JUL 3 1 2018

Dominion Diamond Ekati ULC
c/o Ms. Claudine Lee, Head of Environment
900-4920 52ND STREET
YELLOWKNIFE NT X1A 3T1
(e-mail) claudine.lee@ddcorp.ca

Dear Ms. Lee:

Dominion Diamond Ekati Corporation – Approval of Wildlife Effects Monitoring Plan (WEMP), including Caribou Road Mitigation Plan (CRMP)

Thank you for your letter of June 29, 2018 providing final outstanding information that contributes to meeting the requirement for Condition # 1 requiring Dominion Diamond Ekati ULC (Dominion Diamond) to meet conditions of approval of the Wildlife Effects Monitoring Plan (WEMP). This letter is to acknowledge that Dominion Diamond has submitted the necessary outstanding documents identified in the letter dated June 1, 2017 in which conditional approval was given to Dominion Diamond's WEMP and Caribou Road Mitigation Plan (CRMP) in fulfillment of Measure 6-1 of the Report of Environmental Assessment for the Jay Project.

With respect to the six conditions outlined in the Thursday, June 1, 2017 letter to Dominion Diamond, Conditions 1 through 4 required Dominion Diamond to submit specific documents to satisfy the requirements of the WEMP and CRMP. The Department of Environment and Natural Resources (ENR) acknowledges receipt of relevant documentation in subsequent letters from Dominion Diamond including:

- With respect to Condition #1 requiring Dominion Diamond to provide ENR with a Standard Operating Procedure (SOP) and datasheets, for site surveillance monitoring, ENR acknowledges the clarification provided in your letter of June 29, 2018 (Attachment 1) and deems this condition met.

- With respect to Condition #2 requiring Dominion Diamond to provide ENR with an SOP for deterring raptors from initiating nesting in mining pit walls, ENR acknowledges receipt of this SOP on July 26, 2017 (Attachment 2). ENR deems this condition met.

.../2

- With respect to Condition #3 requiring Dominion Diamond to increase the exclusion zone for caribou to a minimum of 1 km in their blasting SOP, ENR acknowledges receipt of an updated SOP for Surface Mining: Blasting, Guarding and Initiating on July 4, 2017 (Attachment 3), as well as the commitment to implement this change during construction of the Jay Project provided in a letter from Dominion Diamond. ENR deems this condition met.

- With respect to Condition #4 requiring Dominion Diamond to provide ENR with their SOP which describes their camera trapping methods, ENR acknowledges receipt of this document on July 4, 2017 (Attachment 4), and deems this condition met.

ENR expects these documents to be included within the text and appendices of future versions of the WEMP.

With respect to the remaining two conditions identified in the June 1, 2017 letter, Condition 5 required incorporation of specific analyses into Dominion Diamond's annual reporting and Condition 6 required inclusion of more explicit reference to specific processes used to incorporate traditional knowledge into the WEMP. ENR will continue to monitor to ensure that these inclusions are made.

As such, ENR no longer considers the March 2017 version of the WEMP as conditionally approved. ENR deems the March 2017 version of Dominion Diamond's WEMP, which includes the CRMP in addition to the documents included herein, as approved.

Please contact Ms. Andrea Patenaude, Wildlife Biologist, at (867) 767-9237, extension 53228 or andrea_patenaude@gov.nt.ca if you have any questions.

Sincerely,

for

Dr. Joe Dragon
Deputy Minister
Environment and Natural Resources

Attachments

c. Ms. Rita Mueller, Assistant Deputy Minister, Operations
Environment and Natural Resources

Dr. Brett Elkin, Director, Wildlife
Environment and Natural Resources

Mr. Julian Kanigan, A/Director, Conservation, Assessment and Monitoring
Environment and Natural Resources

Ms. Lorraine Seale, Director, Securities and Project Assessment
Lands

Ms. Jaida Ohokannoak, Chairperson
Independent Environmental Monitoring Agency

Ms. April Hayward, Superintendent – Environment
Dominion Diamond Ekati Corporation

Ms. JoAnne Deneron, Chairperson
Mackenzie Valley Environmental Impact Review Board

Mr. Mark Cliffe-Phillips, Executive Director
Mackenzie Valley Environmental Impact Review Board

CONTACT LIST

Ms. Jaida Ohokannoak, Chairperson
Independent Environmental Monitoring Agency
monitior1@monitoringagency.net
(fax) 867-669-9145

Ms. April Hayward, Superintendent – Environment
Dominion Diamond Ekati Corporation
april.hayward@ddcorp.ca

Ms. JoAnne Deneron, Chairperson
Mackenzie Valley Environmental Impact Review Board
jdeneron@reviewboard.ca

Mr. Mark Cliffe-Phillips, Executive Director
Mackenzie Valley Environmental Impact Review Board
mcliffephillips@reviewboard.ca

Dominion Diamond Mines

Dominion Diamond Ekati ULC
900-4920 52 Street (867) 669-6100
Yellowknife, NT X1A 3T1 (867) 669-6134 fax
www.ddmines.com

29 June 2018

Ms. Andrea Patenaude
Environment and Natural Resources
PO Box 1320
Yellowknife, NT X1A 2L9

Dear Ms. Patenaude:

Dominion Diamond Ekati ULC (Dominion Diamond) is writing in response to your January 30, 2018 email, WEMP approval – Condition # 1 SOP for site surveillance. We appreciate that the GNWT took the time to reach out for further clarification on Dominions Diamond's submission that were intended to fulfill the conditions upon which approval of the Wildlife Effects Management Plan (WEMP) was given.

Condition 1 states:

> *"ENR notes that the WEMP does not include a SOP for site surveillance monitoring, which is a basic level of monitoring required to identify wildlife onsite, prevent human-wildlife conflicts, prevent injury to wildlife, and ensure mitigations are effective. Paragraph 95(2)(c) of the Wildlife Act requires that a WMMP identify processes for monitoring impacts and assessing whether mitigative measures are effective. Further, DKFN highlighted this omission and recommended that a SOP that outlines the specific methods and data sheets for this type of routine systematic monitoring be included in the WMMP."*
>
> **Condition:** *"DDEC will provide ENR with a SOP, including datasheets, for site surveillance monitoring for wildlife within one month of approval of the WMMP."*

Dominion Diamond would like further to clarify its response that "site surveillance monitoring" standard operating procedure doesn't exist at Ekati and its does not make logical or operational sense to create this document.

During the Jay Project Environmental Assessment, Dominion Diamond spent extensive time and expended significant effort engaging on and developing the WEMP. According to the GNWT *"Wildlife Management and Monitoring Plan Guidelines 2: Content Requirements"* (Guidelines) states:

"A Wildlife management and monitoring plan must include:

a) a description of potential disturbance to big game and other wildlife included in the regulations, potential harm to wildlife and potential impacts on habitat;
b) a description of measures to be implemented for the mitigation of potential impacts;
c) other requirements that are outlined in the regulations"

Dominion Diamond asserts that the WEMP as submitted to ENR satisfies not only all the requirements listed in the Guidelines, but also satisfies everything requested in Condition 1.

Dominion Diamond Mines

Dominion Diamond Ekati ULC
900-4920 52 Street (867) 669-6100
Yellowknife, NT X1A 3T1 (867) 669-6134 fax
www.ddmines.com

Section 1.1 lists the objectives of the WEMP and section 1.5 describes concordance with the Guidelines. Section 2 of the WEMP gives an overview of how the document was developed including a list of predicted residual impacts, valued ecosystem components and species of concern. Section 4 and Appendix C of the WEMP is dedicated to describing in detail the entire list of mitigations being applied at the Ekati mine, in order to minimize the likelihood of any of the potential residual impacts (listed in section 2) occurring. While section 5 of the document describes the entire suite of monitoring being conducted by Dominion Diamond to monitor for potential impacts to wildlife and test the efficacy of mitigation measures.

Additionally, appendix F contains all of the standard operating procedures for the monitoring described in section 5. When considered as a whole, these procedures explicitly describe how all monitoring "*required to identify wildlife onsite, prevent human-wildlife conflicts, prevent injury to wildlife, and ensure mitigations are effective*", is completed at the Ekati mine. Which is above and beyond the "*base level*" requested by the GNWT.

As described above, Dominion Diamond would like to emphasize that the development and submission of the WEMP completely satisfies all of the requirements detailed in Condition 1 of the WEMP and CRMP conditional approval. The WEMP is a high level standard operating procedure and the generation standard operating procedures requested in Condition 1 would be a duplication of effort, producing a redundant document.

Dominion believes that the legal requirement for a WEMP exists specifically to address all of the items listed in Condition 1. Dominion Diamond expects that you find this letter clear and informative, if you have any additional questions or concerns please do not contact Harry O'Keefe Team Leader – Environment Projects at 1-403-910-1933 ext 2408 or Harry.O'Keefe@ddcorp.ca if you require additional information.

Sincerely,

Claudine Lee

Claudine Lee
Head of Environment

Attachment 2

EKA WI. 2115.18 Active Pit Monitoring

Version:	1.1
Replaces:	N/A
Creation Date:	2014-03-26
Scheduled Review Date:	2017-12-15
Review Date:	2017-6-20
Document Team Members:	Wildlife Advisor, Environment Operations Superintendent
Document Owner:	Wildlife Advisor
Document Approver:	Environment Superintendent: Operations
Related Documents:	N/A
Key Contacts:	Wildlife Advisor
Change Requests:	Wildlife Advisor
Brief Description:	Monitoring Active Pits to Identify and Prevent Nesting Activity

Table of contents:

Contents

Task Description

Monitor active pits and the surrounding location to document, track and deter all bird activity including nesting activity, resting or hunting. Every effort must be made to identify and deter any bird investigating active pits. This region should be made as unwelcoming to ravens and all raptor species as possible. This is done through the use of propane cannons, audio devices, physical barriers to high quality habitats and pyrotechnic devices (flares) and non-pyrotechnic devices (bangers & screamers).

HSE Information / Safety Risks:

- Working in Active Mining Area
- Working at Heights (on or near the Pit high wall)
- Wildlife encounters
- Heavy equipment and other traffic
- Blasting
- Operating Deterrent Devices
- Aggressive birds
- Poor Communication
- Fatigue management
- Hearing or Vision damage

Additional Resources Required:

- Binoculars
- Spotting scope and tripod
- SLR camera with zoom lens
- GPS
- Data-sheets, clipboard and pencil
- Birds identification field guide
- PPE
- Audio playback sound system
- Propane cannon (remote controlled and timed)
- Bear bangers and screamers
- Laser gun
- Infrared camera
- Ropes with flagging tape
- Snow fencing
- Radio

Work Preparation:

1. Know the cliff nesting bird species that you may encounter during a survey. Historically, birds found nesting on the pit walls are the: rough-legged hawk (RLHA; *Buteo lagopus*), peregrine falcon (PEFA; *Falco peregrinus tundrius*), gyrfalcon (GYRF; *Falco rusticolus*), and common raven (CORA; *Corvus corax*). Other species that may be encountered are the: golden eagle (GOEA; *Aquila chrysaetos*), bald eagle (BAEA; *Haliaeetus leucocephalus*), merlin (MERL; *Falco columbarius*) and American kestrel (AMKE; *Falco sparverius*).

2. Be aware of the conservation status of the cliff nesting bird species.

   - The Peregrine falcon is listed as "Special Concern" by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) and SARA (Species at Risk Act – Government of Canada). The ENR (Environment and Natural Resources – GNWT) general status rank is "Sensitive".

   - The gyrfalcon, rough-legged hawk, common raven, merlin, bald and golden eagles, and the American kestrel are "Not at Risk" according to COSEWIC.

Task Description:

1. Be familiar with the locations of the pits and other mining infrastructure that may host nesting birds and the standard protocol on how to access these locations.

2. Travel to the survey locations specified. Stop at vantage points around the top of the pits. Get out of vehicle making sure to keep at least 2m from the edge of the pit and never cross over berms.

3. Look for bird activity, which encompasses looking for nests on the pit walls. The best way to locate a nest it to look for white wash on the walls or follow a flying bird to their nesting location. Use of a spotting scope is recommended when a potential nest is found. For identification purposes, use a scope when a bird is spotted perched on a pit wall.

4. Record all potential nests and any suspected nesting activity. Potential nesting activity includes a bird that stays around the pit or a nest site. Nesting activity includes defensive behavior, carrying food or sticks, prospecting for sites, and a nesting bird on a nest or a ledge.

5. Take photos of potential nesting sites and any birds. Ensure that there are landmarks in the photograph so that cross-shifts can easily locate where the photograph was taken from.

6. Upon return to the office upload nest location photos onto Sharepoint after marking the nest location on the photograph using 'Paint' or other similar program. Enter data into the Pit Wall Survey spread sheet on SharePoint and QA/QC entered data. File data sheet in WEMP binder.

7. Report all nesting activity to Environment Advisor – Wildlife and the Environment Team Leader.

General Remarks:

- In natural habitats peregrine falcons, gyrfalcons, rough-legged hawks, and common ravens nest on ledges and precipitous cliff faces. Open pit walls at EKATI resemble steep sided ledges and offer attractive nesting locations. Cliff nesting birds have also been observed nesting on ledge-like structures such as cairns, towers, mining dredges and bridges. Attracting cliff nesting birds to pit walls is a concern, particularly for birds that have conservation status.
- If a nest with eggs is stablished, all deterrent use on those birds must immediately stop.
- A General Wildlife Permit is acquired annually prior to the start of this program.

Approval signatures record

REVIEWER ROLE	NAME	SIGNATURE	DATE
Wildlife Advisor	Laura Corey	[signature]	20/6/2017
Environment Superintendent	Harry O'Keefe	[signature]	20/6/2017

Surface Mining
Blasting, Guarding and Initiating
EKA WI. 1702.06

Task Description:
Guarding for a Blast, Blast Initiation and Incomplete Initiation of an Explosive.
HSE Information / Safety Risks:
• **No personnel will be within 750 meters of the blast and no equipment should be within 500 meters of the direct line of fire of a blast.** • **No caribou will be within 1000m of the blast** • **Premature detonation of Blast Holes** • **Unauthorized access into Blast Area.**

Work Preparation:

Item	Task Description
1	The day before the blast is scheduled the Team leader will ensure that an announcement will electronically through email and on the TV monitors through-out the mine site and Blast sign updated. The information will read where and when a blast is to take place.
2	During a blast, if there is a problem such as a misfire or incomplete detonation the Blaster will inform the Team Leader immediately.
3	During the sweep, if caribou are found inside the blast zone (1000m), the Team Leader will notify the Environment Department and wait to blast until all wildlife has left the area.
4	Group JHA will be completed on the morning of blast between Team Leader and Blaster

Work Execution Steps:

Item	Task Description
1	All drilling and explosives loading will have been completed and all equipment moved off the pattern before the tying in of any blast holes begins.
2	The perimeter of the pattern will be adequately guarded while the surface detonating cord and delays are being prepared.
3	The Production Team Leader and the Blaster will conduct a formal written JHA on where to locate equipment for the blast and for designating the "safe area" for firing the shot.

Surface Mining
Blasting, Guarding and Initiating
EKA WI. 1702.06

4	Two hours prior to the scheduled blasting time, the Team Leader will announce The Two Hour Warning via radio on the appropriate operations channel. The Team Leader will also advise the Ekati Airport of The Two Hour Warning.
5	Before every blast, the "Blaster" will check the blasting machine as per the manufactures' recommendations.
6	Prior to the ten-minute warning, all guards will: • Take up their assigned guard positions and ensure that no one enters the danger zone; and • Notify the team leader when they have completed their sweep and they in their guarding position • Hold their position until the Team Leader authorizes them to leave
7	Ten minutes prior to the scheduled blast time, the Team Leader will announce a ten-minute warning via radio on the appropriate operations channel. The Team Leader will also advise the Airport Technician of the ten-minute warning.
8	At the end of two minutes, the Team Leader will: • Sound the blast-warning siren for 3 short loud soundings • Notify the Blaster that he may take his shot.
9	Airport Technician will announce the two-minute warning on the aircraft radio channels.
10	Two minutes prior to the scheduled blast time, there will be a one minute blast siren and the Team Leader will announce, on the appropriate operations radio channels, a two-minute blast warning and radio silence.
11	At the end of two minutes, the Team Leader will: • Sound the blast-warning siren for 3 short loud soundings • Notify the Blaster that he may take his shot.
12	The Blaster will • The blaster will notify the Team Leader once the shot has fired and that he is entering the pit to inspect the blast. • The blaster will inspect the blast for complete detonation. • The blaster will inspect the blast area for blast gases to be safely dissipated. • The blaster will notify the Team Leader that the blast area is "All Clear" after determining the blast has completely detonated and the blast gases have safely dissipated.

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13	Team Leader will contact the Airport Technician on the operations radio channel and announce the "ALL CLEAR". "All guards will be authorized from their positions. Crews can return to work in the blast area and radio communications may resume".
14	The Team Leader will sound the blast siren for twenty seconds signalling the "All Clear".
	Incomplete Initiation of an Explosive
1	If the firing device is not working another one will be used in its place. No Ten-minute waiting time is needed in this situation.
2	If there is a problem such as a misfire or incomplete detonation the Blaster will inform the Team Leader immediately.
3	If an improper initiation or detonation of the blast occurs Team Leader will ensure that the Blaster waits 10 minutes before they proceed to inspect the cause.
4	The Blaster will disconnect the firing device from the blasting cap and ensure the leg wires are shorted before proceeding into the blast area to investigate any problems.
5	The guards must remain in their position unless otherwise directed by the Team Leader.
6	The Blaster will inform the Team Leader when he is ready to fire the blast again.
7	The Team Leader will then request from the airport if all air traffic is clear of the vicinity of the blast area. Only upon a positive response Team leader will inform the Blaster to fire when ready.
8	The Blaster will then inform over the radio that they are firing the blast.
9	Refer to Work Execution Steps 11, 12 and 13
	General Radio Blast Announcements
	2 Hour Warning Blast Time: *"Notice To All Personnel: This the 2 Hour warning to blast time in Misery Pit, I repeat this is the 2 hour warning to blast time in Misery Pit"*
	10 Minute Warning Blast Time: Notice To All Personnel: This is the 10 minute warning to blast time in Misery Pit, I repeat this is the 10 minute Warning until Blast time in Misery Pit
	2 Minute Warning Blast Time: 1 minute blast signal: *"Notice to all personnel: This is the 2 minute warning to blast time in Misery Pit, I repeat this is the 2 minute warning to blast time on Misery Pit. Radio silence is in effect and will remain in effect until the all clear has been given. I repeat this is the 2 minute warning until blast time in Misery Pit"*

Documents and Records

APPROVAL SIGNATURES EKA WI 1705.03 Version [2.0]			
REVIEWER	**Role**	**SIGNATURE**	**Date**
	Mining - Superintendent	[signature]	June 14/17

Surface Mining
Blasting, Guarding and Initiating
EKA WI. 1702.06

Surface Mining Senior TL	[signature]	June 14/17.
Surface Mining TL		

Memorandum

ERM

Refer to File: C.1_Ekati Caribou Crossing Photo Analysis Memo.docx

Date: August 30, 2016

To: Laura Corey, Environment Advisor – Wildlife, Dominion Diamond Ekati Corporation (DDEC)

From: Christine Rock

Cc: Harry O'Keefe, Team Leader – Environment Projects

Subject: **Ekati Diamond Mine: Caribou Crossing Photo and Road Features Analysis – 2011 to 2015**

1. INTRODUCTION

1.1 Background

The Ekati Diamond Mine, operated by Dominion Diamond Ekati Corporation (DDEC), is located in the Southern Arctic Ecozone of the Northwest Territories, approximately 300 km northeast of Yellowknife between Yamba Lake and Lac de Gras (Figure 1-1). The Ekati Diamond Mine began construction in 1997 and officially opened in October 1998. Between 2011 and 2015, the Ekati Diamond Mine had two operational pits (Fox and Misery Pits) and two underground mines (Koala Underground and Koala North Underground; Figure 1-2). However, operations at Fox Pit ceased in June of 2014, and the pit is now inactive. Operations at the approved Pigeon Pit (Land Use Permit W2008D0008) began in 2014 and stripping continued in 2015, increasing the amount of traffic on Sable Road between Pigeon Pit and the Waste Rock Storage Facility. In late summer of 2015, DDEC began development of the Lynx Pit, including a fish-out of Lynx Lake and improved road infrastructure to the pit.

Roads have been constructed at the Ekati Diamond Mine, the longest of which is Misery Road, connecting Main Camp to Misery Camp approximately 26 km to the southeast. Misery Road is an all-season haul road constructed of clean granite with berms of varying heights that were constructed to adhere to the NWT Mine Health and Safety Act requirements and comply with safety standards set by the *Mines Act*. Upgrades to Misery Camp were completed in 2012 in preparation for Misery Pit Pushback, and traffic along Misery Road is expected to increase during the operation of Misery Pit while kimberlite is hauled to Main Camp for processing. Additional changes to the features of Misery Road were implemented in 2014, with the establishment of push outs (ramps backfilled with granite material that provide vehicle and equipment access) for the construction and operation of the Misery Road powerline that runs the full length of Misery Road. This included leveling and gravelling access points for drill equipment at each power pole site, approximately every 100 meters along the entirety of Misery Road.

Figure 1-1
Location of the Ekati Diamond Mine, Northwest Territories

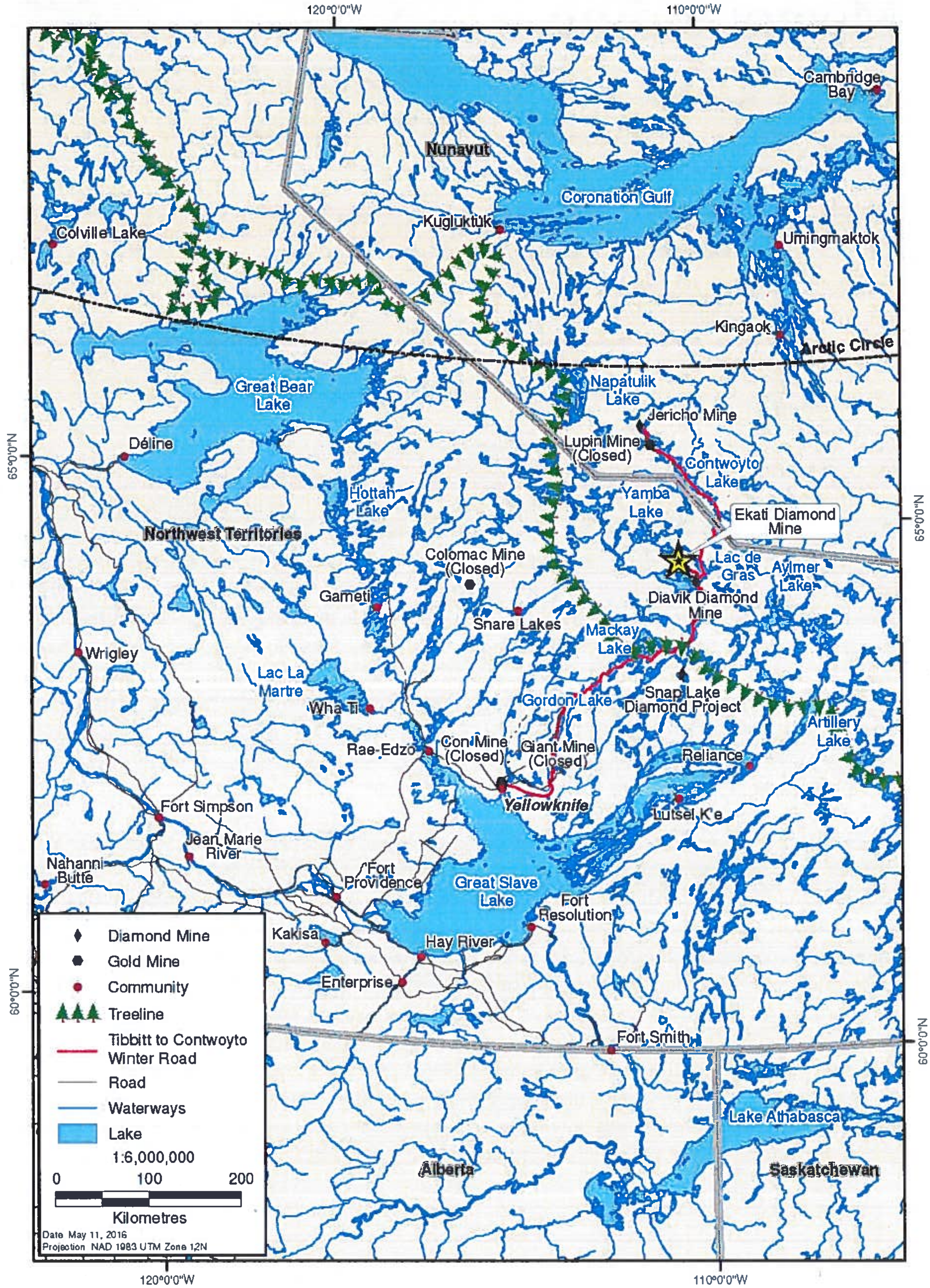
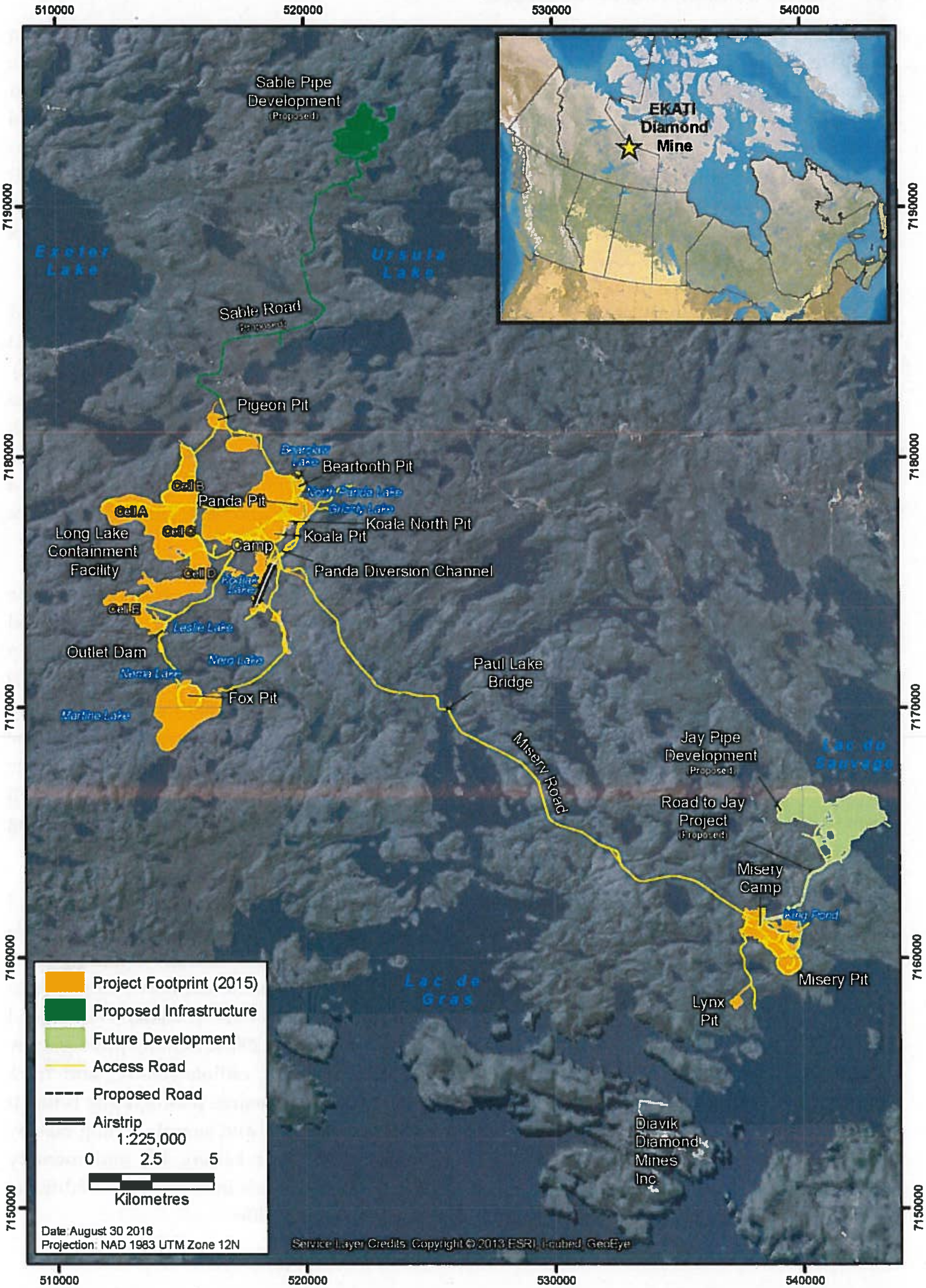


Figure 1-2

The Ekati Diamond Mine



1.2 Caribou Monitoring at the Project

Caribou (*Rangifer tarandus*) are one of the most important terrestrial mammals in the Canadian north. They provide a food resource for aboriginal communities, play a significant top-down role in tundra ecology, are an important prey species for predators and mammalian scavengers, and are a northern cultural icon for both indigenous and nonindigenous people (Bolen 1998, Hummel and Ray 2008). Northern communities are particularly concerned about potential impacts to caribou in light of the significant population declines observed in recent decades (GNWT ENR 2013). DDEC is committed to the on-going evaluation of its wildlife programs to ensure those programs utilize the best information and techniques available to monitor and mitigate impacts to wildlife.

As part of the annual monitoring programs at the Ekati Diamond Mine, roadways are monitored as semi-permeable barriers to wildlife movement. Roads are continuous linear features that wildlife may have to cross during the seasonal movement patterns (e.g., caribou migration). There is a growing body of evidence of the negative effects that roads may have on wildlife (Trombulak and Frissell 2000; Underwood and Angold 2000; Carr et al. 2002; Roedenbeck et al. 2007; Wilson et al. 2016). If road conditions, such as berm grain size or berm slope, prevent wildlife from crossing, it may be necessary for animals to travel along or around the road until a suitable crossing location can be found. This expends both energy and time, and could reduce their condition during critical migration periods.

Mitigation measures, such as caribou crossing ramps along Misery Road, provide a low slope pathway for caribou to cross roads. The locations of these ramps were suggested by Traditional Knowledge holders and other land users during a Caribou and Roads study that was undertaken in the mid-2000's, and during various site visits hosted by the Ekati Diamond Mine between 2009 and 2015. Caribou crossing ramps are intended to enable caribou to more easily cross these linear features (roads) and minimize habitat fragmentation. Additional mitigation measures to reduce the risk of wildlife-vehicle collisions include giving wildlife the right of way, deploying signage along the road during periods of high wildlife activity, speed enforcement, and temporary road closures. Motion triggered cameras have been used as one component of the caribou monitoring program at the Ekati Diamond Mine.

The use of remote motion-triggered cameras has a long history in wildlife research (Cutler and Swann 1999), and over the past two decades camera traps have become more readily available and affordable. The result has been a rapid and diverse growth in the application of motion-triggered cameras (Rowcliffe and Carbone 2008). Wildlife cameras are now being used to monitor wildlife activity around roads and other human infrastructure (Olsson, Widén, and Larkin 2008; Braden et al. 2008; Dunne and Quinne 2009; Noel et al. 2006). Remote photography has replaced traditional methods of visual surveys, drive counts, radiotelemetry, and track counts (Silveira, Jácomo, and Diniz-Filho 2003). A distinct benefit of remote photography is that it can be completed year-round. In addition, cameras remove observer and sample timing bias by providing data coverage 24 hours per day. Combined with 1-year battery life and memory storage for approximately 30,000 photos, data collection opportunities increase over traditional techniques with minimal human involvement or invasiveness to wildlife.

DDEC has deployed up to 90 cameras per year at various locations at the Ekati Diamond Mine since 2011, with the objective of better understanding how wildlife interact with roads and other infrastructure. Results from the 2011 to 2013 camera monitoring program suggest that the road is not a barrier to caribou movement through the Ekati Diamond Mine area, either due to the physical construction of the road or due to current traffic volumes (ERM Rescan 2014a). The program continued in 2014 and 2015. As a component of the overall camera monitoring program, motion triggered photos collected from roadside camera locations combined with data on roadside characteristics at historical camera locations were analyzed to determine whether road features along Misery Road influence road crossing behavior by caribou and to identify what road features may facilitate or hinder caribou crossing events.

1.3 Objectives

The current memorandum summarizes additional analysis that evaluates how road features may influence caribou movement and crossing behaviour. Information from Misery Road can be applied to the construction of road caribou crossing ramps to facilitate crossing as part of the mitigation and management plan for roads currently under construction (i.e., Sable Road). Additionally, this information can be incorporated into the final road design of caribou crossings ramps for the Jay Project in areas where caribou movement has been identified based on visible evidence of historical caribou tracks, vegetation and landform information, observations, site experience of the Ekati Diamond Mine Environment Department personnel, biologists, Traditional Knowledge (where available), and advice obtained from Elders and IBA community members.

2. METHODS

2.1 Camera Deployment

As part of the Wildlife Effects Monitoring Program (WEMP) infrared motion-triggered cameras (PC800 Hyperfire Professional Semi-Covert IR; Reconyx™ LLP, Holman, WI) were deployed between 2011 and 2015 in eight general geographical regions around the Ekati Diamond Mine, including Misery Road, Sable/Pigeon and Access Roads, proposed Sable Road, Long Lake Containment Facility (LLCF), Fox Pit, Waste Rock Storage Facility, Misery/Lynx Area, and reference locations on the tundra (> 300 m from infrastructure; Table 2-1; Figure 2-1).

The majority of cameras were placed near Misery Road[1] (208 cameras; Figure 2-1). In general, cameras were retrieved and redeployed to new locations each year from 2011 to 2015 (Figure 2-1). Lone cameras were set-up at pull out locations along Misery Road that allowed safe deployment, with the exception of 2015, a year when cameras were set-up in a paired design between Km marker 16 and 25, with two cameras at safe locations adjacent to each shoulder of the road, paired with two cameras set-up on tundra habitat at distances of approximately 230 m to 300 m from roadside cameras (totaling 4 cameras in a straight line). Camera effort was tracked as the number of camera days a camera was operational at a location, and taking at least one programmed, timed photo per day.

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[1] see ERM Rescan 2014, for detailed methods related to 2011-2013 wildlife camera monitoring program

Table 2-1. Number of Cameras Deployed around the Ekati Diamond Mine by Year and Region

Year	Misery Road	Sable/Pigeon and Access Roads	Proposed Sable Road	LLCF	Fox Pit	Waste Rock Storage Facility	Misery/ Lynx Area[1]	Reference Sites	Total
2011	28	8	0	2	0	0	0	11	**49**
2012	55	21	0	11	1	2	0	0	**90**
2013	45(2)	24	0	7(4)	9(9)	5(5)	0	(20)*	**90**
2014	40	16	0	0	0	2	3	0	**61**
2015	40	0	12	0	0	0	7	3	**62**
Total	**208 (2)**	**69**	**12**	**20 (4)**	**10 (9)**	**9 (5)**	**10**	**14 (20)**	**291**

** Numbers in brackets refer to the number of cameras relocated during the grizzly bear DNA program between June and August 2013. Data from that time period were not analysed in ERM Rescan (2014a).*

[1] Includes the area surrounding Misery Camp and access roads to the Lynx Pit and proposed road to the Jay Project.

2.2 Caribou Groups, Composition, and Behaviour

All photos were processed for detections of lone caribou or caribou groups. Given the limitations to quantifying animal behaviour from timed photographs, behavioural analyses were restricted to motion-triggered photos (and those timed photos that were within the same field of view as the motion-triggered photos) to remove any potential bias in caribou detections. In addition, the cameras' limited field of view likely meant that portions of some groups were never photographed. Thus, remote camera monitoring yields conservative estimates of group size.

Animal behavior was quantified from the motion-triggered cameras, including the number of caribou and their dominant behaviors. When possible, individuals were classified by age (adult or juvenile) and sex (male, female, unknown). The dominant behaviour of each caribou group was determined (Table 2-2; Plate 2-1). Categorizing road usage and road avoidance was prioritized. Additionally, each individual that was exhibiting alert behaviour was noted (e.g., body oriented towards a potential stressor, ears erect and pointed in a particular direction, or remaining motionless in an alarm posture throughout several consecutive motion-triggered photos). Potential stressors, such as vehicles traveling along the road, were also recorded whenever evident in the photos. As a conservative estimate of behaviour frequency, calm behaviours (i.e., foraging, bedded or standing) had the lowest priority in terms of scoring the dominant group behaviour (Table 2-2).

2.3 Road Features Surveys

In 2014 and 2015, all historical (2011 to 2013) or current camera locations along Misery Road were re-visited to obtain road feature information at the camera location. Structural features of Misery Road were assessed as certain roadway features may potentially inhibit the ability of caribou and other wildlife to disperse across roadways (Wolfe et al. 2000; Bissonette and Cramer 2008). These features include differences in elevation between the road surface and the surrounding tundra, or between the adjacent berm and the toe (located at the beginning of the road's shoulder), the slope off of the road, including the angle and the distance of the road slope, and the composition of rocks of a certain size along and adjacent to the road. Data on these specific road features were collected based on recommendations from the previous camera monitoring program (ERM Rescan 2014b).

Figure 2-1
Camera Locations at the Ekati Diamond Mine, 2011 - 2015

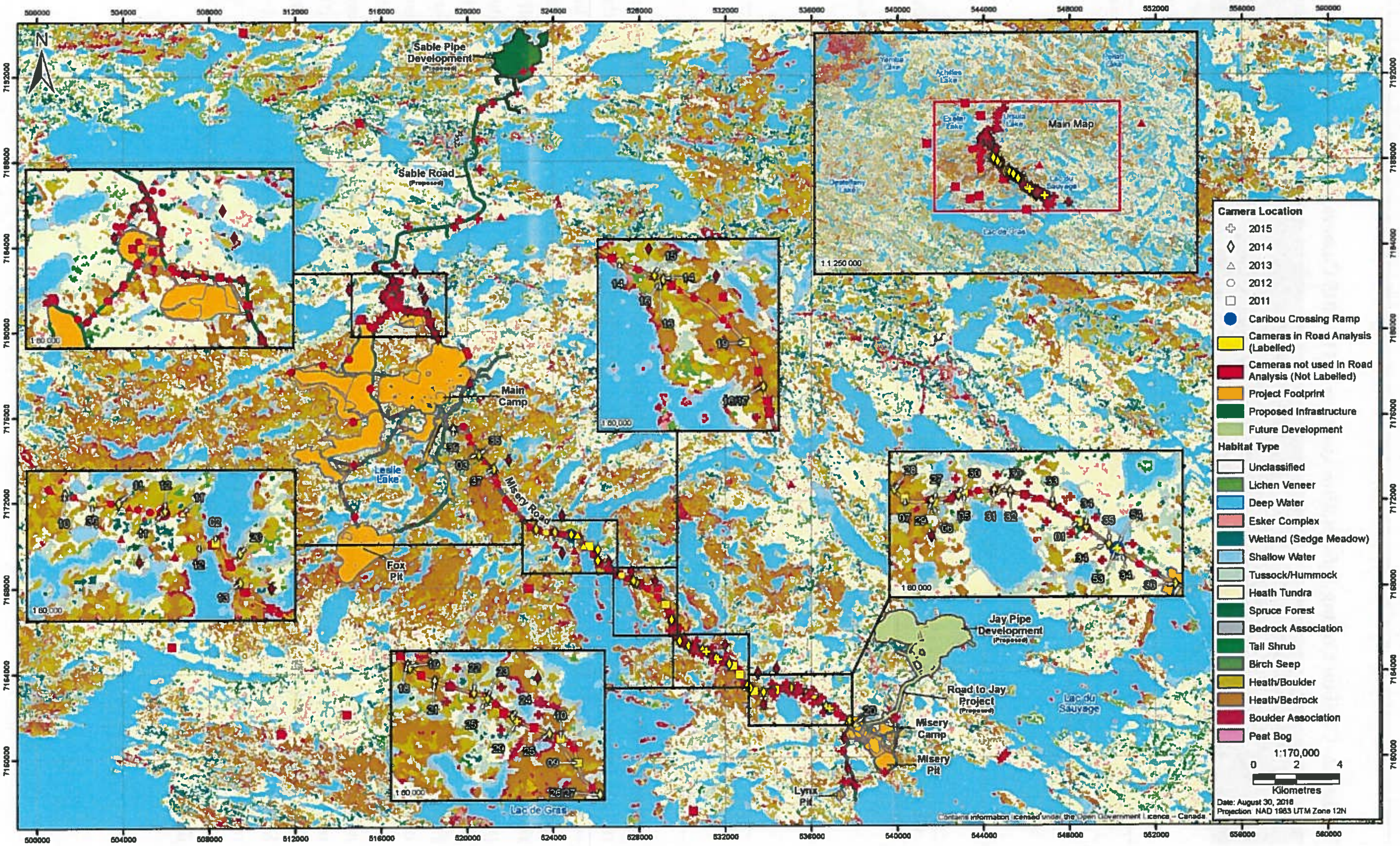


Table 2-2. Caribou Coding Information Used for 2011 - 2015 Camera Data

Caribou Codes		
Behavioural Classification	Behavioural Codes	Description
Crossing Event	CC, ROR, or CR	Crossed road walking or running (fully crossed road; on occasions the code ROR [running off road] was used to indicate crossing whilst running)
Deflection Event	D, or DR	Deflected/deterred from path of motion (did not fully cross road)
Grouped Calm Behaviours	B, or RER	Bedded away from or near road
	F, FR, or FW	Foraging away from or near road
	FW	Foraging while walking
	IC	Investigating camera
	RE	Resting/bedded
Grouped Stressed Behaviours	Alert	Evidence of startle or stress (tail flick, head went up, quick run or change of direction)
	D, or DR	Deflected/deterred from path of motion (did not fully cross road)
	R	Running (away from road)
	RAR	Running along road
	ROR	Running off road
Neutral Behaviour	S	Stop and stand
	WA, CW	Walking along road

Four road feature parameters were measured within the 30 m of the camera (the approximate trigger range of the camera; Reconyx 2012): 1) road height (in meters) from the tundra to the flat edge of the road; 2) roadside slope (in degrees); 3) distance of the roadside slope from the tundra to top of road (referred to as the hypotenuse, in meters); and 4) number of rocks categorized in three size categories (< 0.1 m, 0.1 - 0.3 m, and > 0.3 m; referred to as grain size). All four parameters (height, slope, slope distance, and rock grain size) were recorded at 5 m intervals within the 30 m field-of-view of the camera, for a total of six sampling locations per camera (referred to as sub-locations). The height of road was measured as the vertical distance from the tundra to the top of the road (where non-human influenced habitat connects in a consistent manner with road materials). The slope of the road was measured with a compass or clinometer as the slope of the incline from the tundra to the top of the road. The hypotenuse was measured by laying a transect perpendicular to the road at each sub-location and measuring the distance between the tundra and the top of road (the hypotenuse represents the distance that a caribou hypothetically travels up to get from the tundra to the top of the road). Rock grain size was measured at the same time as slope height; at each sub-location transect perpendicular to the road, the number of rocks within each size class that intersected the transect within the 5m distance interval were counted.

Crossing/crossed road
(Misery Road camera # 54, August 1, 2015)

Investigating camera
(Misery Road camera #5, October 26, 2011)

Running on / off road
(Misery Road camera # 53, July 27, 2015)

Foraging near road (red circle)
(Misery Road camera # 49; August 1, 2015)

Plate 2-1. Examples of behaviours: crossing, investigating, running, and foraging.

To assess which habitat features on the landscape might attract or deter caribou (i.e., during foraging events), or facilitate movement through the Ekati Diamond Mine study area near the roadside, each camera was additionally assigned to an individual habitat classification based on the dominant habitat type within 30 metres of the camera based on pre-existing habitat mapping.

In cases where push outs were constructed within 30 m of a previous camera placement upon re-visiting a site in 2014 or 2015, partial road feature surveys were conducted only at locations where the road features remained unchanged from historical conditions that were present at the time of original camera placement. In cases where all road features within 30 m of the historical camera location changed due to push out construction, no road feature surveys were completed.

2.4 Data Summary

Data collected during the 2011 to 2015 camera monitoring program, including caribou groups, composition, and behavioural data, were combined with road feature survey data collected in 2014 and 2015 along Misery Road. These data were assessed in two ways. First, the relationship between road features and number of road crossings was assessed for each road feature individually (univariate analyses) and together (multivariate statistics). Second, the complete camera dataset of caribou detections was filtered to include only observations where caribou were observed crossing the road on motion-triggered photos. These data were used to produce a unique subset of camera locations along Misery Road where caribou successfully crossed that could be used to characterize roadside characteristics conducive to road crossings. At cameras where photo events occurred, the number of caribou groups, caribou individuals, and crossing events were summarized by camera location. To categorize crossings based on the rock grain size, a coarse summary variable (i.e., dominant grain size) was estimated based on the majority of rocks that fell within the rock grain size category; however, dominant grain size was used for summary purposes only due to limitations in categorizing this count data. Statistical analyses were conducted more precisely on the full dataset for rock grain size, hypotenuse, slope, and height variables across all six transects per camera.

2.5 Statistical Analysis

Due to the relatively rare occurrences of caribou deflection events along Misery Road (3 events, or 1% of all caribou group observations) between 2011 and 2015, road features at camera locations where deflections occurred were summarized, but were not analyzed statistically with road feature data. Statistical analyses focused on examining the relationship between road features and the number of caribou road crossing events and characterizing road features that appear to be conducive to caribou road crossing.

2.5.1 Relationship between Road Features and Number of Caribou Road Crossings

A comparison of road feature variables relative to the number of caribou crossings was conducted by averaging values across all six transect sub-locations per variable, as well as the maximum and minimum values per variable, and plotting summarized data relative to the number of caribou crossings detected per camera.

To assess differences in road features between the camera locations with and without road crossings, an exploratory analysis of the detailed multivariate road features data was carried out using Principal Components Analyses (PCA). PCA projects multivariate data onto a smaller dimensional space and provides a few summary variables that capture the majority of information contained in the data. Here, PCA was used to summarize the slope, height, hypotenuse, and rock composition measurements in a few summary variables. Data collected per road feature variable at the six sample sub-locations within 30m of each camera were pooled and the PCA was ran on the complete data set. Hypotenuse and rock grain size variables were log transformed for the PCA as their distributions were right skewed.

2.5.2 *Characterization of Road Features Conducive to Caribou Crossings*

Statistical tests comparing mean values are useful for assessing shifts in central tendency. Central tendency is only one summary of a variable's distribution. To characterize the road features that are conducive to caribou crossings, it is important to understand the range of values associated with road crossings. The range of values were assessed to determine appropriate road features for caribou crossings for future developments. A conservative approach was undertaken by defining appropriate road features to be those within the upper 95% confidence bound on the 25th percentile and lower 95% confidence bound on the 75th percentile. Many of the cameras were located within close proximity of each other, potentially leading to spatial correlation in the road feature data. Thus, standard methods for calculating confidence intervals (CIs) may produce underestimates of the variability and CIs that are too narrow. Therefore, bootstrap methods were used to obtain confidence intervals on the summary statistics. The road features at all six sub-locations from each camera were used to characterize crossing locations.

3. RESULTS

3.1 Data Summary

3.1.1 *Caribou Groups, Composition, and Behaviour*

Of the complete camera dataset along Misery Road (208 cameras) between 2011 and 2015, detailed road feature data were available for 149 camera locations. Caribou crossing events (fully crossed road walking or running) and deflection events (deflected/deterred from path of motion (did not fully cross road) along Misery Road triggered 31 cameras between 2011 and 2015 (Table 3-1 and Table 3-2). No caribou were detected at any cameras along Misery Road in 2014. Caribou deflections were relatively rare, occurring in 1% (3 occasions) of caribou group observations along Misery Road (Table 3-1 and Table 3-2). A number of cameras detected multiple caribou crossing events (Table 3-3).

From the 31 cameras that detected caribou crossings and deflections, 228 caribou groups and 586 individuals were recorded in motion-triggered photos during 3,853 days of camera effort (Table 3-1). A total of 144 caribou individuals were detected crossing Misery Road during 69 events (Table 3-2). Detections included single individuals or groups of males, females, yearlings, and calves (Plates 3-1, 3-2, and 3-3). A number of cameras detected multiple caribou crossing events (Table 3-2).

Across all years of study, there was a total of 69 caribou crossing events where at least one caribou individual fully crossed the road. Camera 10 detected the highest number of caribou crossings detected in a given year, recording 27 individual caribou crossings over the course of six crossing events in 2011. The second highest number of caribou crossings was recorded at Camera 16, where 19 individuals crossed the road during one crossing event in 2012. In 2012, one of the cameras was situated at a caribou crossing ramp (Camera 11), which detected two individuals crossing the road in a single crossing event (Table 3-2). In 2015, two cameras (Camera 53 and 54) were placed on adjacent sides of an esker that intersected with Misery Road and spanned both sides of the road. The esker serves as a natural sloped area resembling a ramp. Camera 53 was located on the west side of Misery Road and camera 54 was located directly opposite to camera 53 on the east side of

Misery Road, and was slightly offset from the edge of the esker. Camera 54 was also located on a powerline pushout area, which further created a gentle ramp up to the road surface. A total of 11 crossing events involving a single individual were recorded at Camera 53 and one crossing event involving a single individual was recorded at Camera 54. While caribou were detected crossing at both camera locations, the unequal detection of caribou crossing events indicates that caribou could have been passing behind Camera 54 while crossing the road, or beyond the motion trigger distance of that camera, or traveling along the road.

Table 3-1. Total Caribou Detected from Motion-Triggered Cameras along Misery Road, 2011 to 2015

Year	Camera ID	Easting	Northing	Total Caribou Groups	Total Caribou Individuals	Camera Effort (Number of Cameras Days)
2011	*01*	*536182*	*7162731*	*17*	*65*	*103*
	02	*525663*	*7169941*	*13*	*34*	*104*
	04	534799	7163248	15	37	103
	05	*534297*	*7163206*	*23*	*94*	*103*
	06	*533789*	*7163063*	*20*	*65*	*104*
	07	*533326*	*7163127*	*11*	*36*	*104*
	09	*532643*	*7163911*	*16*	*42*	*104*
	10	*532355*	*7164317*	*17*	*49*	*104*
	11	531912	7164500	12	24	95
	16	529726	7165692	14	32	92
	19	*529220*	*7167203*	*2*	*3*	*97*
2012	*03*	*520497*	*7174263*	*1*	*1*	*177*
	11*	524817	7170442	1	2	107
	14	*527161*	*7168567*	*1*	*1*	*104*
	16	*527843*	*7168238*	*1*	*19*	*123*
	20	529598	7166109	1	2	113
	27	*533814*	*7163093*	*1*	*1*	*151*
	30	*534835*	*7163246*	*7*	*16*	*107*
	34	*536655*	*7162367*	*2*	*2*	*98*
	36	523645	7170591	1	1	117
	60	534128	7163150	1	1	137
	61	534128	7163149	2	2	146
2013	11	525127	7170442	7	7	182
	12	*525404*	*7169935*	*1*	*1*	*158*
	20	*538057*	*7161597*	*8*	*9*	*160*
	33	536335	7162609	6	6	182
	34	*536870*	*7162260*	*2*	*2*	*182*

(continued)

Table 3-1. Total Caribou Detected from Motion-Triggered Cameras along Misery Road, 2011 to 2015 (completed)

Year	Camera ID	Easting	Northing	Total Caribou Groups	Total Caribou Individuals	Camera Effort (Number of Cameras Days)
2014	n/a	n/a	n/a	n/a	n/a	n/a
2015	*25*	*531110*	*7164986*	*7*	*12*	*133*
	29	*531637*	*7164610*	*2*	*4*	*133*
	*53***	*536799*	*7162278*	*14*	*14*	*132*
	*54***	*536816*	*7162294*	*2*	*2*	*98*
Total Detected at Cameras with Known Road Features				**168**	**472**	**2,579**
Total				**228**	**586**	**3,853**

Notes: Cameras with road feature survey data available represented in italics type, n/a refers to years when no caribou were detected crossing roads
**Camera located at caribou ramp*
*** Cameras placed at an esker (natural ramp); Camera 54 also placed at a powerline pushout area, thus further creating a ramp area to the road surface.*

Table 3-2. Total Caribou Misery Road Crossings Events Detected from Motion-Triggered Cameras Compared with Road Characteristics along Misery Road, 2011 to 2015

Year	Camera Number	Number of Crossing Events	Number of Caribou Individuals Crossing	Number of Caribou Individuals Deflected	Dominant Grain Size (Meters)
2011	*01*	*3*	*3*	*0*	*0.1 – 0.3*
	02	*1*	*1*	*1*	*0.1 – 0.3*
	04	4	6	0	unknown
	05	*1*	*2*	*0*	*0.1 – 0.3*
	06	*5*	*10*	*0*	*0.1 – 0.3*
	07	*2*	*10*	*0*	*0.1 – 0.3*
	09	*1*	*2*	*0*	*0.1 – 0.3*
	10	*6*	*27*	*0*	*0.1 – 0.3*
	11	2	8	0	unknown
	16	4	5	0	unknown
	19	*2*	*3*	*0*	*0.1 – 0.3*
2012	*03*	*1*	*1*	*0*	*0.1 – 0.3*
	11*	1	2	0	unknown
	14	*1*	*1*	*0*	*0.1 – 0.3*
	16	*1*	*19*	*0*	*< 0.1*
	20	1	2	0	unknown

(continued)

Table 3-2. Total Caribou Misery Road Crossings Events Detected from Motion-Triggered Cameras Compared with Road Characteristics along Misery Road, 2011 to 2015 (completed)

Year	Camera Number	Number of Crossing Events	Number of Caribou Individuals Crossing	Number of Caribou Individuals Deflected	Dominant Grain Size (Meters)
2012 *(cont'd)*	*27*	*0*	*0*	*1*	*< 0.1*
	30	*2*	*5*	*1*	*< 0.1*
	34	*1*	*1*	*0*	*0.1 – 0.3*
	36	1	1	0	unknown
	60	1	1	0	unknown
	61	1	1	0	unknown
2013	11	5	5	0	unknown
	12	*1*	*1*	*0*	*0.1 – 0.3*
	20	*1*	*1*	*0*	*0.1 – 0.3*
	33	1	1	0	unknown
	34	*1*	*1*	*0*	*0.1 – 0.3*
2014	n/a	n/a	n/a	n/a	n/a
2015	*25*	*5*	*8*	*0*	*0.1 – 0.3*
	29	*1*	*4*	*0*	*0.1 – 0.3*
	*53***	*11*	*11*	*0*	*< 0.1*
	*54***	*1*	*1*	*0*	*< 0.1*
Total Detected at Cameras with Known Road Features		**48**	**112**	**3**	
Total		**69**	**144**	**3**	

Notes: Cameras with road feature survey data available represented in italics type, n/a refers to years when no caribou were detected crossing roads.
**Camera located at caribou ramp.*
*** Cameras placed at an esker (natural ramp); Camera 54 also placed at a powerline pushout area, thus further creating a ramp area to the road surface.*

Table 3-3. Summary Statistics for Road Feature Parameters

Parameter	No Caribou Crossing Events		Caribou Crossing Events	
	Minimum	Maximum	Minimum	Maximum
Hypotenuse (m)	0.83	26.60	1.8	13.35
Height (m)	-0.55	3.56	0.00	3.15
Slope (degree)	0.00	70.00	0.00	42.00
Number of Small Rock Grain Size (< 0.1 m)	4.00	800.00	0.00	100.00
Number of Moderate Rock Grain Size (0.1 to 0.3 m)	0.00	206.00	0.00	23.00
Number of Large Rock Grain Size (> 0.3 m)	0.00	57.00	0.00	18.0

Plate 3-1. One juvenile caribou crossing at location with moderate grain size (0.1 m to 0.3 m) at Camera 1 on September 5, 2011.

Plate 3-2. Two caribou (red circle) crossing at location with moderate grain size (0.1 m to 0.3 m) at Camera 25 on July 17, 2015.

Plate 3-3. Caribou group (red circle) crossing at location with smaller grain size (< 0.1 m) at Camera 16 on May 24, 2012.

Camera 27 detected one deflection event, but no crossing events. Camera 27 was therefore included in the summarized data, but excluded from the statistical analysis that focused on cameras that recorded crossing events, bringing the total number of cameras that detected crossing events to 30 cameras for this analysis.

3.1.2 *Caribou Crossings and Road Features*

Data describing roadside features were available for 67% (n = 20) of the 31 cameras along Misery Road where caribou crossings or deflections were detected, including one camera that was placed at a caribou ramp and two cameras that were located at natural crossing areas (Table 3-2, Figure 2-1). Road feature data were unavailable for the remaining 10 cameras due to camera access points being either unsafe for surveyors or in locations where road features have changed due to road construction since the camera was deployed.

Both male and female caribou and all age groups were observed crossing over a range of road features. Caribou individuals or groups were detected crossing Misery Road at 16 cameras that were characterized as in locations where roadsides were dominated by 0.1m to 0.3m rock material (Plates 3-1 and 3-2). Groups of caribou up to 27 individuals were also observed crossing the road at locations where 0.1 m to 0.3 m grain size was predominant. At the remaining four cameras where caribou were observed crossing, < 0.1 m material dominated the road and slope of the roadside. At one of these cameras (Camera 16) a large group of caribou (19 individuals) was detected during one crossing event in 2012 (Table 3-2; Plate 3-3). In 2015, the majority of crossings recorded across all cameras (11 of 19 crossing events) occurred at Camera 53, a location characterized by predominately small grain material (< 0.1 m) due to placement at an esker. Adjacent road camera, Camera 54 recorded fewer crossing events, likely because caribou were crossing the road behind Camera 54, or beyond the motion trigger distance of that camera. This highlights a benefits of the paired camera study design that was utilized in 2015. Two of the three caribou deflection events occurred at locations where < 0.1 m grain size dominated the roadside (Table 3-2).

3.2 Statistical Analysis

3.2.1 Relationship between Road Features and Number of Caribou Road Crossings

A large range of road slopes, heights, hypotenuse, and rock grain size values were observed. Variability in these road feature parameters was evident across camera locations, as well as across all six sampling sub-locations that were surveyed at each camera location. The road features data collected at the six sampling sub-locations for each camera were moderately correlated [mean correlation coefficients: slope, r = 0.63; height, r = 0.77; hypotenuse, r = 0.69; number of small rock grain size (< 0.1 m), r = 0.61; number of moderate rock grain size (0.1 to 0.3 m), r = 0.41; and number of large rock grain size (> 0.3 m), r = 0.54]. Despite variability in the data, caribou crossing events were associated with a limited range of parameter values (Table 3-3; Figure 3-1 and 3-2).

Results of the multivariate road feature analysis showed that the first three principal components captured the majority (80%) of the variability in road features (38%, 26% and 16%; Table 3-4). The first principal component (PC1) represents a general component capturing the relative magnitude of the hypotenuse, height and rock composition (Table 3-4). The second (PC2) represents the relative magnitude of height and slope. The third represents a contrast between rock sizes. That is, PC3 is large when the number of rocks > 0.3 m is large and the number of rocks up to < 0.1 m is small. There was no clear relationship between the number of caribou road crossing events and the road feature data as represented in the first three principal components (Figure 3-3).

Table 3-4. Road Feature PC Loadings and Proportion of Variance Explained

Variable	PC 1	PC 2	PC 3
logHypotenuse	0.84	-0.27	0.04
Height (m)	0.67	0.63	-0.12
Slope (degree)	0.17	0.88	-0.28
log Number of Small Rock, Grain Size (< 0.1 m)	0.54	-0.35	-0.65
Number of Moderate Rock, Grain Size (0.1 m to 0.3 m)	0.67	-0.41	0.07
Number of Large Rock, Grain Size (0.3 m)	0.60	0.20	0.65
Proportion of Variation Explained	0.38	0.26	0.16

Figure 3-1

Road Features by Number of Caribou Crossings

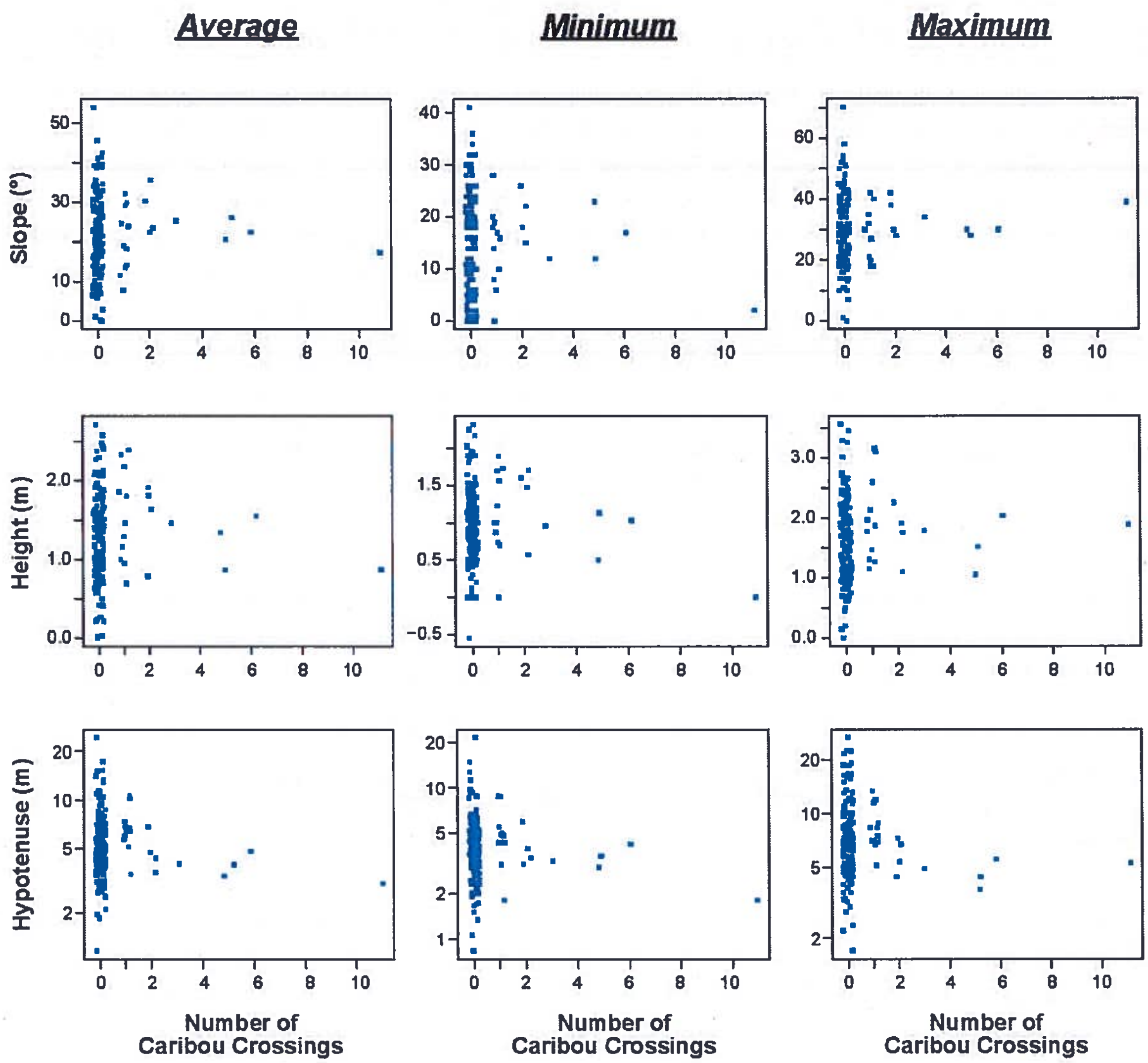


Figure 3-2
Rock Composition by Number of Caribou Crossings

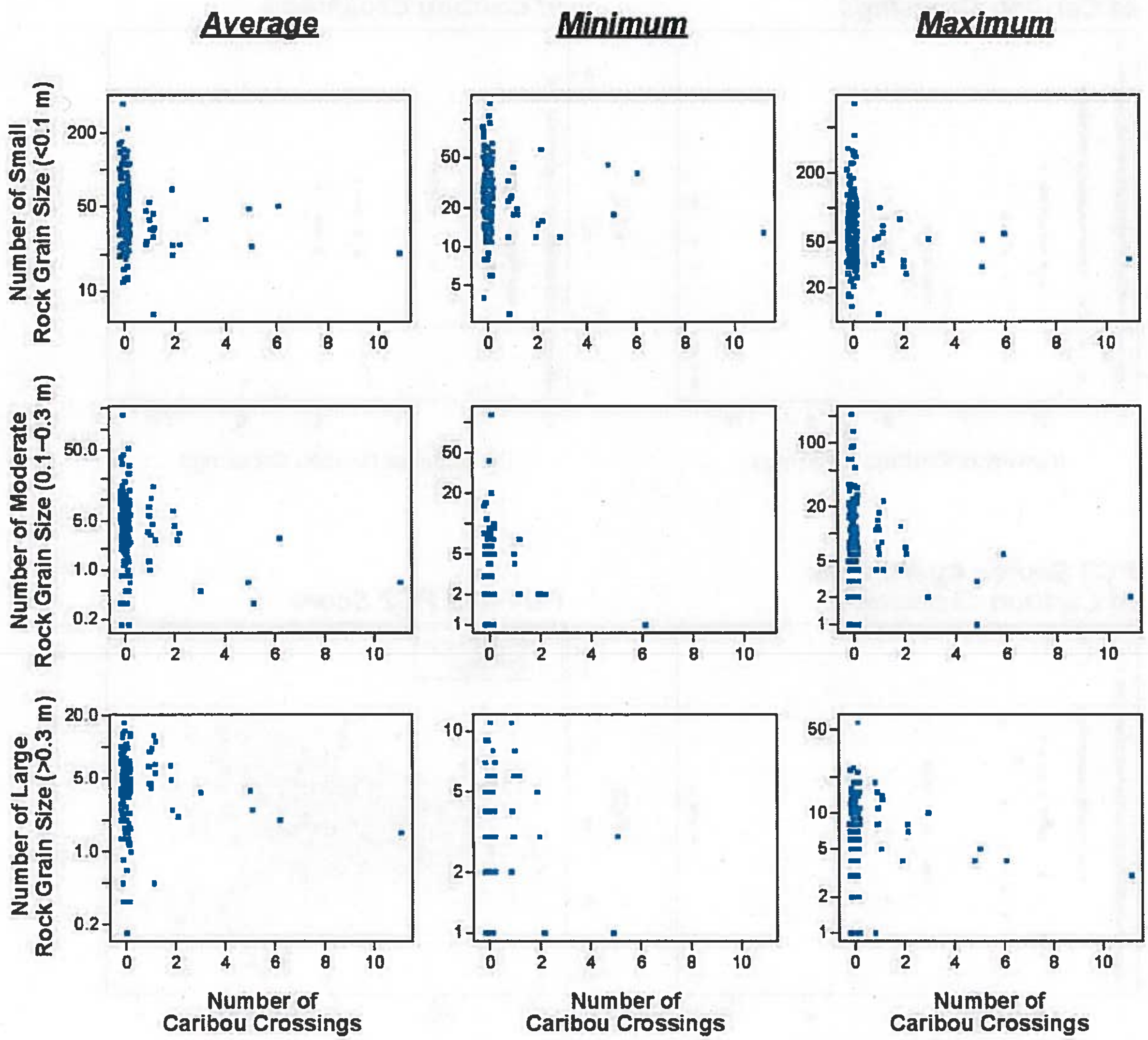
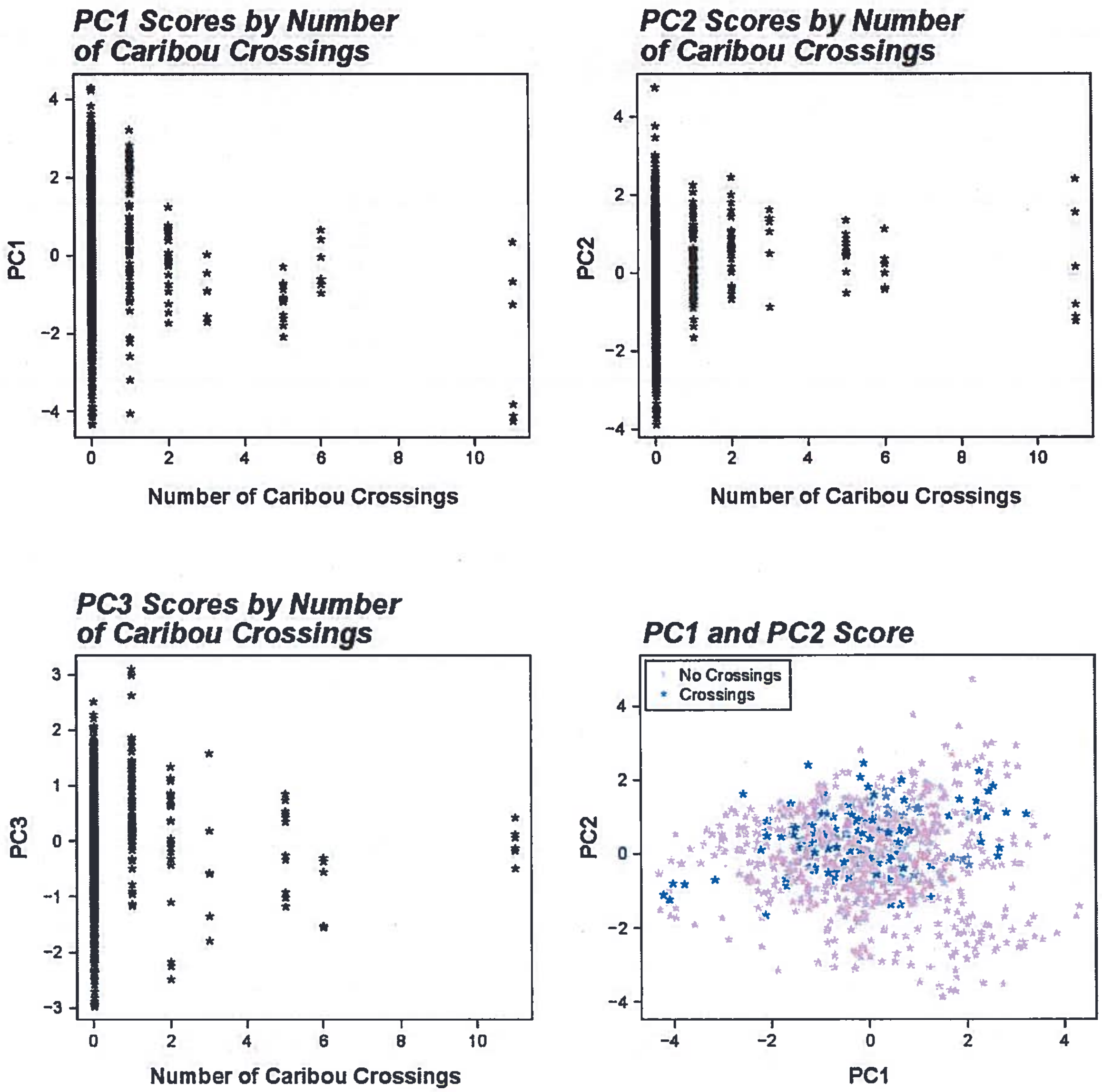


Figure 3-3

Principle Component Scores by Number of Caribou Crossings



3.2.2 *Characterization of Road Features Conducive to Caribou Crossings*

The distributions of road feature parameters for locations with caribou road crossings were characterized into 25th percentile, median, and 75th percentile bounds using empirical percentiles along with bootstrap confidence intervals (Table 3-5). For example, the hypotenuse distribution based on road features at Misery Road was characterized by a median of 5.10 m [95% CI, (4.8, 5.49)]; 25th percentile of 3.92 [95% CI, (3.60, 4.30)]; and the 75th percentile of 6.80 [95% CI, (6.14, 7.57)]. Therefore, a conservative estimate of an acceptable range of hypotenuse values that are conducive to caribou crossings would include hypotenuse values between 4.30 m and 6.14 m.

Table 3-5. Bootstrap Estimates with Lower and Upper 95 Percent Confidence Bounds for Road Features Variables

	25th Percentile			Median			75th Percentile		
Parameter	Estimate	Min	Max	Estimate	Min	Max	Estimate	Min	Max
Hypotenuse (m)	3.92	3.60	*4.30*	5.10	4.80	5.49	6.80	*6.14*	7.57
Height (m)	1.03	0.97	*1.18*	1.47	1.30	1.65	1.82	*1.75*	1.94
Slope (degree)	17.00	14.00	*18.00*	22.00	20.00	24.00	30.00	*27.00*	30.00
Number of Small Rock Grain Size (< 0.1 m)	21.00	18.00	*24.00*	31.00	28.00	36.00	46.00	*41.00*	51.00
Number of Moderate Rock Grain Size (> 0.1 to 0.3 m)	1.00	0.00	*2.00*	3.00	2.00	4.00	6.00	*5.00*	7.00
Number of Large Rock Grain Size (> 0.3 m)	3.00	1.00	*3.00*	5.00	4.00	6.00	8.00	*6.00*	8.00

Notes: Italics type refers to suggested range of road feature parameter values that are conducive to caribou crossings.

4. SUMMARY

Northern communities are particularly concerned about potential impacts to caribou in light of the significant population declines observed in recent decades. DDEC has been monitoring roadways to detect the extent to which roads act as semi-permeable barriers to wildlife movement. Remote camera data collected at cameras placed along Misery Road between 2011 and 2015 were used to identify locations where caribou groups or individuals crossed the road or were deflected from the road.

The univariate and multivariate analyses carried out here did not indicate any significant relationship between the number of caribou road crossing and deflection events and the road features parameters that were examined (slope, height, hypotenuse, and rock grain size). Characterization of road feature parameters at additional locations along Misery Road in combination with ongoing monitoring at other roads will provide data to further refine the analyses and provide a clearer understanding of the relationship between road features and caribou crossing and deflection events. This information will also advance our understanding of the semi-permeable barrier effect that roads may have on caribou at the Ekati Diamond Mine.

The results of this study suggest the use of 0.1 m to 0.3 m rock material (including 0.1 m to 0.3 m that may potentially be used for the construction of future caribou ramps) does not deter caribou from crossing roads, relative to smaller grain sizes (< 0.1 m). Furthermore, a berm slope between 18° and 27°, height between 1.18 m and 1.75 m, and hypotenuse of 4.30 m and 6.14 m, appear to be conducive to the majority of caribou crossings observed (the upper limit of the 25th percentile and lower limit of the 75th percentile). These monitoring and management learnings from Misery Road can be applied to road caribou crossing ramps currently being implemented (i.e., Sable Road), and in planning construction (i.e., Jay Road, following regulatory approval). DDEC has already begun to implement these recommendations. Recently constructed caribou ramps along Lynx Road follow similar guidelines, with a slope of approximately 25 degrees, and 0.1 m to 0.3 m rock grain size.

As a conservative approach, selecting road features within the range from the upper bound of the 25th percentile estimate to the lower bound of the 75th percentile estimate provides a reasonable estimate of the range of road feature values that may facilitate caribou crossings. However, there was a limited range of rock grain size at the camera locations where caribou crossed the road. There may be a wider range of road feature values that are conducive to crossing but were not recorded in this study at the road feature sampling sub-locations. Ongoing monitoring using a paired study design (i.e., a camera placed at the road and a paired reference camera on the tundra at least 300 m from the road) and the 2016 camera study expansion to include the Sable Road area may refine the upper and lower bound limits for road feature parameters at caribou crossing locations. This information will better inform how roads act as semi-permeable barriers, and offer means to further mitigate and manage those effects.

The camera locations that did not detect caribou road crossing events may in fact be appropriate for crossing, but did not detect crossing events simply because there were no caribou in the vicinity. Without a paired camera design approach, it is unclear whether caribou were present to cross the road at camera locations where the rock grain size material was larger. A paired camera design will provide an opportunity to distinguish whether or not caribou are avoiding road locations with larger rock grain size material. This paired design was implemented in 2015, and will continue in 2016.

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Prepared by:

Original has been signed

Christine Rock, M.Sc., R.P.Bio.
ERM

Reviewed by

Original has been signed

Brian Milakovic, Ph.D.
ERM

Original has been signed

Tonia Robb, Ph.D.
ERM