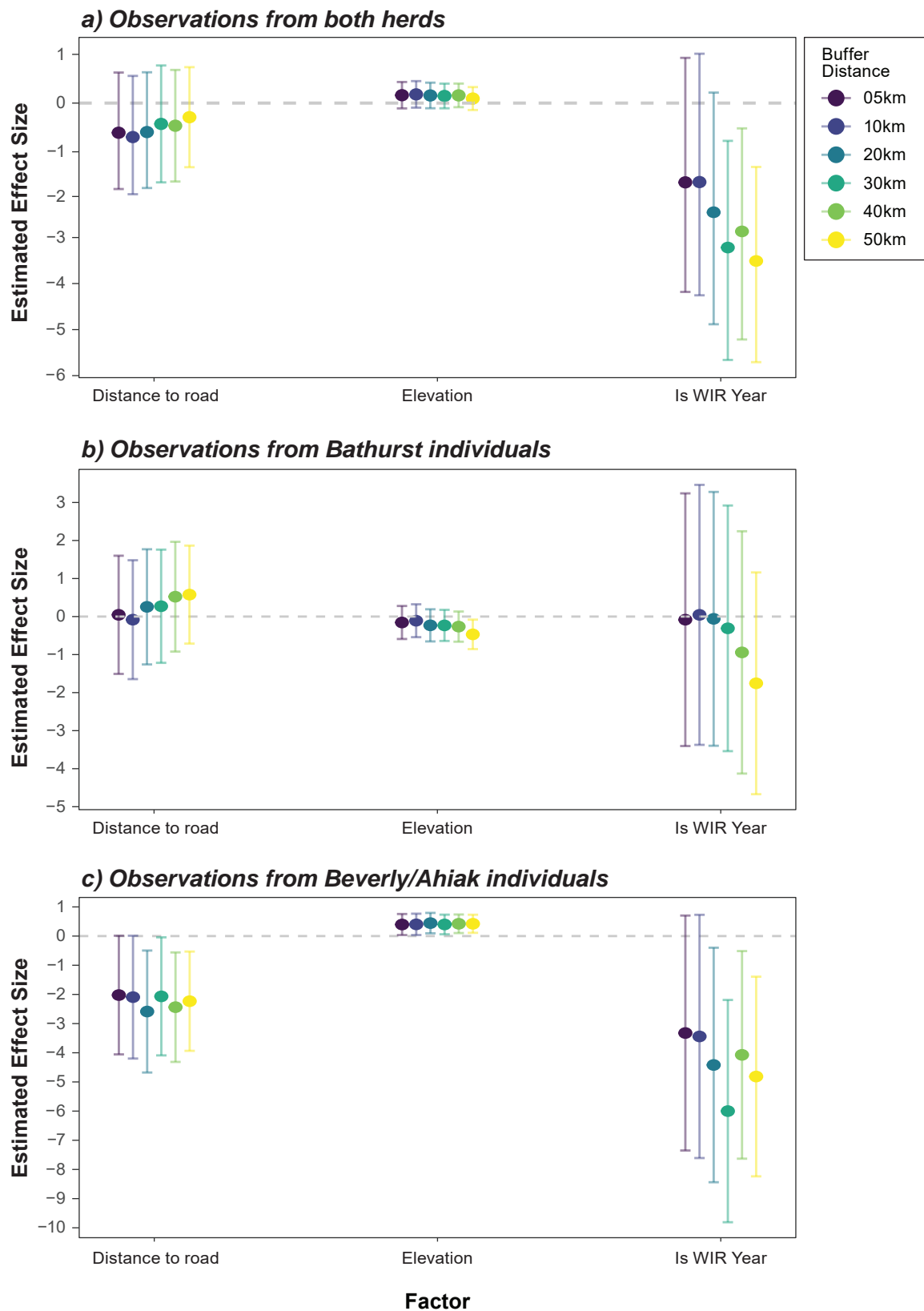
Note: Only variables in models with a cumulative weight >95%, only observations within 25 km radius of WIR.

3.5 Step-Selection Analysis

Overall, the step-selection analysis did not find any evidence that caribou turned away from the WIR when it was active in 2019, compared to previous years. In fact, this analysis indicated that caribou were more likely to turn towards the road as they approached the road. This is consistent with caribou moving in a strongly directional way towards the calving ground.

A step-selection analysis was conducted to test the hypothesis that caribou turned away from the road when they were near it in years when it was active. The estimated effect of the treatment-year interaction term in the top step-selection models was negative in all subsets of observations, suggesting that in 2019, individuals displayed a stronger negative effect of distance to road than in years before the road was constructed (Figure 3.5-1).

In other words, caribou were more likely to turn towards the road when they were closer to the road vs. when they were further from the road. However, 95% confidence intervals overlapped zero in subsets of observations within 5 km or 10 km of the road, distances at which a project effect would be most likely observed (Figure 3.5-1a), meaning the effect for those subsets was not significant. The same is true when observations were subset to Bathurst caribou (Figure 3.5-1b) and Beverly/Ahiak caribou (Figure 3.5-1c).



Notes: A negative effect indicates that a one-unit increase in the factor results in the corresponding decrease in effect size, or the probability of taking that step (i.e. for every 1km further from the road a step is, the less likely a caribou will take that step). The factor "Is WIR year" represents the BACI effect year interaction term.

Figure 3.5-1: Estimated Effect Size for Key Factors in Step Selection Analyses Given Subsets of Data within Increasingly Large Buffers from the Road

The estimated effect of distance to road varied depending on the subset of observations. In a pooled dataset of all observations, individuals tended to take steps towards the road the closer they were to the road, but this effect was not significant (Figure 3.5-1). Confidence intervals overlapped zero regardless of the buffer distance used to subset observations (5, 10, 15, 20, 30, 40, or 50 km; Figure 3.5-1), which may be a product of the strong directional movement towards calving grounds and as a by-product, the road area.

Similarly, individuals in the Bathurst herd tended to be more likely to take steps towards the road the closer they were to the road (Figure 3.5-1). This effect was only significant in subsets of observations greater than 20 km from the road. In contrast, the estimated effect size of the road was positive for Bathurst/Beverly individuals, indicating that individuals tended to take steps towards the road further from the road, and took steps away from the road closer to the road (Figure 3.5-1). This effect was not significant in any buffer size subset. Elevation was included in the top model for each subset. This effect was only significant in the Bathurst herd subset, where the effect was significantly positive, indicating that individuals were more likely to take steps towards higher elevation (Figure 3.5-1).

4. DISCUSSION

Caribou collar data were analysed from the region around the Back River WIR to test for changes to caribou movement during spring migration in 2019, when the ice road was active. Several analyses were used to examine for caribou hesitating to cross the road, including: two qualitative analyses, a brownian bridge movement model and histograms of movement rate and step length with distance to the WIR route. A tortuosity mixed-effects modelling analysis and a step-selection analysis were also conducted to quantitatively address this question.

Exploratory analyses indicated that caribou were more active in the region from 2017-2019 than in previous years, particularly Bathurst caribou, which previously did not pass through the region on their annual migration to their calving grounds on the West side of Bathurst Inlet. However, in 2017, 2018, and 2019, 26% of collared Bathurst individuals crossed to the east side of Bathurst Inlet before turning west to return to their calving grounds. The implication that the migratory routes for one or both herds may have been in flux in recent years highlights the challenge of isolating behavioural changes caused by the road in a single year. This is particularly true because of the small sample size of observations in the area immediately surrounding the road in 2019, which reduced the power of these statistical analyses.

Nevertheless, by accounting for habitat effects, grouping analyses by behavioural units such as herd, including individual caribou as a random effect, and focusing solely on behaviour in 2017-2019, it was possible to filter out much of the noise in data of this nature and focus in on the behavioural effect of the road itself.

A rigorous statistical analysis was unable to detect any significant change in caribou movement behaviour following the construction of the WIR. There was no indication of caribou hesitating or slowing down in the qualitative analyses as a result of hesitation (as modelled by step length in the tortuosity analysis) or as a result of deflection (as modelled by the step-selection analysis).

The data were filtered to one location per day for each individual, and an increase in temporal resolution may have helped detect a “within-day” response. The data available for these variables were too coarse to include in statistical analyses, so some variance is potentially still unaccounted for. Gated collars with more frequent location fixes near the WIR would be required to address potential effects at a small scale.

4.1 Tortuosity Mixed-Effects Modelling

The tortuosity mixed effects model was designed to test the hypothesis that individuals were hesitating before crossing the road. In spite of potential caveats discussed above, it was possible to detect consistent effects of habitat variables with these models. Topographic variables such as elevation and terrain roughness had a notably consistent effect on tortuosity, where step length was shorter as elevation and terrain roughness increased.

There was also a complete lack of habitat variables related to food availability (EVI, land cover) in top models, which were consequently not reported on in results tables. This may be indicative that during spring migration, food availability is a less important predictor of migratory route choice than topographic variables that relate to ease of travel. This is particularly important because the winter ice route travelled over a topographic feature of steep and rough terrain, which likely would have confounded any behavioural response to the road if not modelled together. When topographic variables were accounted for in the tortuosity models, the interaction term representing the effect of distance to road in the effect year of 2019 was not consistently positive or negative and was not significant, meaning that the models did not detect an effect of the winter ice road on step length.

Step length, along with turning angle, are the two components that make up tortuosity, where low step length and high turning angle are indicative of high tortuosity and a more contorted path. As the turning

angle models were found to be uninformative, step length was used as a proxy for tortuosity in this analysis. The distance to road variable had a consistently negative effect on step length, meaning that step length was larger the closer to the road, regardless of whether the road was there or not. This was possibly a by-product of the timing of migration, where peak speed and directionality in late April coincided with the closest approach to the road between the overwintering and calving grounds.


4.2 Step-Selection Analysis

A step-selection analysis was conducted to test the hypothesis that caribou tended to turn away from the road when they were near it. The results of this analysis suggest that caribou did not preferentially choose habitat away from the WIR in 2019, when the road was active. As with the tortuosity modelling, topography was a major determining variable in step selection probability, with elevation included in the best fitting models. The large topographic feature crossing through the WIR likely contributed to this observed trend. Another similarity to the tortuosity model was that habitat variables related to food availability (EVI, land cover) did not improve model fit as evidenced by AIC. This indicates that spring migratory routes chosen by caribou are mediated by factors other than the quality or type of underlying vegetation.

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APPENDIX 5D BACK RIVER PROJECT: STANDARD OPERATING PROCEDURE 008 – WASTE MANAGEMENT

 Sabina GOLD & SILVER CORP.	Standard Operating Procedure – Waste Management		Version 0
	Back River Project		March 20, 2019 SOP-008
Approved by:	Jaymes Dircks	Reviewed by:	Kevin LeDrew
Operational Department:	Site Manager	Department/Area:	HSE

1. OBJECTIVE

To define the management and operational processes for waste management at the Back River Project to reduce the risks associated with the various safety hazards to people and environmental aspects identified at the Back River Project as they relate to regional wildlife.

2. SCOPE

Applies to all employees, contractors and visitors working at the Back River Project and its designated and/or affiliated operational and exploration areas.

3. DEFINITIONS

Designated Person – a person who by skill, experience, and training has been formally designated by the responsible area Manager for specific task accountability.

Job Hazard Analysis (JHA) – Is a formal risk assessment process which is completed by the supervisor and workers prior to initiation of work on a specific job or task (also referred to as a Task Hazard Assessment or THA). The JHA process serves to assist the work team in

1. the identification of hazards associated with the work,
2. the development of specific and/or unique controls that when enabled will
3. minimize the risk of injury, loss of process or impact to the environment.

PPE – Personal Protective Equipment as may be defined in the JHA.

4. RESPONSIBILITIES

WORKERS

Shall ensure that they

- Understand their role in the management system objectives, policies and procedures.
- Report any deficiencies in this procedure to their Supervisor.
- Follow the guidance of this approved procedure in their work tasks.
- Report concerns of nonconformance to this procedure to their Supervisor immediately.

SUPERVISORS

Shall ensure that they

- Participate &/or assist in the development of Operational Procedures for their areas.
- Support and enforce the requirements of this procedure in their area(s).
- Lead the management of waste and waste initiatives in their areas of responsibility.

MANAGEMENT

Shall ensure that

- Compliance to the MHS Regulations is met & promote best practice.
- Requirements of this procedure are communicated to all affected personnel.
- All parties are tested and deemed competent as they relate to this procedure.
- All personnel understand the intent of this procedure, its requirements & responsibilities.
- A review and/or investigation is completed for non-conformances associated with any deviation of the requirements herein as well as any reports of non-compliance.

HSE MANAGER, OR DESIGNATE

Shall ensure that

- Responsibility is assigned for development and approval of documentation.
- Implementation and maintenance of this procedure is to recognized standards.
- Responsibility for control of HSE documentation and Records is assigned.
- This procedure is reviewed annually and updates and recommendations for improvements are incorporated in any changes.

TRAINING DESIGNATES

Shall ensure that

- Effective improvement opportunities to training tools to meet Compliance and the intent of this procedure are identified.
- Personnel are assessed and verified to be competent in this procedure.

5. PROCEDURE

5.1 Onsite Handling

5.1.1 All solid, non-hazardous wastes (Domestic Waste) will be separated from hazardous wastes by category:

- Oil Filters
- Engine Hoses (Coolant, Fuel, Hydraulic, etc.)

- Tires
- Aerosol cans
- Combustible cylinders
- Sewage bags
- This list will continue to be developed

5.1.2 All domestic waste will be contained in clear plastic garbage bags as issued by Camp Management.

5.1.3 Domestic waste must be collected and incinerated immediately as scheduled by Camp Management.

5.1.4 Aerosol cans and other pressurized containers are stored in separate containers such as an “Enviro-Drum” which is shipped off-site to an approved Hazardous Waste handler.

5.1.5 All waste containers on-site are to be kept covered or protected from exposure, so they don’t attract animals, prevent contents from being blown by the wind and don’t accumulate snow and/or rainwater requiring additional handling or treatment.

5.1.6 PACTO sewage bags are incinerated as they are generated and not stored.

5.2 Off-Site Disposal

5.2.1 All waste destined for shipment offsite is managed and tracked by KBL of Yellowknife, through individual Purchase Order or service agreement, by; load, material type & material quantity. The following is a brief list of materials to be shipped offsite:

- Aerosol cans
- Combustible cylinders
- Engine Hoses (Coolant, Fuel, Hydraulic, etc.)
- Oil Filters
- Tires
- Waste Oils and Hydrocarbons
- Wet and Dry Cell Batteries

5.2.2 A Waste Inventory Log is maintained onsite to track seasonal inventories and shipments.

5.2.3 The Yellowknife landfill will accept scrap metal, plastic, rubber & tires and recycling opportunities will be coordinated through KBL & Sabina Gold as available.

5.2.4 Scrap material will be secured & stored in appropriate containers for seasonal shipment.

5.3 Food Products

5.3.1 Unload food goods from the aircraft & transport them to the kitchen as soon as possible.

5.3.2 Store all food goods as soon as they arrive; fresh, frozen and lastly dried & canned goods.

5.3.3 No food will be stored outdoors.

5.4 Food Wastes

- 5.4.1 Food waste and uneaten foods are to be returned to the camp garbage for incineration.
- 5.4.2 At remote sites follow the guidance; "...if you pack it in, pack it out...".
- 5.4.3 Food wastes & other domestic garbage are to be incinerated with kitchen wastes daily.
- 5.4.4 Volume of garbage taken to the incinerator should not exceed the incinerator load capacity without adequate and appropriate storage.
- 5.4.5 Grease from kitchen grease traps can be incinerated with kitchen garbage.
- 5.4.6 Used (cool) cooking oil (6-7 litres) can be poured into double, garbage bag, lined pails.
- 5.4.7 Pails are labelled with the contents to; minimize spills & keep volumes to safe levels.
- 5.4.8 Used oil can be burned with wet wastes or sewage, but load size must be reduced.
- 5.4.9 Return emptied pail to the kitchen for reuse.

Waste aerosol cans, pressurized containers and batteries are disposed of and handled separately and are NOT to be disposed of in the general garbage; separate containers are available.

5.5 Packaging Waste

- 5.5.1 Cardboard boxes must be broken down to remove food traces & reduce handling need.
- 5.5.2 All food packaging will be placed in the normal garbage stream for incineration.

5.6 Incinerator Operations

- 5.6.1 Only authorised camp services personnel may fire, or add waste, to the incinerator.
- 5.6.2 Personnel must wear gloves and goggles whenever shovelling ash, handling steel from the ash, and wear gloves when handling bags of garbage.
- 5.6.3 Personnel must wear disposable latex or rubber gloves when handling sewage sludge and wash hands after handling these bags.
- 5.6.4 Incinerator Operator must inspect the contents of the clear garbage bags carefully to ensure there are no unauthorised substances (i.e. aerosol containers, sharps). If unauthorised substances are present, carefully remove the substances and discard or store appropriately.
- 5.6.5 After inspection, put the bags in the incinerator and lock the incinerator door.
- 5.6.6 Clean out incinerator ash daily, in the morning, and place it in a properly labelled drum. Use caution while removing ash to avoid damaging the liner, close lid after removing ash.
- 5.6.7 Separate large steel pieces from the ash into pails allocated for this purpose.

5.7 Items that Can Be Incinerated

- 5.7.1 Camp food waste, garbage from offices, rooms, grease from kitchen grease traps etc.
- 5.7.2 Rags used for cleaning purposes and old clothes.

5.8 Items that CANNOT Be Incinerated

- 5.8.1 Aerosol or other pressurised containers.
- 5.8.2 Dry cell batteries.
- 5.8.3 First Aid Room sharps such as needles or glass.
- 5.8.4 Rubber products such as rubber boots, rubber hoses, fan belts or tires.

Direction or guidance from the HSE Manager or designate prior to disposal of any garbage that is not listed in Section 7, “Items That Can Be Incinerated”, is required.

5.9 Items that Can Be Incinerated with Special Precautions

- 5.9.1 Absorbent pads and snow contaminated with spills of gasoline, Jet-B, solvents, diesel fuel or hydraulic fluid may be burned, with Special Safety Precautions (see below).
- 5.9.2 Oily or greasy rags from drilling operations, with Special Safety Precautions (see below).
- 5.9.3 Engine oil filters can **only** be burned **after** they are drained & **cut in half** to remove excess oil. (Otherwise they are stored for shipment offsite in an Enviro-Drum).
- 5.9.4 Waste cooking oil in quantities not exceeding 15 L per burn.
- 5.9.5 An animal carcass remnant, only with approval by a Nunavut Conservation Officer.

5.10 Special Precautions

- 5.10.1 No more than one half of a normal size garbage bag at a time may be added.
- 5.10.2 Add product to the first load and fire the incinerator immediately to avoid vapor buildup
- 5.10.3 Stored products must be located away from potential risk of spontaneous combustion.

5.11 Incinerator Waste Handling

- 5.11.1 When ash drums are at approximately 90% capacity, close and seal the lid.
- 5.11.2 Store the drum in the waste storage area on a pallet & update the waste inventory log.
- 5.11.3 Operate the incinerator as often as necessary to maintain minimal waste inventory.
- 5.11.4 Collect full metal & plastic garbage pails (from ash) and dump into waste collection bins.

5.12 Incinerator Maintenance

- 5.12.1 Check the fuel level in the incinerator before each burn.
- 5.12.2 Check for fuel leaks in the tank, lines and incinerator before each burn. If a leak or ground stain is found, notify your supervisor immediately.
- 5.12.3 The blocks lining the incinerator will last ~five years; inspect daily to note any damage.
- 5.12.4 For details on operating specs or other technical data, please refer to the OEM manual.

5.13 Waste Inventory Management

- 5.13.1 The Matrix Camp Manager or Site Supervisor is responsible for issuing waste inventory tracking numbers and recording the numbers and materials in the waste inventory log.

- 5.13.2 The Site Supervisor will designate an individual to label the drums with the waste inventory log number that is legible and easy to find.
- 5.13.3 All waste for storage in crates or barrels/drums must be stored in uniquely numbered containers which are pre-approved, and the number issued by the Site Supervisor.
- 5.13.4 A WHMIS workplace label must be affixed to all containers that contain controlled products or hazardous material.
- 5.13.5 When the barrel or crate containing controlled products or hazardous material is full, it must be moved to the Waste Storage Area.
- 5.13.6 The person moving a barrel or crate is responsible to advise the Site Supervisor that the crate/barrel has been moved.
- 5.13.7 Individual contractors requiring a crate or barrel/drum for waste storage must see the Site Supervisor who keeps the "Waste Inventory Log"; which records the following:
- Unique identification number for barrel or crate
 - Date issued
 - Location where the barrel or crate will be used
 - Name of person requesting crate or barrel
 - Date that the crate or barrel is moved to waste storage
 - Spill report number if waste is as result of a spill
 - Comments section to describe container and contents

A WHMIS workplace label will be issued to be placed on the side of the barrel/drum or crate.

WASTE INVENTORY LOG (Example)

ID#	Date	Location	Request by	Spill #	Stored	Comments
MLAW001	Jun 6/18	Area 1	ABC	na	Jul 15/18	200 l drum - used oil filters
MLAW002	Jun14/18	FC	ABC	na	Aug 1/18	2'*2' wood crate - air filters
MLAW003	Jun 30/18	MLA	EFG	2018-010	Jan 1/19	200 l drum - Absorbent pads

Notes:

Several containers can be issued numbers and labelled in advance.

Pre-numbered barrels will be stored away from potential water sources.

All hazardous waste must have a WHMIS workplace label affixed.

6. REVIEW

This procedure will be reviewed on an annual basis, or any time there is a major change to a work site or locations.

7. COMMUNICATIONS

Department Management is responsible for the communication of this procedure and its requirements to affected employees and contractors.

8. COMPETENCY REQUIREMENTS

Affected employees will be identified by Department and qualified in this procedure by a competent and authorized person.

9. RECORDS

Records for orientation and awareness sessions on this procedure will be maintained by the site HSE Advisor and/or the Training Coordinator.


10. REFERENCES

This procedure has been developed based on the minimum requirements identified in the current Mine Health & Safety Act and Regulations of the Nunavut Territory.

MANAGEMENT SYSTEM REVISION CONTROL SHEET

[illegible]

APPENDIX 5E BACK RIVER PROJECT: STANDARD OPERATING PROCEDURE 010 – NO LITTERING

	Standard Operating Procedure – Waste Management – No Littering	Version 0
	Back River Project	March 25, 2019 SOP-010
Approved by: Operational Department:	Jaymes Dircks Site Manager	Reviewed by: Department/Area: Kevin LeDrew Health & Safety

1. OBJECTIVE

To define the processes for waste management with respect to the prevention of littering on the Project site.

2. SCOPE

Applies to all employees, contractors and visitors on the Project and designated sites.

3. DEFINITIONS

Designated Person – a person who by skill, experience, and training has been formally designated by the responsible area Manager for specific task accountability.

Essential Tasks - Tasks essential to the continuation of the ordinary workings of the project.

Job Hazard Analysis (JHA) – Is a formal risk assessment process which is completed by the supervisor and workers prior to initiation of work on a specific job or task (also referred to as a Task Hazard Assessment or THA). The JHA process serves to assist the work team in

1. the identification of hazards associated with the work,
2. the development of specific and/or unique controls that when enabled will
3. minimize the risk of injury, loss of process or impact to the environment.

PPE – Personal Protective Equipment as may be defined in the JHA.

WIR – Winter Ice Road

4. RESPONSIBILITIES

WORKERS:

Shall ensure that they

- Understand their role in the management system objectives, policies and procedures.
- Report any deficiencies in this procedure to their Supervisor.
- Follow the guidance of this approved procedure in their work tasks.
- Report concerns of nonconformance to this procedure to their Supervisor immediately.

SUPERVISORS:

Shall ensure that they

- Participate &/or assist in the development of Operational Procedures for their areas.
- Support and enforce the requirements of this procedure in their area(s).
- Ensure that general and hazardous wastes are managed according to the legislated requirements and all procedures in practice at the Project site.

MANAGEMENT

Shall ensure that

- Compliance to the MHSA & Regulations is met & best practice is promoted.
- Ensure that the scope of the management system (MS) is appropriate for the range of activities relevant to the Back River Project.
- Requirements of this procedure are communicated to all affected personnel.
- All parties are tested and deemed competent in accordance with the procedure.
- All personnel involved understand the intent of this procedure, its requirements and their responsibilities.
- A review and/or investigation is completed for non-conformances associated with any deviation of the requirements herein as well as any reports of non-compliance.

HSE MANAGER, OR DESIGNATE

Shall ensure that

- Responsibility is assigned for development and approval of documentation.
- Implementation and maintenance of this procedure is to recognized standards.
- Responsibility is assigned for control of MS documentation.
- A format and process for maintaining documentation and implementation is established.
- A review of this procedure is conducted and support for its update is provided through recommendations for improvements and on training needs/requirements.

TRAINING DESIGNATES

Shall ensure that

- Improvement opportunities are effectively implemented into training tools to meet Compliance and the intent of this procedure.
- Assessment and verification of competency is conducted on affected employees to this procedure.

5. PROCEDURE

Preservation of the environment and minimizing wildlife attractants is of paramount importance at the Sabina Gold and Silver Corp. and has a “No Littering Policy” which all personnel and contractors must adhere to and ensure that garbage is placed in suitable containers. All personnel are encouraged to pick up garbage that may be lying around and put it into suitable containers.

If site personnel observe visitors or others littering it is their responsibility to explain the “No Littering Policy” and ensure that waste is placed in a suitable container. Cigarette butts must be placed in appropriate containers. If in an area, where there is no container, then butt-out and put the filter and remnants in your pocket until you can dispose of it in a proper container. Ensure there is no risk of starting a fire if on the tundra.

All waste food products and packaging must be placed with the camp garbage for incineration. Liquids cannot be disposed of on the ground, avoid throwing coffee and juices out of vehicles or anywhere on the land, return unused portions to the camp kitchen for proper disposal.

If in doubt about where to place waste/scrap/garbage items, ask your Supervisor.

6. REVIEW

This procedure will be reviewed on an annual basis, or any time there is a major change to a work site or locations.

7. COMMUNICATIONS

Department Management is responsible for the communication of this procedure and its requirements to affected employees and contractors.

8. COMPETENCY REQUIREMENTS

Affected employees will be identified by Department and qualified in this procedure by a competent and authorized person.

9. RECORDS

Records for orientation and awareness sessions on this procedure will be maintained by the site HSE Advisor and/or the Training Coordinator.

10. REFERENCES

This procedure has been developed based on the minimum requirements identified in the current Mine Health & Safety Act and Regulations of the Nunavut Territory.

MANAGEMENT SYSTEM REVISION CONTROL SHEET

[illegible]

APPENDIX 6A INCIDENTAL BIRD OBSERVATIONS, 2019

Appendix 6A: Incidental Bird Observations, 2019

Date	Location	Distance from Camp	Direction Travelling	Number	Mammal	Comments (# of calves, etc.)	Name of Observer
17-May-19	Goose	overhead	N	200	Geese		RMD
24-Jul-19	MLA	Road to treatment plant		1	Falcon		JPk

APPENDIX 7A INCIDENTAL MARINE MAMMAL OBSERVATIONS, 2019

Appendix 7A: Incidental Marine Mammal Observations, 2019

Date	Location	Distance from Camp	Direction Travelling	Number	Mammal	Comments (# of calves, etc.)	Name of Observer
11-Apr-19	MLA		NE	1	Seal		Seal
12-Apr-19	MLA	+/- 30 km		1	Seal	calf	Michael Marchildon
7-Jun-19	MLA	on ice strip		1	Seal		Michael
23-Jun-19	MLA	3 km	N	1	Seal		Michael Marchildon

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